XIX BRAZILIAN CONGRESS OF PLANT PHYSIOLOGY

Center for Experiences (Fernando Sabino Academic Cultural Space) - UFV Viçosa, MG / Brazil

PLANT PHYSIOLOGY AT THE FRONTIERS: FROM OPTIMAL TO STRESS CONDITIONS

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Schedule

October 7th

08:30-12:30 AM
Short Courses
Check short courses schedule for more informations.
- *In situ hybridization for locating gene expression in plant tissues*
- *Introduction to gene editing in plants using CRISPR technique*
- *Construction and modeling of A/Ci and A/Cc curves*
- *Metabolic analyses*
- *Obtaining and using mutants in Plant Physiology research*
- *Ecophysiology of woody plants in brazilian tropical biomes*
- *Plant Nutrition: Concepts and Applications*
- *Da pesquisa ao mercado: como tirar seu projeto da bancada*

04:00-06:30 PM
Registration

06:30-07:00 PM
Opening Ceremony

07:00-08:00 PM
Dr. John LUNN (Opening Lecture)
Global challenges for plant biology in the 21st century
Max Planck Institute of Molecular Plant Physiology, Germany

08:00 PM
Cocktail
October 8th
PHOTOSYNTHESIS AND METABOLISM

October 8th

08:30-09:20 AM
Dr. Andreas WEBER
Natural variation in photosynthetic carbon assimilation and synthetic biology approaches to improve photosynthetic efficiency
Heinrich Heine University Düsseldorf, Germany

09:20-10:10 AM
Dr. Elizabete CARMO-SILVA
The effect of heat stress on Rubisco activase in cowpea
Lancaster University, United Kingdom

10:10-10:40 AM
Social Break & Networking
10:40-11:30 AM
Dr. Stefan TIMM
Harnessing optimized photorespiration to improve plant resilience – a guard cell perspective
University of Rostock, Germany

11:30-12:20 AM
Dr. Jaume FLEXAS
Why should plant ecophysiology prioritize studies on plants from climatically extreme environments: from 'sherplants' to 'shercrops'
University of Balearic Islands, Spain

12:20-02:00 PM
Lunch Time
GROWTH AND DEVELOPMENT

02:00-02:50 PM
Dr. Angus MURPHY
The ABCBs of auxin and brassinosteroid signalling: sometimes exclusion is better than inclusion
University of Maryland, USA

02:50-03:40 PM
Dr. Maria Magdalena ROSSI
Beyond light signaling: the multiple roles of BBX transcription factors in plant development
University of São Paulo, Brazil

03:40-04:20 PM
Social Break & Networking

04:20-05:10 PM
Dr. María Laura VIDOZ
I will survive: how tomato plants deal with flooding stress
Botanical Institute of the Northeast, Argentina

05:10-06:00 PM
Dr. Letícia DOS ANJOS (BNWPS Session)
Gender Equality in Brazilian Plant Sciences: past, present and future perspectives
Brazilian Network of Women in Plant Sciences
Federal University of Ceará, Brazil

06:00-08:00 PM
Poster Session
Informations available soon, please stay tuned!

October 9th

HYDRAULICS AND PLANT WATER RELATIONS

08:30-09:20 AM
Dr. Christine SCOFFONI
Leaves in distress: a hydraulics perspective
California State University Los Angeles, USA

09:20-10:10 AM
Dr. Sandra J. BUCCI
Plant hydraulic and water relations in response to drought and freezing temperatures: from forests to deserts
National University of Patagonia, Argentina

10:10-10:40 AM
Social Break & Networking

10:40-11:30 AM
Dr. Augusto César FRANCO
Insights on the hydraulic strategies and water relations in trees from the Cerrado savannas and southern Amazonian forests
University of Brasília, Brazil

11:30-12:20 AM
Dr. Rafael Silva OLIVEIRA
How plant hydraulics drive ecological processes across scales
State University of Campinas, Brazil

12:20-02:00 PM
Lunch Time

02:00-05:00 PM
Fisio Pop
Informations available soon, please stay tuned!
PLANT-PATHOGEN INTERACTIONS

02:00-02:50 PM
Dr. Jürgen ZEIER
Metabolic regulation of plant systemic acquired resistance
Heinrich Heine University Düsseldorf, Germany

02:50-03:40 PM
Dr. Marcelo L. CAMPOS
The role of jasmonates in plant host and nonhost resistance against insects
Federal University of Mato Grosso, Brazil

03:40-04:20 PM
Social Break & Networking

04:20-05:10 PM
Dr. Elizabeth P.B. FONTES
Cross-communication between plant immunity and growth control via a begomovirus-interacting signaling hub
Federal University of Viçosa, Brazil

05:10-06:00 PM
Dr. Leonardo DE LA FUENTE
Life inside the xylem: interactions between the bacterial pathogen Xylella fastidiosa and its plant hosts
Auburn University, USA

06:00-08:00 PM
Poster Session
Informations available soon, please stay tuned!

October 10th

GENETICS AND MOLECULAR PLANT PHYSIOLOGY

08:30-09:20 AM
Dr. José JIMÉNEZ-GÓMEZ
Metabolic adaptation in Arabidopsis plants from Cape Verde Islands
Polytechnic University of Madrid, Spain

09:20-10:10 AM
Dr. Luciano FRESCHI
Dissecting the role of nitric oxide in tomato fruit development and beyond
University of São Paulo, Brazil

10:10-10:40 AM
Social Break & Networking

10:40-11:30 AM
Dr. Raquel CHAN
From the biomolecule to the field. Unrevealing the molecular mechanisms taking place when HaHB4 and HaHB11 confer beneficial phenotypes to crops
UNL-CONICET Joint Research Institutes, Argentina

11:30-12:20 AM
Dr. Yunde ZHAO
Improved gene editing technology reveals insights into auxin-mediated organogenesis
University of California San Diego, USA

12:20-02:00 PM
Lunch Time
STRESS PHYSIOLOGY AND SYSTEMS BIOLOGY

02:00-02:50 PM
Dr. Carlos M. FIGUEROA
Regulation of carbon metabolism in C4 plants by trehalose 6-phosphate
Instituto de Agrobiotecnología del Litoral, Argentina

02:50-03:40 PM
Dr. Maria Fabiana DRINCOVICH
Metabolic engineering of malate levels to improve plant performance and resilience in a changing climate
Universidad Nacional de Rosario, Argentina

03:40-04:20 PM
Social Break & Networking

04:20-05:10 PM
Dr. Jorge GAGO
How to improve photosynthetical capacity and stress tolerance? Learning from the experts
University of Balearic Islands, Spain

05:10-06:00 PM
Dr. André R. dos REIS (Diamond sponsor Gran7)
Plant physiology tools for mitigation of abiotic stresses to achieve higher crop yields under field conditions
São Paulo State University - Tupã, Brazil

06:00-08:00 PM
Brazilian Society of Plant Physiology Meeting

October 11th

08:30-09:05 AM
Dr. Marcelo O. RODRIGUES (Emerald sponsor: Krilltech)
The nanotechnology revolution in Plant Physiology
University of Brasilia, Brazil

09:05-09:40 AM
Rejane de MORAES (Sapphire sponsor: Plant-DiTech)
PlantArray: Novel Efficient Plant Physiology Phenotyping System
Plant-DiTech, Israel

09:40-10:10 AM
Social Break & Networking

10:10-12:00 PM
VI Plant Physiology Forum
Equity in open access publications: Opportunities and barriers for Brazilian Plant Science
- Dr. Gustavo Habermann - Editor-in-chief – Theoretical and Experimental Plant Physiology (Springer)
- Dr. John Lunn - Editor-in-chief – Journal of Experimental Botany (Oxford Academic)
- Dr. Paulo R. Ribeiro - Associate editor – Plant Physiology and Biochemistry (Elsevier)
- Dr. Raquel Chan - Editor-in-Chief – Plant Science (Elsevier)
- Dr. Susanne C. Brink - Editor-in-chief – Trends in Plant Science (Cell Press)
- Dr. Yunde Zhao - Editor-in-Chief – Plant Physiology (Oxford Academic)

Moderator: Dr. Marina C M Martins, Soldi, In Press.

12:00-02:00 PM
Lunch Time

02:00-03:15 PM
Young Researcher Session
02:00-02:25 PM

Freire, Francisco Bruno Silva - *Disentangling the role of sucrose for stomatal movement regulation*

02:25-02:50 PM
Lima, Valéria Freitas - *Establishment of a GC-MS-based 13C-positional isotopomer approach suitable for investigating metabolic fluxes in plant primary metabolism*

02:50-03:15 PM
Machado, Kleiton Lima de Godoy - *Plant age-dependent dynamics of annatto pigment (bixin) biosynthesis in Bixa orellana L.*

03:15-04:00 PM
Closure Ceremony

04:00 PM
Closure cocktail

More information about the XIX CBFV can be found at:

sbfv.org.br

Summary

(by subareas)

Genetics and Molecular Plant Physiology

A TOMATO B-BOX PROTEIN REGULATES PLANT DEVELOPMENT AND FRUIT QUALITY THROUGH THE INTERACTION WITH PIF4, HY5, AND RIN TRANSCRIPTION FACTORS

Juliene dos Reis Moreira, Lumi Shiose, Bruno Silvestre Lira, Gabriel Ponciano, Raquel Tsu Ay Wu, Javier Francisco Botto, Marcelo José Pena Ferreira, Alain Goossens, Luciano Freschi, Magdalena Rossi

During the last decade, knowledge about BBX proteins has greatly increased. Genome-wide studies identified the BBX gene family in several ornamental, industry, and food crops; however, reports regarding the role of these genes as regulators of agronomically important traits are scarce. Here, by phenotyping a knockout mutant, we performed a comprehensive functional characterization of the tomato locus Solyc12g089240, hereafter called SlBBX20. The data revealed the encoded protein as a positive regulator of light signaling affecting several physiological processes during the life span of plants. Through inhibition of PHYTOCHROME INTERACTING FACTOR 4 (SlPIF4)–auxin crosstalk, SlBBX20 regulates photomorphogenesis. Later, it controls the balance between cell division and expansion to guarantee correct vegetative and reproductive development. In fruits, SlBBX20 is transcriptionally induced by the master transcription factor RIPENING INHIBITOR (SlRIN) and, together with ELONGATED HYPOCOTYL 5 (SlHY5), up-regulates flavonoid biosynthetic genes. This work clearly demonstrates that BBX proteins are multilayer regulators of plant physiology, because not only do they affect multiple processes during plant development but they also regulate other genes at the transcriptional and post-translational levels.

Analysis of heme binding proteins in Arabidopsis thaliana

Jochuan Israel Bezerra do Nascimento, Fernando de Oliveira Vilas Bôas, Erica Monik Silva Roque, Felipe de Castro Teixeira, Murilo Siqueira Alves

Heme is a prosthetic group found in a variety of proteins, including cytochromes, hydroxylases, catalases, peroxidases, and hemoglobins, playing an essential role in cellular processes. In conjunction with these proteins, heme participates in numerous processes involving electron transfer and it is also present in reactions that can release free iron and carbon monoxide. These reactions occur rapidly and transiently, allowing heme to function as a sensor responsive to environmental changes. The heme group exists in several forms, such as heme a, heme b, heme c, heme o, and siroheme, with heme b being the most prevalent. This study presents a comprehensive analysis of heme-binding proteins in Arabidopsis thaliana, using structural bioinformatics tools to elucidate their interaction patterns and evolutionary relationships. We analyzed 390 protein sequences for conserved motifs and evolutionary relationships. Our findings show that the majority of these proteins contain the cytochrome P450 and peroxidase domains. Despite extensive sequence divergence, conserved residues for heme binding were identified through multiple alignment and structural analyses. To achieve a comprehensive understanding, 27 structures from the Protein Data Bank (PDB) were compared to sequences from A. thaliana, including eight from A. thaliana and others from related species with high sequence similarity. These structures were analyzed using RING to identify non-covalent interactions with heme. Additionally, AlphaFold2-generated models were used to supplement the structural data, and molecular dynamics simulations were conducted to refine heme-binding interactions. The findings provide insights into the structural and functional diversity of heme-binding proteins, contributing to the understanding of their roles in cellular processes and offering potential targets for future research in plant biochemistry and molecular biology.

ANALYSIS OF THE PHENOMENON OF HETEROSIS IN DOUBLE MUTANTS IN TOMATO (Solanum lycopersicum L)

Érica Lopes Batista, Lucas de Maia Aquino, Rafael Rodrigues dos Anjos, Karla Gasparini, Phelipe Henrique Costa de Miranda, Caris dos Santos Viana, Cássia Nayana da Silva Vitorino, Hendril da Silva Lopes, Agustín Zsögön

A hybrid progeny comes from crossing two genetically different parents. Furthermore, it is observed that hybrid lineages of plants or animals present the phenomenon of heterosis or hybrid vigor, that is, a better performance or vigor than the parents that originated them. It has been demonstrated that vigor occurs because of altered patterns of gene expression resulting from specific combinations of parental alleles. Here, two genetic loci, each with two alleles in the tomato are the subject of analysis: epinastic (epi) and SINGLE FLOWER TRUSS (sft). On the one hand, plants harboring the epi allele have the effect of overproduction of the hormone ethylene, as well as a phenotype characterized by epinastic leaves, a compact growth habit, and thick stems. On the other hand, the genetic effect of sft is late-flowering plants with a strong vegetative development. We combined epi and sft in heterozygosis in a single plant, so that through analyses of plant architecture and fruit productivity we could assess how epi and sft drive heterosis in tomato. The results show that the sft × epi F1 genotype performed better in terms of yield (number of fruits and fruit diameter). However, we did not observe significant statistic difference in plant height between the genotypes. This confirms what the literature predicts: the combination of the sft and epi alleles in the hybrid lineage (sft × epi F1 genotype) makes it perform better than plants that harbor these alleles in isolation (epi × MT F1 and sft × MT F1 genotypes), especially in plant yield.

CAFFEOYL SHIKIMATE ESTERASE (CSE): THE MISSING LINK BETWEEN THE METABOLISM OF CHLOROGENIC ACIDS AND LIGNIN?

Gabriel Garon Carvalho, Thiago Geronimo Pires Alegria, Luis Eduardo Soares Netto, Igor Cesarino

Chlorogenic acids (CGAs) and lignins, both derived from the phenylpropanoid pathway, serve critical roles in plants. CGAs are associated with stress responses, while lignins are vital for structural support and waterproofing in xylem vessels. Although CGAs share chemical similarities with intermediates of the lignin biosynthetic pathway and can be converted to hydroxycinnamoyl-CoAs in vitro, their role in lignin production remains uncertain. The enzyme caffeoyl shikimate esterase (CSE), a key player in lignin biosynthesis, acts on caffeoyl shikimate, which closely resembles caffeoyl quinate, a CGA. This similarity suggests that CSE might also metabolize CGAs. This study investigates the hypothesis that CSE is involved in CGA metabolism by examining its function in potato (Solanum tuberosum), a species known for high CGA accumulation. Phylogenetic analysis revealed a single CSE gene (StCSE) in the potato genome. Transcriptomic analysis, using RT-qPCR, showed a positive correlation between StCSE and StHCT, a lignin biosynthetic gene, and a negative correlation with StHQT, a CGA biosynthetic gene. Recombinant StCSE was produced in Escherichia coli, purified, and tested in vitro with three substrates: caffeoyl shikimate, caffeoyl quinate (a CGA monoester), and 3,5-dicaffeoyl quinate (a CGA di-ester). The enzymatic assays demonstrated that StCSE efficiently utilizes CGAs, with higher activity compared to caffeoyl shikimate. These findings indicate that CSE is involved in both lignin and CGA metabolism, potentially facilitating the conversion of CGAs into lignin monomers or other phenylpropanoids. This research provides new insights into CSE's dual role, shedding light on its impact on phenylpropanoid metabolism and its potential effects on plant development and stress responses.

Characterization of the ALDH2B subfamily in Setaria viridis and their involvement in the phenolic metabolism

Arthur Netto Escudeiro, Igor Cesarino, Bianca Meeihua Sung

The main component that provides mechanical and structural support for the secondary cell wall of plants is lignin, an aromatic heteropolymer that also waterproofs the xylem vessels and participates in plant defense responses. However, lignin is the major bottleneck for the conversion of plant biomass into bioproducts in biorefineries. Thus, a better understanding of lignin metabolism and related processes is essential for the development of biotechnological strategies to produce optimized crops for the bioeconomy. The Aldehyde Dehydrogenase (ALDH) superfamily is composed of enzymes involved in the metabolism of aldehydes, converting them into their respective carboxylic acids. Regarding phenolic metabolism, some members of the ALDH superfamily are capable of metabolizing phenolic aldehydes considered intermediates of lignin biosynthesis, while others are related to the metabolism of benzenoids, metabolites structurally related to lignin. ALDHs from subfamily 2B has been linked to benzenoid synthesis, but it is still very little explored, with few genes properly characterized. Benzenoid metabolism is also still poorly understood, especially in grasses. Here, we performed the genomewide characterization of the ALDH superfamily in the model grass Setaria viridis and identified the members of ALDH2B family potentially involved in the phenolic metabolism. Phylogenetic, in silico expression analysis, and RT-qPCR suggest that both SvALDH2B might function redundantly in the metabolism of benzenoid in S. viridis. Further functional studies will validate the function of SvALDH2Bs in the phenolic metabolism.

CHARACTERIZATION OF THE POLYAMINE BIOSYNTHETIC PATHWAY AND ITS LINK TO LIGNIFICATION IN 'SETARIA VIRIDIS'

Hugo Ramalho de Souza, Igor Cesarino, Leandro Francisco de Oliveira

Polyamines are small aliphatic amines with polycationic properties found in all known living cells. These compounds play crucial roles in plant development and in its responses to biotic and abiotic stresses. Despite their significance, the understanding of polyamine metabolism in the model C4 grass Setaria viridis remains limited. This project aims to investigate the polyamine biosynthetic pathway in S. viridis and characterize its genes, considering its potential link to lignin metabolism, as both pathways utilize S-adenosylmethionine (SAMS) as substrate. Using BLASTp in the Phytozome platform, 40 biosynthetic genes were found in the genome of S. viridis, which were distributed among nine families related to the polyamines metabolism. This provided information for creating a database containing each gene CDS, cDNA and peptide sequences. Corresponding peptide sequences were used to generate phylogenetic trees, which allowed functional inferences based on genetic orthology. Additionally, the chromosomal locations of each gene were mapped and illustrated in a chromosomal map. Public expression data from PhytoMine were applied to generate a heatmap, illustrating the expression patterns of these genes across various plant tissues. Notably, sequences related to SvSAMS genes clustered with key genes associated with lignin biosynthesis, suggesting a potential function in lignification. On top of that, SvSAMS1 showed a similar expression pattern to lignin biosynthetic genes in 4 regions regarding the elogating internode of S. viridis, reinforcing its potential role in lignification. Our data provide novel insights into polyamine metabolism in grasses and identify SvSAMS1 as a potential hub connecting polyamine and lignin biosynthesis pathways in S viridis.

CHARACTERIZATION OF THE ROOT SYSTEM IN THE MODEL Glycine max cv. MiniMax

Phelipe Miranda, Hendril da Silva Lopes, Caio Melo Balarini, Karla Gasparini, Gabrielli Cristina Marques dos Santos, Maximiller Dal-Bianco Lamas Costa, Agustin Zsögön

Considered one of the most important crops in the world, soybean (Glycine max) is of fundamental importance as a source of protein and vegetable oil. Like most legumes, soybeans form symbiotic associations with beneficial microbes in their roots. Research to understand root characteristicsis in soybean present some complications due to their large root volume, long life cycle, large genome, and recalcitrance to transformation. The Williams 82 (W82) cultivar used currently as the model, has a 90-days cycle and a complex root system similar to the existing elite cultivars. Thus, using a genetic model system in soybeans would be convenient, especially with a reduced root system and early life cycle. The aim of this study is to assess the effectiveness of a dwarf soybean cultivar Minimax as a new genetic model, by charactarizing it root system in comparision to the W82 model currently in use. The roots of the MiniMax cultivar showed mean values of 2.21 ± 0.50 cm^3, considerably ($p = 0.001$) smaller than those of Williams 82 (9.78 cm^3). The root length (MiniMax = 19.79 ± 1.92 cm vs W82 = 46.17 ± 1.92; $p = 0.001$) and mean diameter (MiniMax = 0.37 mm vs W82 = 0.52 ± 0.02; $p = 0.001$). A trial was also carried out inoculating Bradyrhizobium elkanil with MiniMax, which demonstrated better phenotypic expression ($P = 0.038$) in a situation of inoculation with nodulating bacteria, promoting greater nitrogen supply to the plants. The results indicated a statistically significant reduction in MiniMax for the evaluated characteristics. The MiniMax cultivar appears to have great potential as a model plant for study Findings in this study showed that dwarf soybean cultivar may be useful model plant for research on G.max improvement and can be directly related to the varieties grown in the field.

CORRELATION BETWEEN PRODUCTIVITY AND SUGAR AND PIGMENT COMPOSITION IN Capsicum chinense

Caris dos Santos Viana, Paulo Mafra de Almeida Costa, Rodrigo Alves Rodello, Camily Rodrigues Oliveira, Adriano Nunes Nesi, Agustin Zsögön

The species Capsicum chinense likely has origins in the Amazon Basin, with considerable natural variation in morphological, physiological, metabolic, and production characteristics, linked to the species' evolutionary adaptation process. Accessions of C. chinense collected across a wide geographic distribution may provide insights into the genetic diversity associated with productivity and its key components. The aim of the research was to evaluate and correlate productivity, sugar composition, and pigments in 137 accessions of C. chinense grown under field conditions. The accessions were obtained from the Vegetable Germplasm Bank of the Federal University of Viçosa, the National Vegetable Research Center of the Brazilian Agricultural Research Corporation, whereas well-known commercial varieties (Biquinho and Habanero) used as genetic controls. Analyses of chlorophyll a and b, carotenoids, sucrose, fructose, and glucose were conducted using leaves collected before the onset of flowering. Productivity was assessed based on the weight and number of fresh fruits harvested at 99, 125, and 173 days after transplanting. The level of association between the variables was calculated using Pearson's correlation coefficient. The pigment and sugar values among the 137 accessions showed less variation than the production parameters, which exhibited scattered values. This may be due to the leaves for pigment and sugar analyses being collected during the vegetative phase, with some accessions extending this period and having later flowering, which affected production variability and resulted in a null correlation between these variables. Fresh fruit productivity per plant was positively correlated with the number of fruits, with 56 accessions producing more than 1000 fruits per plant, indicating tremendous potential of their use for improving C. chinense productivity. The genetic variability in fruit production and the diverse phenological patterns among the accessions had a greater impact on production than the relationship with pigments and sugars.

CREATION AND CHARACTERIZATION OF A TRIPLE MUTANT OF THE CETS GENE FAMILY IN TOMATO

Yuri Gomes Figueiredo, karla Gasparini, Caris dos Santos Viana, Phelipe Henrique Costa de Miranda, Patricio Andrés Segundo Delgado Santibáñez, Rafael Rodrigues dos Anjos, Lucas de Maia Aquino, Agustín Zsögön

SELF PRUNING (SP), SINGLE FLOWER TRUSS (SFT), and SELF PRUNING 3C (SP3C) are genes of the CETS family (CENTRORADIALIS, TERMINAL FLOWER 1, SELF PRUNING) that influence plant development, affecting growth habit, architecture, flowering, and response to abiotic stress. Despite their importance, these genes have been studied in isolation, underestimating potential interactions. This study aims to explore the genetic interactions and effects of the SP, SFT, and SP3C genes in the tomato cultivar Micro-Tom (MT) by creating a triple mutant line (sp sft sp3c) and phenotypically characterizing 149 F2 generation plants derived from the cross sp sft x sp sp3c. The days to flowering (DTF), the number of leaves to the first inflorescence (NLFI), and plant height were evaluated. NLFI was the most consistent variable for distinguishing the control genotypes (MT = 4.0 ± 0, sp3c = 5.6 ± 0.517, and sft = 10.1 ± 0.333), being used to calculate phenotypic ratios in the F2 population. The results indicated that the segregation of recessive mutants for the sft gene followed Mendel's laws, as per the chi-square test ($X^2 = 0.530201$; tabled value $X^2 = 3.841$ at 5% significance). Of the 149 plants, 33 showed an NLFI higher than the remaining population. However, the segregation of the SP3C gene did not follow the same ratio, as the chi-square for plants with NLFI between 6 and 8 (57 plants) was higher than the tabled value. This suggests that this gene does not manifest the flowering control phenotype independently. Genotypic analysis using specific molecular markers and gel electrophoresis will allow associating the observed phenotypes with the genotype of each plant and provide a more detailed evaluation of the potential epistatic effect and gene dosage.

De novo RNA-seq transcriptome assembly of Solanum sessiliflorum and functional comprehension as revealed by phylogenetic analysis

Priscila Oliveira Silva, Priscila Morais Rodrigues, Higor Fernando Salvador, Joao Henrique Frota Cavalcanti

Compelling evidence has demonstrated the potential application of crop wild relatives in Solanum breeding. Significant efforts have focused on generating genomic data from wild Solanum plants to assess the insertion of advantageous traits in crop species. South America hosts a broad range of plant diversity that has been neglected in molecular studies. Solanum sessiliflorum is a wild species whose phenotype seemingly involves a mechanism associated with tolerance to Ralstonia solanacearum and nematode infection. Overall, this study aims to contribute to our understanding of the genetic basis of stress tolerance in wild Solanum species and, when considered together, provides valuable information for the development of improved crop varieties through breeding and genetic engineering approaches. To achieve such goal, Illumina platform was used to construct the transcriptome of S. sessiliflorum. The data generated were employed in bioinformatics tools for both phylogenetic comparison and bioprospecting for disease-related genes. This work provides the first leaf transcriptome assembly of S.sessiliflorum, enabling both phylogenetic comparisons and stress-tolerant gene bioprospection. De novo assembly generated 114,184 unigenes. Comparison of the S. sessiliflorum unigene dataset against other Solanum nucleotide genomic resources revealed greater similarity to Solanum tuberosum than Solanum melongena. Nonetheless, the phylogenetic tree revealed that S. sessiliflorum within the Leptostemonum group alongside S. melongena provides features related to Solanum clade evolution. Bioprospection by disease response targets identified 122 potential candidate unigenes retrieved from the S.sessiliflorum dataset. The abundant expression of fragments of disease-related and hormonal defense genes seems to constitute a housekeeping mechanism to avoid pathogen attack in leaves. 1,091 unigenes were classified as transcription factors, among which a notable presence of TFs associated with biotic resilience was observed. These results highlight the potential for exploration of the genomic diversity of S. sessiliflorum, which will be useful for application in breeding programs

Deficiency in ATP-Mg/Pi Transporters 1 Alters Root Sensitivity to Aluminum in Arabidopsis thaliana

Rita de Cássia Monteiro Batista, Barbara Schirato Gonçalves, Bruno Jerônimo do Nascimento Gomes, Júlia de Paiva Gonçalves, Ana Luiza Viana Silva, Roberto Neri da Silva, Wagner L. Araújo, Adriano Nunes-Nesi

Aluminum (Al^{3+}) toxicity in acidic soils significantly limits agricultural productivity. Al^{3+} exposure induces the production of reactive oxygen species (ROS) in root cells, leading to oxidative stress that impairs root growth and nutrient uptake. ATP-Mg/Pi Transporter 1 (APC1), a member of the mitochondrial carrier family, is important for maintaining energy homeostasis under stress. This study investigates the role of APC1 in root growth and aluminum stress responses in Arabidopsis thaliana. We analyzed four CRISPR-Cas9 mutant lines deficient in APC1 (L8.7, L10.2, L10.9, and L11.2) and compared their root responses to aluminum stress with those of wild-type (WT) plants. Root growth was measured, and histochemical assays were conducted to detect aluminum accumulation and ROS in root tissues. The plants were subjected to three treatment conditions: -Al at pH 5.7, -Al at pH 4.0, and +Al (300 µM aluminum chloride) at pH 4.0. APC1-deficient plants exhibited significantly reduced root growth under acidic conditions, even without Al^{3+}, highlighting APC1's possible role in root development. Interestingly, under Al^{3+} stress, the mutants demonstrated less severe root growth inhibition compared to WT. Hematoxylin staining confirmed aluminum presence only in seedlings at pH 4.0 with Al^{3+}, with no clear differences in aluminum accumulation between genotypes. Nitro blue tetrazolium staining revealed higher ROS levels in plants exposed to Al^{3+} at pH 4.0 compared to pH 5.7. Plants grown at pH 4.0 without Al^{3+} also displayed elevated ROS levels, indicating that low pH alone induces stress. Mutant plants exhibited more intense ROS accumulation than WT under both Al^{3+} and low pH conditions. These findings suggest that APC1 deficiency might activate alternative metabolic pathways to counteract aluminum toxicity, possibly through increased organic acid exudation. This emphasizes the importance of APC1 in root growth under varying conditions and points to potential avenues for improving root resilience to aluminum stress in crops.

Dynamic of oxidative status during in vitro culture of passionfruit species with divergent morphogenic responses

Débora Alice Moreira Silva, Henrique Scalco Surerus de Almeida, Diego Ismael Rocha

Passiflora edulis Sims and P. cincinnata Mast. are passionfruit species that exhibit temporally divergent morphogenic responses during in vitro cultivation of endosperms. Although well-established protocols exist for both species, the physiological processes regulating these responses are still poorly understood. This study aimed to characterize the morphoanatomy and the dynamics of the oxidative status of P. edulis and P. cincinnata endosperms during the regeneration of adventitious buds, seeking to understand the structural and biochemical differences between the species. Endosperms of both species were disinfected and inoculated in organogenesis-inducing medium, supplemented with 1.0 $mg.L^{-1}$ of thidiazuron for P. edulis and 2.0 $mg.L^{-1}$ of benzyladenine for P. cincinnata, and cultivated in a growth room at 27 ± 2 °C. Samples were collected pre-cultivation and after 5, 15, and 30 days of cultivation. Initially, the explants were white with isodiametric cells. By day 5, P. cincinnata started to form calluses and exhibited a greenish color, characteristics absent in P. edulis. By day 30, P. cincinnata already displayed differentiated adventitious buds, whereas P. edulis had not yet developed well-defined organogenic structures. Interestingly, P. edulis showed higher levels of MDA throughout the process, while P. cincinnata had no detectable MDA at day 5. The H_2O_2 content in P. cincinnata decreased at day 5 and remained significantly lower than in P. edulis. The production of $O_2^{\bullet-}$ was also lower in P. cincinnata. The activities of antioxidant enzymes POX, APX, and SOD varied between the species, with P. cincinnata showing a steady increase in these activities throughout the regenerative process. The results suggest that differences in the production of ROS and in the activity of enzymes involved in antioxidant metabolism may be associated with the spatiotemporal differences observed in the in vitro cultivation of P. edulis and P. cincinnata endosperms.

EFFECTS OF ADP/ATP CARRIER 2 ON SEED GERMINATION AND YIELD IN ARABIDOPSIS THALIANA

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Cells require energy to sustain numerous metabolic processes. ADP/ATP Carrier 2 (AAC2), a mitochondrial adenylate transporter from the Mitochondrial Carrier Family, exchanges ATP in the inner mitochondrial matrix for cytosolic ADP, supporting energetic turnover. This exchange is crucial during seed germination, as it provides the ATP needed for the transition from dormancy to active growth. We investigated how AAC2 affects energy metabolism during seed germination and its impact on final seed yield. We hypothesize that reduced AAC2 expression disrupts energy balance, impairing both germination and seed quality. To test this, we conducted experiments using wild-type (WT) Arabidopsis thaliana and AAC2-deficient lines, including a T-DNA insertion mutant (aac2) and an antisense line (p35s::AAC2). Germination tests were performed on half-strength Murashige and Skoog medium with and without 1% sucrose for 72 hours, followed by evaluation of germination parameters. Reduced AAC2 expression led to morphological changes in seeds, such as shrinkage and reduced viability. Seeds with low AAC2 expression exhibited increased length and thousand-seed weight, although there was no reduction in the total weight of aac2 and p35s::AAC2 seeds compared to WT. Results indicated that AAC2-deficient mutants display lower germination rates compared to WT. Specifically, the aac2 line exhibited a 37% reduction and the p35s::AAC2 line a 56% reduction in germination rates without sucrose. Although germination improved with sucrose, mutant lines still had lower rates than WT. Germination rates were approximately 93% for WT, 84% for aac2, and 79% for p35s::AAC2 without sucrose, and 98%, 80%, and 87% with sucrose, respectively. AAC2 mutants also had a higher speed germination index, indicating faster germination once it began. These findings suggest an important role of AAC2 in maintaining energy balance and its impact on seed development.

EVALUATION OF HETEROSIS IN A HYBRID COMPARED TO ITS PARENTS IN TOMATO (Solanum lycopersicum L.)

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Heterosis, or hybrid vigor, is a genetic phenomenon in which hybrid progeny are superior to their parents. In tomato (Solanum lycopersicum cv. Micro-Tom), several mutants when heterozygous display this phenomenon, which is essential for agriculture. Auxin is a phytohormone fundamental for developing several aspects of plant growth and development, both at the cellular level and in aspects of the whole plant. entire (e) is a tomato mutation that inactivates the IAA9 gene,a repressor of the auxin response, resulting in plants with different phenotypic characteristics, such as the presence of simple leaves, in addition to the development of fruits before fertilization, resulting in some of the fruits presenting parthenocarpy. The obv mutant, in turn, lacks the bundle sheath extension (BSE), a physiological characteristic that connects the vascular cylinder with the epidermis, presenting high physiological value for plants, and expressing a greater response to auxin. In this study, the tomato mutants e (e/e); obv (obv/obv); and the hybrid, e × obv (e/obv) were studied. During the research, we sought to infer their interaction within the plants and evaluate whether the hybrid shows the phenomenon of heterosis. Measurements of agronomic parameters were performed and we inferred that although the progeny did not present a significant height difference, the fruits of the hybrid double mutant, e × obv, showed greater weight and polar diameter than its parents, being superior to MT by 81% and 27%, to obv by 63% and 13% and to entire by 55% and 23% respectively. Therefore, we can conclude that the hybrid displays greater vigor because of larger fruits, thus manifesting the phenomenon of heterosis. This knowledge can be used for the improvement of commercial cultivars.

EXPRESSION OF GENES RELATED TO COFFEE QUALITY AT DIFFERENT STAGES OF FRUIT DEVELOPMENT AND MATURATION

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The accumulation of biochemical compounds in the coffee bean during development and maturation are key to achieving high quality standards. These compounds are regulated by the activation or repression of genes, which in turn are influenced by various factors in the plant. Studies in Coffea arabica have shown that genes such as ascorbate peroxidase (APX) and catalase (CAT) contribute to prolonging the time of fruit development, which allows a greater accumulation of compounds in the bean. Likewise, sucrose synthase (SUS1 and SUS2) and invertase (INV3) genes have been suggested to regulate different biochemical compounds. Therefore, the aim of this study is to analyze the expression of these genes during fruit development and ripening. Gene expression profiling analysis was done using C. arabica libraries of fruits at different stages of development, available at the Sequence Read Archive (SRA) database, after library quality assessments, fragment alignments, sorting and removal of duplicate reads, and quantification of mapped fragments. Expression values were then calculated as log-transformed Fragments Per Kilobase of transcript per Million mapped fragments (log(FPKM+1)), and a heatmap of relative gene expression was generated. Two groups of genes with similar expression patterns, more or less expressed, were identified. By examining the expression patterns it was found that, of the 21 genes (1 SUS2, 2 SUS1, 8 EXT, 3 INV3, 1 CAT, 6 APX) analyzed, at least one gene from each group is expressed in all libraries analyzed, thus demonstrating that they have an involvement in fruit development at those stages. Further research is needed to determine possible interactions between these genes and the key points at which they could be regulated in order to develop new strategies to contribute to improving coffee bean quality and, consequently, the final quality of the beverage.

FRUITS GO ROUND: BBX17 TOMATO PROTEIN REGULATES FRUIT SHAPE

Raquel Tsu Ay Wu, Gabriel Ponciano, Juliene dos Reis Moreira, Bruno Silvestre Lira, Letícia Guimarães Barbosa, Magdalena Rossi

The B-Box (BBX) proteins are zinc-finger transcription factors which regulate processes such as photomorphogenesis, stress response, and flowering. In tomato, Solanum lycopersicum, the few functionally characterized SlBBX play a role in shade avoidance, abiotic stress response, plant growth, development, and flowering, and determination of fruit nutritional quality. Thus, to expand the knowledge about SlBBXs roles in plant development and yield, SlBBX17, whose expression is induced by light, and repressed upon fruit ripening, was selected for functional characterization. First, by RT-qPCR, a comprehensive transcriptional profile carried out in several organs revealed a notably high transcript accumulation in flowers, particularly before pollination, hinting a role in floral organ development. Then, a CRISPR-Cas9 mediated knockout mutant, named Slbbx17, was generated and functionally characterized. Interestingly, Slbbx17 plants exhibited more leaves until anthesis, hinting that SlBBX17 deficiency may either delay floral meristem transition or enhance leaf primordia differentiation in vegetative meristem. After 112 days of cultivation, edited plants showed reduced aerial part weight, and flower and fruit number. Moreover, not only ovary, but also fruit shape index was reduced in Slbbx17 plants due to reduced organ height. Additionally, mutant fruits had increased pericarp thickness, and, while most fruits had three locules, the proportion of fruits with two locules was higher in Slbbx17 genotype, hinting altered cell proliferation and/or expansion. Finally, Slbbx17 fruits displayed reduced seed number, indicating a compromised pollination, and reduced color intensity, probably due to alteration in carotenoid content. Collectively, our results provide evidence that SlBBX17 plays not only a role in plant development regulating vegetative growth, but also in reproductive development by controlling ovary shape, flower number, and fruit shape, number, and nutraceutical composition.

Functional analysis of the NIK1-mediated signaling pathway in response to drought stress in tomato plants

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The NIK1 is a leucine-rich repeat receptor-like kinase (LRR-RLK), which recognizes viral effectors and functions in antiviral immune response. The antiviral mechanism involves the activation of the RPL10 protein and interaction with MYB-like protein, L10-INTERACTING MYB DOMAIN CONTAINING PROTEIN (LIMYB) to down-regulate the translational machinery in the nucleus. Recently, NIK1 has also been described as a component of the signaling cascade acting as a hub that converges responses from biotic and abiotic stress. Here, we describe the NIK1 function in the growth and development of tomato plants in response to drought stress using AtNIK1, mutant NIK1-, T474D-, T474D/T469A-overexpressing lines. Under normal conditions, transgenic lines and control plants showed greater plant height when compared to the stressed groups, 7 days after stress (DAS). Several physiological parameters were severely changed in the stressed plants 7 DAS. However, the principal component analysis (PCA) showed partial recovery of plants at 14 DAS. Regarding floral traits, most of the transgenic lines in the stressed and unstressed groups displayed higher numbers of inflorescences, flowers and fruit than non-transgenic lines in the stressed and unstressed groups. Analysis of fruits 50-DAS showed that T474D and T474D/T469A mutants were severely affected. RNA-seq analyses of the mutants vs control plants under normal conditions revealed that a large fraction of genes involved in development, such as F-box transcription factor, Sweet12, pectin methylesterase inhibitor, cellulose synthase were upregulated in mutant lines. Additionally, several transcription factors of the MYB-like family were upregulated in the LIMYB-overexpressing lines. Structural analyses showed that these MYB-like genes harbor a non-canonical SANT/MYB-like DNA-binding domain, which is important in the control of gene expression and tomato cell expansion. In conclusion, these data suggest a sophisticated mechanism of interaction between NIK1/LIMYB/ and Myb-like transcription factors in the control of gene expression, plant growth and development of tomato plants.

Functional characterization of ALDEHYDE DEHYDROGENASE 2C (ALDH2C) subfamily in grass Setaria viridis (L.) P. Beauv

Bianca Meeihua Sung, Igor Cesarino

Lignin is a phenolic biopolymer mainly found in secondary cell walls of supportive and water-conductive tissues. It provides mechanical strength and hydrophobicity to such cells, allowing them to withstand the force of gravity and transport water and nutrients along the plant. Superfamily aldehyde dehydrogenase (ALDH) comprises enzymes involved in aldehyde metabolism, converting aldehydes into their respective carboxylic acids. Regarding phenolics metabolism, some members of the ALDH superfamily metabolise phenolics aldehydes considered intermediates of the lignin pathway. The content of ferulic acid is known to negatively affect cell wall digestibility in grasses, thus the comprehension of acid ferulic synthesis is important in the context of lignin engineering strategies. With the objective to provide further knowledge in grass phenolics metabolism, we performed a genome-wide characterization of the ALDH superfamily in the model grass Setaria viridis and identified potential involved genes in the phenolic metabolism. Initially, all members of the superfamily were studied by bioinformatics tools. Then, RT-qPCR experiments and in situ hybridization assays identified two ALDH2C candidates that are potentially involved in the metabolism of phenolic aldehydes in S. viridis. Our data help bridging some gaps of the phenolic metabolism in grasses and may support future biotechnology strategies to reduce biomass recalcitrance.

GENETIC SEGREGATION OF C4 PHOTOSYNTHESIS RELATED TRAITS: EXPLORING INTERSPECIFIC HYBRIDS IN THE CLEOMACEAE FAMILY

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The Cleomaceae family is of great significance to the study of the evolution of C4 photosynthesys, as it encompasses representatives of all three photosynthetic pathways: C3, C4 and C3-C4. The C4 mechanism evolved independently of C3, involving morphological and physiological adaptations in plants. These include the differentiation of bundle sheath cells, changes in the enzymatic machinery, and increased metabolic transport, which collectively result in greater photosynthetic efficiency. In this context, intergeneric hybrids between Tarenaya longicarpa (C3) and Gynandropsis gynandra (C4) were generated, both from the Cleomaceae family. The hybrids displayed characteristics indicative of an intermediate photosynthetic mechanism with proto-Kranz anatomy. Subsequent backcrosses with both parental lineages and self-pollination of these hybrids were performed to investigate genetic segregation with the aim of selecting hybrid lines that express C4 traits. The backcrossing of the hybrids with both parents resulted in production of smaller siliques (measuring 10 cm and 6 cm, respectively) and a reduced number of seeds per silique (75 and 10, respectively) in comparison to the self-pollination of the hybrids (measuring 13 cm and producing 140 seeds, respectively). The germination rates were comparable to those of the parental lines in backcrossing with T. longicarpa (65%), but exhibited a decline in self-pollination and backcrossing with G. gynandra (35% and 30%, respectively). The study encompassed the evaluation of photosynthesis at low CO2 and venation density (VD) parameters. The analysis of the F2 generation revealed a high degree of segregation, with intermediate photosynthesis values observed in both backcrosses and a slight increase in VD in the lines derived from the backcross with G. gynandra. The results illustrate the genetic diversity that arises from segregation, underscoring the need for further investigation of subsequent generations. Furthermore, these findings highlight the potential of the Cleomaceae family as a model for investigating evolutionary mechanisms of CO2 concentration.

Gibberellin and Abscisic Acid regulation in floral bud development in Coffea arabica L.

Catherine Oliveira Peralta, Lillian Magalhães Azevedo, Raphael Ricon de Oliveira, Gabriel Lasmar dos Reis, Antonio Chalfun Junior

During the reproductive development of Coffea arabica L, it is described that the floral buds at the G4 stage enter in a period of latency associated with the water deficit and resume its growth upon rehydration. This study aimed to investigate the interactions between these plant growth regulators (PGRs) and their relationship with floral bud development. In an experiment conducted with C. arabica cv. Paraíso MG2, GA and ABA were applied at three concentrations in August (floral bud latency period). Floral buds were collected two hours after application. The expression of genes involved in the biosynthesis, signaling, and degradation of GA and ABA, as well as genes related to floral development, was analyzed by RT-qPCR. Application of GA and ABA promoted the expression of CaAP1 and CaLFY . This indicates that these PGRs may have a positive relationship with the floral development in coffee plants. ABA increased the expression of CaGA3ox1 while high concentration of GA and all concentrations of ABA reduced the expression of CaGA2ox1. The expression of CaDELLA3 did not show a significant difference, but it tends to increase in some concentrations of both hormones. The regulation of CaNCED1 also did not show a significant difference but showed an inverse relationship with ABA concentration. CYP707A7 expression was promoted by GA. These findings suggest that ABA promotes GA synthesis and reduces its degradation, while GA promotes ABA degradation. This indicates a balance between these hormones in regulating bud development, with ABA appearing downstream of GA in promoting floral development. These findings have significant implications for understanding the reproductive physiology of C. arabica and may assist in the development of management strategies to synchronize floral bud development.

HORMONAL PROFILE AND ANATOMY OF PASSION FRUIT ENDOSPERMS DURING de novo SHOOT ORGANOGENESIS

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The endosperm is a triploid reserve tissue present in most angiosperms, which has been used as a tool for obtaining triploid plants. However, data related to the biology of this process are lacking. Considering the importance of hormones in the induction of regeneration processes, this study aimed to characterize the anatomy and quantify the hormonal profile during the induction of adventitious buds from in vitro endosperms cultivation of Passiflora cincinnata Mast. and Passiflora edulis Sims. Endosperms of both species were inoculated in MS culture medium, supplemented with 2 mg/L-1 benzyladenine cytokinin for P. cincinnata and 1 mg/L-1 thidiazuron for P. edulis. Samples of the initial explant and those collected at 5, 15, and 30 days after inoculation were analyzed. The explants after 5 days of cultivation presented high concentrations of indoleacetic acid (IAA) and salicylic acid (SA), which decreased during the regeneration phases in both species. The content of abscisic acid also followed this pattern, suggesting that the initial explant of both species was under stress. At 15 days of cultivation, a period of intense cell proliferation, there was a rise in zeatin (ZEA), 1-aminocyclopropane-1-carboxylic acid (ACC), and brassinosteroids (BRA) in P. cincinnata. In P. edulis, a peak of jasmonic acid was observed at the same stage. At 30 days, the levels of IAA and SA continued to decline in both species, and ACC, BRA, and ZEA also decreased in P. cincinnata. Microscopy results showed that the tissues were initially white with equidimensional cells. After 5 days, P. cincinnata endosperms already showed callus formation. At 30 days, these explants presented differentiated adventitious buds. The results obtained here demonstrate that endogenous hormones may be linked to the spatiotemporal differences observed during the regeneration of P. cincinnata and P. edulis via de novo organogenesis.

I need some BBX, help! Tomato BBX proteins mediate jasmonate signaling

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The B-BOX (BBX) proteins are zinc finger transcription factors (TF) that regulate several physiological processes. Although scarcely reported, even in Arabidopsis thaliana, it has been shown that some BBXs mediate the defense against pathogens. In many cases, this response relies on the jasmonic acid (JA) signaling, which induces the degradation of the repressor JAZ (JASMONATE-ZIM) proteins, alleviating the repression over the master TF MYC2, leading to the expression of JA-responsive genes. While the transcriptional responsiveness of BBX genes to JA has been reported in several species, the role of BBX proteins in JA signaling cascade is poorly known. Thus, this work aims to investigate whether tomato, Solanum lycopersicum, SlBBXs mediate JA response. First, to investigate if all members of the JAZ protein family encoded in tomato genome are known, a genomic survey using A. thaliana sequences as bait was performed, followed by a phylogenetic reconstruction of the sequences from both species. Then, we searched in the promoter of SlJAZ and SlBBX genes for binding motifs of BBX and MYC2, respectively. Finally, by RT-qPCR, we evaluated the responsiveness of SlBBXs to JA treatment, as well as whether JA-response is compromised in genotypes deficient for selected SlBBXs. Our survey identified the same number of SlJAZ proteins as previously reported. Putative BBX binding motifs were found in the promoters of several SlJAZs, as well as MYC2 binding sites in the promoter of the surveyed SlBBXs. In line with this, not only the transcript level of the analyzed SlBBXs was modulated by JA treatment, but also, the lack of SlBBXs altered JA responsiveness by means of the mRNA content of SlMYC2, and SlJAZs. Collectively, our results provide evidence that SlBBXs are part of the JA-signaling pathway, being putative modulators of tomato defense against pathogens and herbivores.

IDENTIFICATION OF THE EXPRESSION PATTERN IN GRAFTED HEVEA BRASILIENSIS AFFECTING NATURAL RUBBER PRODUCTION

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Natural rubber (cis-1,4-polyisoprene) is widely used as a raw material in industry, with isopentenyl pyrophosphate (IPP) as the key precursor monomer. These pathways can be regulated, thereby affecting rubber production through the interaction between the scion and rootstock, which has a significant influence on this system. Thus, this study aimed to identify the transcriptional profile of genes related to biological processes and those associated with interactions in different combinations of cloned RRIM600 scion (S) with rootstocks (RS) derived from seeds of different genotypes (PB235 and non-selected seeds (NSS)). In this study, two contrasting treatments were evaluated: rootstock/scion combinations of PB235 × RRIM600 and NSS × RRIM600. Genotype confirmation was performed using microsatellite markers. Differential expression analyses (DEG) were conducted based on the average dry rubber production of 266 g in PB235 and 165 g in the less productive NSS. Our results enabled the identification of the rubber biosynthesis pathway, with the gene related to isopentenyl diphosphate (IDI) upregulated in PB235-RS × S and downregulated in IAN873-RS × S, suggesting a potential variation in the MVA pathway depending on the rootstock. The squalene synthase (SQS) gene, upregulated exclusively in NSS-RS × S, acts in steroid formation in the MVA pathway, which is involved in the oxidative stress response, KEGG found variations related to metabolism were found, specifically in the KEGG pathway for terpenoid backbone biosynthesis (hbr00900) in PB235. This variation was observed throughout the HRR network, demonstrating the influence of rootstocks on scions under different conditions, resulting in reduced natural rubber production. These findings facilitated the characterization of expression variation resulting from the interaction between the scion and rootstock, demonstrating that each rootstock influences rubber production of grafted genotypes differently. This influence is due to genes related to oxidative stress as well as alterations in natural rubber synthesis metabolism.

Identification of UDP-Glycosyltransferases involved in tricin glycosylation in Setaria viridis, a model C4 grass

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Plant secondary metabolism produces diverse components, including lignin, a phenolic polymer crucial for structural support and stress protection. Because of its recalcitrant nature, it is considered an obstacle to the extraction of fermentable sugars from plant biomass. Recently, the flavone tricin was identified as an authentic lignin monomer present mainly in grass lignin, functioning as an initial polymerization site. Glycosylation, catalyzed by UDP-dependent glycosyltransferases (UGTs), affects secondary metabolite properties. Since the glycosylation of monolignols influence their transport and storage, we hypothesized that UGTs may help control the incorporation of tricin into lignin in Setaria viridis, a model C4 grass. In order to evaluate the potential roles of UGTs in tricin metabolism and incorporation into lignin, we first performed a genome wide analysis of SvUGTs, which identified 195 putative UGT genes. Then, we selected one candidate tricin UGT, which we dubbed SvUGT706C1, based on previous studies of rice flavone UGTs. This gene was expressed in Escherichia coli and kinetic assays showed very high sensitivity to tricin. Therefore, SvUGT706C1 is an interesting target for overexpression to verify its impact in lignin structure and recalcitrance, and in biomass accumulation in Setaria viridis.

INTEGRATIVE TRANSCRIPTOME AND DNA METHYLOME RESPONSE OF SUSCEPTIBLE AND RESISTANT E. GRANDIS GENOTYPES TO THE PHYSIOLOGICAL DISORDER SYNDROME.

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Eucalyptus Physiological Disturbance Syndrome (EPDS) affects the productivity of high-quality woody, geographically concentrated in Bahia and Espírito Santo, but does not occur in São Paulo. It is speculated that EPDS is due to abiotic stresses. Molecular and epigenetic mechanisms may be related to EPDS. Combined transcriptome (RNA-Seq) and global methylation pattern by bisulfite sequencing (WGBS) of susceptible and resistant E. grandis genomes to associate Differentially Expressed Genes (DEGs, log2fold-change>; padj<0.05) with Differentially Methylated Regions (DMR>25% / 100CpG; padj<0.05). Both analyses were on stems and leaves of Asymptomatic Susceptible (0520-AS), Symptomatic Susceptible (0520-SS), and Resistant (1404-R) Eucalyptus Clones with biological triplicates of 7-month-old plants grown under the same environmental and cultivation conditions. In stems, RNA-seq identified 4286 DEGs (1620 upregulated and 2666 downregulated) in the 0520SS-vs-0520AS contrast, and 3853 DEGs (1979 upregulated and 1874 downregulated) for the 1404R-vs-0520AS contrast, while, in leaves, the 0520SS-vs-0520AS contrast revealed 96 DEGs (31-up and 65-down) and 1404R-vs-0520AS, 224 DEGs (89-up and 135-down). WGBS contrast 0520SS-vs-0520AS resulted in 89 DMRs (33 Hypermethylated and 56 Hypomethylated) and 192 DMRs (53-Hyper and 139-Hypo) in the stem and leaves, respectively. The contrast 1404R-vs-0520AS resulted in 6570 DMRs (3639-Hyper and 2931-Hypo) and 10721 DMRs (5767-Hyper and 4954-Hypo) in the stem and leaves, respectively. For the susceptible genotype, integration of DEGs with DMRs revealed ten genes in the stem and only one gene in the leaf. For 1404R-vs-0520AS, however, 414 stem DEGs and 45 leaf DEGs overlapped and were located near DMRs (up to 4kb apart). Integration of RNA-seq and WGBS techniques revealed DE genes near DMRs that may be under epigenetic expression control. Some genes involved in cell death, DNA repair, and abiotic stress, which were DE and overlapping DMRs, are candidates to be associated with the epigenetic regulation of EPDS mediated by DNA methylation.

Interaction between gibberellin, abscisic acid, and ethylene during the reproductive stage of Coffea arabica L.

Lillian Magalhães Azevedo, Raphael Ricon De Oliveira, Gabriel Lasmar dos Reis, Joyce Pereira Alvarenga, Antonio Chalfun Junior

The reproductive development of Coffea arabica L. , an important socio-economic crop, is regulated by different factors especially plant hormones which remains poorly understood. Ethylene is known to promote anthesis of floral buds, whereas gibberellin (GA) and abscisic acid (ABA) may influence floral bud latency. Understanding the hormonal interactions between GA, ABA, and ethylene is essential for elucidating the responses of coffee plants to these growth regulators. This study aimed to investigate the effects of different concentrations of these plant growth regulators on metabolic pathways and gene expression in coffee plants during the reproductive period. Three concentrations of GA and ABA were applied to Coffea arabica plants in August. Leaf and floral bud samples were collected 2h after application. The expression of genes involved in ethylene biosynthesis (CaACS3 and CaACO3) was assessed by RT-qPCR in these tissues. The quantification of 1-aminocyclopropane-1-carboxylate (ACC), ethylene, and ACC oxidase (ACO) enzyme activity was performed. We observed that GA application induced CaACS3 expression and increased ACC levels in the leaves. However, this increase in leaf ACC did not correspond with an increase in leaf ethylene levels. Conversely, in floral buds, GA and ABA application reduced CaACS3 expression but increased CaACO3 expression and ACC levels. This suggests that the ACC accumulated in leaves may have been transported to the floral buds, acting as a signal to trigger anthesis. The increase in ACC in floral buds with GA and ABA applications culminated in higher ethylene production in floral buds. These results indicate a complex interaction between GA, ABA, and ethylene during floral development in coffee plants, with potential implications for anthesis and fruit production.

MANAGEMENT OF DIFFERENT MAGNESIUM SOURCES VIA FOLIAR APPLICATION IN CITRUS

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Magnesium (Mg) is an essential element, necessary for photosynthetic reactions, as well as being required by more than 350 enzymes in citrus plants. The citrus belt is the region with the highest orange production in Brazil. The increase in the productivity of these orchards over the last 30 years is associated, among other factors, with the adjustment of fertilisation recommendations. The aim of this project was to test whether the application of different sources of Mg via foliar fertilisation improves the physiological and biochemical parameters of the plants. The experiment was conducted in a randomised design (5 replications) with 'Pêra' orange seedlings onto Sunki rootstock in protected cultivation. The treatments consisted of 3 doses (125, 500 and 2000 mg/L) of magnesium sulphate (MgSO4) and magnesium nitrate (Mg(NO3)2), and a single dose of magnesium phosphite (Mg3(PO3)2) (500 mg/L), all applied via foliar. Catalase activity (CAT, EC 1.11.1.6), lipid peroxidation (estimated by the content of malondialdehyde, MDA) and SPAD and dry mass measurements were carried out. There was no difference between the treatments for SPAD and dry mass analyses, indicating low efficiency of foliar Mg application regardless of the source and dose. The MDA content was higher in the 125 mg/L nitrate treatment (3.8 Mol of MDA/g) compared to the others. There was a tendency for CAT activity to increase at doses of 2000mg/L for both sources. We conclude that there is low efficiency of foliar Mg application for nutritional and growth parameters, however the application of higher doses may promote the antioxidant activity of citrus plants.

MED5A/MED5B MUTATIONS IN HOP PLANTS DECREASE GIBBERELLIN BIOSYNTHESIS GENE EXPRESSION, AFFECTING FLOWERING TIME

Robert Márquez Gutiérrez, Raphael Ricon De Oliveira, Antonio Chalfun-Junior

The Mediator complex (MED) is a multimeric complex that mediates the interaction between transcription factors and RNA polymerase II in eukaryotes. Previously, it was demonstrated that CRISPR-Cas9-mediated mutagenesis in the MED5a and MED5b genes affects the production of secondary metabolites and flowering time in hop (Humulus lupulus L.). In this work, we identified and classified the gibberellin biosynthesis genes in the hop genome, and analyzed their expressions using available RNA-seq libraries of leaves and lupulin glands, with double mutations and wild type. We found 15 GA-oxidase non-redundant genes in the hop genome classified as: 5 GA20ox genes, 3 GA3ox genes, and 7 GA2ox genes. The expression profile clustered the libraries according to the treatments, indicating that all biological replicates behaved similarly. We identified 1326 differentially expressed genes between wild-type leaves and mutated leaves, of which 613 genes were more expressed in non-mutated leaves. Meanwhile, 3294 genes were differentially expressed between WT lupulin glands and double mutated lupulin glands, with 1686 genes being more expressed in non-mutated lupulin glands. We found that one ortholog of GIBBERELLIN 3-OXYGENASE is more expressed in non-mutated leaves than mutated leaves, while one ortholog of GIBBERELLIN 2-BETA-DIOXYGENASE is more expressed in mutated leaves than non-mutated leaves. These results indicate a higher accumulation of active gibberellins in leaves and lupulin glands of wild-type plants than in the same med5a/med5b tissues. Therefore, it is possible that the shortened flowering time in mutated plants is due to decreased gibberellin biosynthesis.

METAGENOMICS OF THE RHIZOSPHERE AND VEGETATIVE GROWTH OF Salvia hispanica INOCULATED WITH Trichoderma harzianum

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Plants and soil microbiomes are in dynamic interaction, being directly or indirectly influenced by abiotic factors and other organisms. Thus, this study aimed to evaluate the effect of chia seed inoculation with T. harzianum on vegetative development and to assess soil microbiome diversity through metagenomic analysis. The study involved growing chia plants in soil contained in pots under controlled greenhouse conditions. Seeds inoculated with T. harzianum (0; 2.5; 5.0; 10; 20 $\mu L.g^{-1}$ seed) were planted, and parameters such as plant height, number of branches, stem diameter, days to flowering, and dry masses of the aerial and root parts were assessed. After cultivation, soil samples from the rhizosphere region of the plants were collected for chemical and metagenomic analysis and were sent along with samples taken prior to the experiment. Results revealed that increasing doses of T. harzianum promoted an increase in stem diameter, number of branches, dry mass of the root system, and days to flowering, without altering plant height. Metagenomic analysis showed that seed inoculation led to changes in microbial diversity, with greater magnitude in treatments receiving higher doses of T. harzianum. Additionally, chemical modifications and changes in soil quality-related enzymes were observed according to the inoculant dose. Overall, it is suggested that inoculation not only affects specific morphogenetic characteristics of the plant but also has a significant impact on microbial diversity and biochemical functionality of the soil, including an increase in populations of T. harzianum and T. asperellum.

MICROSPOROGENESIS AND SMALL RNA PATHWAYS IN COFFEA ARABICA: UNIQUE PHASIRNA PATTERNS AND EVOLUTIONARY IMPLICATIONS

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The pathways of siRNAs, and especially reproductive phasiRNAs in eudicots, have drawn attention in recent years as their biological roles remain unknown and their biogenesis has taken different evolutionary paths compared to monocots. In this study, we used Coffea arabica L., a recent allotetraploid formed from the hybridization of Coffea canephora and of C. eugenioides unreduced gametes, to explore microsporogenesis and small RNAs-related pathways in a eudicot crop. First, we identified the stages of microsporogenesis during anther development, revealing that pre-meiosis occurs in 1.5 mm anthers within floral buds (FBs), meiosis between 1.5 and 4.2 mm FBs, and post-meiosis in FBs larger than 4.2 mm. These stages coincide with the Brazilian winter, a period of reduced FB growth, suggesting temperature sensitivity and a beneficial effect of cold temperatures on coffee microsporogenesis, consistent with the opposite effect of warm temperatures impairing pollen formation in various species. Next, we identified and quantified the expression of reproductive 21- and 24-nt phasiRNAs during coffee anther development, along with their canonical and novel miRNA triggers, and characterized the DCL and AGO families. Our results showed that the pattern of reproductive phasiRNA abundance in C. arabica is unique among described eudicots, with 21 nt phasiRNAs enriched in post-meiosis and 24 nt phasiRNAs in pre-meiosis, which may reflect diversification along the evolutionary history of woody eudicot species. Additionally, the canonical trigger car-miR2275 is involved in processing 21-nt and 24-nt phasiRNAs. Fourteen DCL genes were identified, but DCL5, related to phasiRNA biosynthesis in monocots, was not found, consistent with its specificity for monocots. Thus, this study addressed the knowledge gap on microsporogenesis and related siRNA pathways in coffee, contributing to the control of reproductive development and improved fertility in eudicots.

MOLECULAR REPROGRAMMING PROMOTING EUCALYPTUS RESISTANCE TO THE GALL WASP Leptocybe invasa

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The genus Eucalyptus L'Hér. has been the main choice for planted forests due to its high productivity, rapid growth, and adaptability. In a climate change scenario, altered temperature and precipitation regimes are expected to increase the frequency and intensity of droughts, a limiting factor for plant cultivation. Additionally, another limiting factor in eucalyptus cultivation is the losses caused by the gall wasp Leptocybe invasa Fisher & La Salle (Hymenoptera: Eulophidae). It is known that the presence of the insect L. invasa causes hormonal changes in hybrids of E. tereticornis x E. camaldulensis between 24 and 96 hours after the attack. In this context, this work investigated the molecular changes associated with the programmed cell death process in eucalyptus plant tissues after the attack of the gall wasp L. invasa. Two hybrid clones of E. tereticornis Sm. × E. camaldulensis Dehnh. one susceptible and one less susceptible (resistant) to L. invasa were used. We evaluated the expression of genes related to hormonal signaling and programmed cell death in shoot apices at 24 and 96 hours after the attack of L. invasa. Regardless of their susceptibility, in infested clones, increased differential expression was observed for genes associated with phytohormone signaling for programmed cell death (NPR1, ERS2), as well as genes directly involved with programmed cell death (BiP). Notably, when infested, the resistant clone increased the expression of the genes PAD4 and ERS2, associated with salicylic acid (SA) and ethylene (ET), respectively, and also NAC1, involved with programmed cell death. Our results indicate that, when infested, the resistant clone activates signaling via SA and ET for programmed cell death to occur in cells attacked by the insect L. invasa. Our study presents a potential mechanism that can partially explain the differential tolerance to L. invasa in eucalyptus clones.

MONOGENIC HETEROSIS IN TOMATO (S. lycopersicum).

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Heterosis is a phenomenon where progeny resulting from the cross between two parents with distinct genomes exhibit increased vigor. This effect is observed in plants and animals, leading to enhanced production, development, and stress tolerance. Previous studies on tomato (Solanum lycopersicum) have investigated an EMS-generated mutant (E), whose phenotype includes epinasty, leaf curling, and stem thickening due to excessive ethylene production. It was established that the E allele in heterozygous condition results in more vigorous progeny. Observing the phenotype of the diminutiva mutant (dmt) suggested that dmt might be an alternative allele to E, a hypothesis confirmed through allelism test. Given that E increases the vigor of heterozygous progeny, it was pertinent to assess whether dmt also confers such an effect. To investigate this, eight plants per treatment were cultivated in a greenhouse, arranged in a completely randomized design (CRD). The treatments included the parental lines VF36 (+/+), diminutiva (dmt/dmt), and the F1 hybrid (+/dmt). Measurements were taken for plant height, stem thickness, and shoot dry mass. The hybrid demonstrated superiority in both height and dry mass compared to its parents (p-value = 0.05). The F1 +/dmt was 10.65% taller than the parental +/+ and 56.61% taller than dmt/dmt. Additionally, the dry mass was 61.53% greater than the parental +/+ and 80.53% greater than dmt/dmt. Such differences may result from a greater metabolic efficiency of the hybrid, which may present higher photosynthetic rates, although this was not measured. Based on the vegetative analysis, it can be inferred that the dmt allele in heterozygous condition is capable of promoting monogenic heterosis in tomato. However, future research should evaluate reproductive and physiological traits to validate the dmt allele advantage in breeding programs.

MORPHOLOGICAL AND TRANSCRIPTOME ANALYSES INTO LINSEED (LINUM USITATISSIMUM L.) SEEDLING ROOT RESPONSE TO NITROGEN STRESS

Yoselin Sandoval, Braulio J. Soto-Cerda, Giovanni Larama, Bourlaye Fofana, Iszavo Soto

Nitrogen (N) is the most important macro-nutrient for plant growth and development, which not only results in the highest cost in crop production but may also lead to environmental pollution. Hence, there is a need to develop N-use efficient genotypes, a prerequisite for which is a better understanding of N-stress adaptation. In this study, the response of two contrasting linseed accessions at the seedlings stage against N stress at phenotypic changes and gene expression in roots were conducted. The results showed that nine out of twelve phenotypic traits were affected under N-stress condition including total root length (TRL), shoot dry weight (SDW), root dry weight (RDW), root to shoot ratio (R/S), plant nitrogen content (PNC), and nitrogen use efficiency (NUE). The N-tolerant genotype outperformed the N-sensitive genotype for all root and shoot traits and NUE under N-stress and N-normal conditions. Transcriptome analysis identified 1,034 differentially expressed genes (DEGs) under contrasting N conditions. DEGs involved in N absorption and transport, root development, starch degradation, amino acid transport, and antioxidant activity were identified. KEGG enrichment analysis revealed 327 significantly enriched pathways associated with the DEGs. Among those most enriched pathways, metabolic pathways (map01100), biosynthesis of secondary metabolites (map01110), plant-pathogen interaction (map04626), MAPK signaling pathway – plant (map04016), plant hormone signal transduction (map04075), diterpenoid biosynthesis including gibberellin biosynthesis (map00904), and nitrogen metabolism (map00910) were more represented among the DEGs. The candidate genes identified in the present study might be playing a pivotal role in N-stress adaptation in linseed, and therefore could be useful in augmenting further research on N-stress response, paving the way toward developing N-efficient linseed cultivars.

Optimizing Tomato Crop Yield through Circadian-Timed Irrigation

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Agriculture accounts for the highest consumption of freshwater worldwide. Therefore, optimizing water use efficiency (WUE) is essential for developing more sustainable agricultural practices. In this context, circadian rhythms, which control various physiological processes in plants, play a crucial role. The circadian-clock helps regulate and synchronize these processes with the light period, displaying oscillating rhythms with a period close to 24 hours. This clock is responsible for coordinating stomatal opening and closing, which directly affects plant water loss.

To better understand how differential irrigation timing influences the circadian rhythm, we conducted an experiment using tomato (Solanum Lycopersicum) cultivar Micro-Tom (MT). Plants were watered either at dawn or at dusk. The treatments did not induce changes in the expression of the GIGANTEA (GI) gene, involved in the flowering process, or the TIMING OF CAB2 EXPRESSION 1 (TOC1) gene, a component of the circadian rhythm. However, the LATE ELONGATED HYPOCOTYL (LHY), SINGLE FLOWER TRUSS (SFT) and CONSTANS (CO) genes exhibited higher expression levels in the dusk treatment.

These changes had a significant impact on the metabolism. Interestingly, plants watered at dusk displayed high expression levels of the flowering-inducing gene SFT, alongside reduced levels of glucose, fructose, sucrose, starch and proline, leading to accelerated development with heavier and more fruits. In contrast, plants watered at dawn exhibited low expression levels of the SFT coupled with increased vegetative growth, resulting in increased number and weight of leaves.

Notably, evening watering uniquely enhances the reproductive yield of tomato plants, stimulating flower and fruit production. Overall, our results demonstrate a physiological mechanism by which timed irrigation contributes can shape crop growth and development, potentially contributing to more sustainable agriculture through improved WUE.

OVEREXPRESSION OF A BROMELIAD AMMONIUM-TRANSPORTING AQUAPORIN GENE IN RICE: INSIGHTS FROM TRANSCRIPTOME AND METABOLOME ANALYSIS

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Rice is one of the most important crops, serving as staple food for more than half of the world's population. Its cultivation demands a high use of nitrogen fertilizers, which leads to several environmental impacts and increases production cost. Thus, the development of cultivars with greater nitrogen (N) use efficiency is highly desirable. In this sense, the objective of this study was to characterize the nitrogen metabolism of transgenic rice plants constitutively overexpressing the gene for an ammonium-transporting aquaporin from the bromeliad Vriesea gigantea (VgPIP1;2). Three transgenic lines overexpressing VgPIP1;2 were obtained, with one of them (VgPIP1;2 3) standing out in terms of transgene expression, initial seedling development, and growth in greenhouse. Plants from this line and the wild type (WT) were grown in hydroponics. The roots of these plants were used for morphological measurements, transcriptome analysis by RNAseq and metabolome assay by gas chromatography and mass spectrometry. The transgenic plants root system was more branched than the WT. Besides, the transgenic plants showed a change in the gene expression profile of various metabolic pathways, especially nitrogen metabolism, showing upregulation of genes involved in nitrogen uptake and assimilation, as well as amino acid biosynthesis. Moreover, the overexpressing plants displayed higher levels of amino acids, especially aspartate, and sugars, such as trehalose and sucrose. Based on these results, it is clear that the overexpression of VgPIP1;2 modulated nitrogen metabolism in rice plants, improving the development of transgenic plants. Thus, the use of the PIP1;2 aquaporin gene from V. gigantea stands out as a biotechnological strategy for the development of high yield rice cultivars with reduced nitrogen fertilizer requirements. CNPq#308054/2022-9

OVEREXPRESSION OF TOMATO SP3C GENE ENHANCES GERMINATION OF ARABIDOPSIS THALIANA SEEDS UNDER OSMOTIC STRESS

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Tomato SELF PRUNING (SP) genes belong to the CETS family, which includes the orthologous CENTRORADIALIS (CEN) from Antirrhinum majus and TERMINAL FLOWER 1 (TFL1) from Arabidopsis thaliana. These genes encode phosphatidylethanolamine-binding proteins (PEBPs) that control shoot apical meristem identity, influencing the transition from vegetative to reproductive growth and determining the flowering and growth habit of plants. There are twelve SP paralogs in tomato plants, and recently, the SP3C gene was characterized. This paralog acts as a repressor of flowering and additionally delays seed germination, increases the number of secondary roots, and improves the drought tolerance of tomato plants. In order to provide new insights into the SP3C tomato gene, we overexpressed it in the model plant Arabidopsis using the 35S CaMV constitutive promoter. To evaluate the influence of SP3C overexpression in Arabidopsis plants under osmotic stress treatments, an in vitro seed germination assay was conducted. For this experiment, 0.5 MS culture medium was modified with three different NaCl concentrations: 30, 75, and 150 mM. Germination rate and time were evaluated under short-day conditions in three different transformation events (SP3C#8, SP3C#9, and SP3C#11), using Col-0 seeds as a control. Interestingly, SP3C#8 events showed a significant delay in germination time (3 days) compared to Col-0 under control conditions, along with a higher germination rate (35.67% more than Col-0) under the 75 mM NaCl treatment after 9 days. These preliminary results suggest enhanced osmotic stress tolerance in the transformed plants. To further validate these findings, gene expression analysis of each transformation event is required to determine whether this resistance correlates with differential expression levels in each event.

PHYSIOLOGICAL AND MOLECULAR APPROACHES TO UNCOVER THE MAIN DETERMINANTS OF DROUGHT TOLERANCE IN A SOYBEAN GENOTYPE

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Climate change increases precipitation variability, particularly in savanna environments. We have used integrative strategies to understand the molecular mechanisms of drought tolerance in soybean plants by comparing the molecular and physiological parameters of the drought-tolerant Embrapa 48 genotype with the drought-sensitive BR16 genotype. The results indicated that Embrapa 48 had a greater capacity for water absorption due to changes in root length and volume. Drought tolerance appears to be ABA-independent, and IAA levels in the leaves partially explain the increased root growth. Profiling revealed up-regulated proteins involved in glutamine biosynthesis and proteolysis, suggesting osmoprotection. Dysregulated proteins in the roots were associated with the phenylpropanoid pathway, including PR-like proteins involved in phenolic biosynthesis, which help prevent oxidative stress and modify cell walls. Under drought conditions, signaling and regulatory genes related to cell wall elasticity and cross-linking were induced. Thus, remodeling of the cell wall may be a genetic characteristic of Embrapa 48, contributing to its differential hydraulic conductivity and maintenance of cell turgor and growth. Consistent with this, the drought-tolerant genotype exhibited a higher growth rate, a larger leaf area, and changes in the root-shoot conductive vessel system. We concluded that alterations in the root-shoot conductive vessel system are crucial for promoting drought tolerance. In fact, photosynthetic parameters from reciprocal grafting experiments indicated that the root system is more essential than the shoots in the drought tolerance mechanism. Finally, we provided a comprehensive overview of the genetic, molecular, and physiological traits involved in drought tolerance mechanisms.

PHYSIOLOGICAL AND OXIDATIVE CHARACTERIZATION OF ADVANCED GENETIC LINES OF VITIS VINIFERA RESISTANT TO POWDERY MILDEW

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Powdery mildew, caused by the biotrophic fungus Erysiphe necator, is the most important pre-harvest disease of grapevines. Its control is mainly carried out with chemical pesticides, resulting in high economic costs and negative effects on health and the environment. As an alternative, the generation of resistant grapevines has been proposed by crossing commercial varieties with genotypes carrying resistance loci, such as the Run1 locus of Vitis rotundifolia. The aim of this study was to evaluate the physiological and oxidative response of advanced Run1 genetic lines resistant to E. necator after inoculation. Resistant lines P09-105-59 and resistant segregant P09 X Carménère were tested during the 2022/2024 seasons. Parameters related to photosynthesis were measured at 10 days post-inoculation (dpi) for P09-105-59 and at 12 dpi for P09 X Carménère. Both lines showed no significant changes in maximum quantum yield, net photosynthesis and transpiration rate and an increase in photosystem II efficiency after inoculation with the pathogen. On the other hand, segregant line P09-Carménère showed an increase in electron transport rate and a decrease in stomatal conductance. Regarding the antioxidant parameters, they coincide in presenting a significant increase in ascorbic acid-dehydroascorbate, total phenolics and antioxidant activity, while they differ in that line P09-105-59 shows a higher chlorophyll content and no changes in lipid peroxidation under inoculation. In the other hand, segregant line P09 X Carménère did not show significant changes at 1-2 and 4 dpi. The results indicate that the responses to inoculation in these Run1 genetic lines resistant to E. necator can maintain constant photosynthetic parameters, while inducing changes in phenolic content and parameters related to ascorbic acid.

POTENTIAL ROLE OF GIBBERELLIN AS A MEDIATOR OF TOR RESPONSE

karla Gasparini dos Santos, Camila Caldana

Plants modulate growth and development through endogenous pathways in response to environmental signals. Target of Rapamycin (TOR) is a key integrator of external cues and internal metabolic signals, modulating various growth and developmental processes. Similarly, plant hormones, including gibberellin (GA), play crucial roles in growth regulation. GA promotes plant growth by degrading DELLA repressor proteins, which are negative regulators of GA signaling. In Arabidopsis, GA loss-of-function mutants exhibit growth arrest and delayed flowering, traits also observed in the Raptor1b (REGULATORY-ASSOCIATED PROTEIN OF TOR 1B) mutant. To investigate the potential TOR-GA relationship, we analyzed plant growth, GA-related gene expression, and DELLA stability in Raptor 1b mutants. GA (10 µM) was applied to the shoot apex every second day for 2 weeks. The phosphoglucomutase (pgm) mutant, a gene known to respond to GA, served as a control. GA treatment did not affect rosette area in Col-0 plants but reduced the rosette area in Raptor 1b mutants. We confirmed that starch accumulation was higher in Raptor 1b compared to Col-0 plants at both the end of the day and night. GA treatment reduced starch content in both Col-0 and Raptor 1b, although Raptor 1b showed less response to GA. GA treatment decreased RGA (repressor of ga1-3) levels in Col-0 but had no effect on Raptor 1b, suggesting reduced GA responsiveness in Raptor1b. This implies a close relationship between TOR and GA, potentially affecting DELLA stability. Understanding these interactions could shed light on how plants integrate environmental and internal signals to regulate growth and development.

PRL2 AND PCBER4 ARE POTENTIALLY INVOLVED IN LIGNIN METABOLISM IN SETARIA VIRIDIS

Gabriel Fontanella Pileggi, Lucas Xavier da Cunha, Leydson Gabriel Alves de Lima, Arthur de Barros Rattes, Igor Cesarino

Lignans are dimers of phenylpropanoid units linked by their central side chain carbons. They are widely distributed among plants and probably have a role in plant defense. Some lignans share coniferyl alcohol as a common unit with lignin, a phenolic polymer present in secondary cell walls that constitute a bottleneck to biomass processing in biorefineries. However, it remains elusive how plants allocate coniferyl alcohol for the biosynthesis of lignans versus lignin. Recent studies suggest the involvement of lignan biosynthetic enzymes from the PIP family (Pinoresinol and lariciresinol reductases - PLRs; Isoflavone reductases - IFRs; Phenylcoumaran benzylic ether reductases - PCBERs), in the lignification process. Here, we performed a genome-wide characterization of the PCBER and PRL families in the model C4 grass Setaria viridis and further identified members potentially involved in lignification. Among the 5 SvPCBER genes and the 2 SvPRL genes found in the S. viridis genome, SvPCBER4 and SvPRL2 were selected as the best candidates based on (i) their phylogenetic proximity to genes from other species that have been associated with lignification in functional studies; (ii) their co-expression with lignin biosynthetic genes in public S. viridis transcriptomic datasets; and (iii) their similar expression pattern to lignin-related genes in a broad set of S. viridis organs/tissues. These data suggest that SvPCBER4 and SvPRL2 might be involved in lignification and, additionally, might modulate the differential availability of coniferyl alcohol for the biosynthesis of lignans and lignin.

REDUCED EXPRESSION OF MITOCHONDRIAL ADP/ATP CARRIERS 1 and 2 ALTERS GROWTH AND REPRODUCTIVE PHASE IN ARABIDOPSIS THALIANA

Crystal Cazor Curilef, Rita de Cássia Batista Monteiro, Bruno Jerônimo do Nascimento Gomes, Marjorie Reyes-Díaz, Wagner L. Araújo, Adriano Nunes Nesi

Mitochondria are essential for respiration and energy production in eukaryotic cells, with ATP as the primary energy metabolite. The Mitochondrial Carrier Family, including ADP/ATP Carriers (AACs), facilitates energy exchange between the mitochondrial matrix and the cytosol. In Arabidopsis thaliana, three genes encode AAC transporters (AAC1, AAC2, and AAC3). To understand the role of AACs isoforms, we characterized A.. thaliana mutants with reduced expression of AAC1 and AAC2. This study investigated their implications for leaf gas exchanges, plant growth, and phenotypes associated with reproductive stages, to identify possible differential roles between these isoforms. This study involves four genotypes: wild type (WT), low expression of AAC1 (aac1), low expression of AAC2 (aac2), and a double mutant, with low expression of both genes (aac1:aac2). Plants were grown under two photoperiods (short and long day) for biometric and reproductive analysis. The results revealed significant differences in dark respiration, biometric parameters, and seed production among the genotypes. The low expression of AAC1 and AAC2 led to a decrease of 46%, 47%, and 39.8% in dark respiration for the aac1, aac2, and aac1:aac2, respectively. Regarding biometric parameters, a reduction in plant height was observed in the aac1, and a decrease in rosette area in the aac2. Interestingly, a significant increase of 150% in seed production per silica was observed in aac1 compared to WT. The decrease in dark respiration may limit mitochondrial energy production, possibly contributing to reduced growth in genotypes with lower AAC1 and AAC2 expression. Increased branching and seed yield in aac1 suggests the activation of compensatory mechanisms to maintain reproductive output, possibly in response to altered energy dynamics. These findings suggest that AAC1 and AAC2 transporters may have an important role in regulating energy-driven plant growth in A. thaliana, particularly in adaptation and compensation under energy-restricted conditions.

RELATIONSHIP BETWEEN GAS EXCHANGE AND STOMATAL DISTRIBUTION IN Capsicum chinense ACCESSIONS

rodrigo alves rodello, Camily Rodrigues Oliveira, Caris dos Santos Viana, Adriano Nunes Nesi, Edgar Augusto de Toledo Picoli, Paulo Mafra de Almeida Costa, Agustin Zsögön

Peppers (Capsicum spp.) are globally recognized and valued both as condiments and as excellent sources of nutrients. The growing demand for new varieties drives ongoing research to meet this need. Crop productivity depends on photosynthesis, which is intrinsically linked to the process of gas exchange in the stomatal pores; any improvement in the efficiency of this process has the potential to increase yield. The objective of this study was to evaluate the relationship between gas exchange and stomatal distribution in Capsicum chinense accessions. Nineteen C. chinense accessions from BGH/UFV and CNPH/EMBRAPA were field-grown, and fully expanded leaves were selected for gas exchange and stomatal distribution analyses. Gas exchange was measured using an infrared gas analyzer (LiCor LI-6400), recording carbon assimilation rate (A), stomatal conductance (gs), internal CO_2 concentration (Ci), transpiration rate (E), intrinsic water use efficiency (WUEintr), and instantaneous water use efficiency (WUEinstant). Stomatal distribution was assessed by stomatal density (total stomata per mm^2) and the percentage of the stomatal index (number of stomata / (number of stomata + number of epidermal cells) × 100) on the abaxial and adaxial leaf surfaces. Overall, variability was observed among accessions across all evaluated characteristics. A strong positive correlation was found between gas exchange parameters; as A increased, gs also increased, allowing greater CO_2 entry (Ci) and water loss (E). A strong negative correlation was observed between WUEintr,WUEinstant, and other parameters (except A), suggesting that greater gas exchange and stomatal distribution reduce WUE. Conversely, the correlation between WUEinstant and A was weak (-0.16 per area and -0.19 per mass), indicating minimal influence. Stomatal parameters showed a weak positive correlation with gas exchange, indicating that although increased stomatal density and index can enhance gas exchange, this relationship is not strong enough to work as a predictor of photosynthetic rates.

SELECTIVE MRNA DEADENYLATION BY CCR4 IS INVOLVED IN HEAT AND WATER STRESS TOLERANCE IN ARABIDOPSIS

Borys Alexander Leon Alcivar, Lucas Roani Ponte, Pedro Augusto Braga dos Reis, Elizabeth Pacheco Batista Fontes, Agustin Zsögön

One of the functions of the CCR4-NOT complex is the poly(A) shortening of transcripts by CCR4 and CAF1 deadenylases in plants. This corresponds to a rate-limiting step in mRNA degradation, as the complex is involved in post-transcriptional regulation of gene expression. The functions and arrangements of the complex under abiotic stress conditions are unknown. In the present work, knockout mutants were developed for the six CCR4 isoforms, as well as plants overexpressing these proteins. The CCR4a isoform (At3g58560) was shown to participate in the response to heat and water stress. It was observed that the ccr4a mutant presents an antagonistic response under these conditions, being susceptible to high temperatures and tolerant to water deficit. Probably some target mRNAs are selectively modulated under these conditions, presenting a higher or lower degradation rate under these conditions. In addition, modulation in the formation of processing bodies (p-bodies) was observed to change under abiotic stress conditions. This would partially explain the drought tolerance, since there is a sequestration of transcripts by this complex. The important role of CCR4 in the modulation of transcripts in cytosolic p-bodies is demonstrated. Additional assays need to be developed to effectively confirm which target mRNAs are being selectively degraded at a higher rate under these stress conditions. This research opens the door to a better understanding of the post-transcriptional modifications that plants make to survive under suboptimal conditions.

SHEDDING LIGHT ON PHYTOCHROME B-DEPENDENT REGULATION OF TOMATO FRUIT RIPENING

José Laurindo dos Santos Júnior, Scarlet Santos Monteiro, Letícia Longuini Gomes, Magdalena Rossi, Luciano Freschi

Within the phytochrome (PHY) family of red/far-red photoreceptors, the constitutively active missense alleles of phytochrome B (YHB) exacerbate PHYB-dependent phenotypes regardless of the surrounding light conditions. In tomato (Solanum lycopersicum), the two PHYB-encoding genes SlPHYB1 and SlPHYB2 have both unique and redundant functions, controlling many processes ranging from seed germination to leaf senescence. However, limited information is currently available on the role of PHYBs in the ripening of climacteric fruits. Here, we dissect the impacts of Slphyb1 and Slphyb2 single and double mutations, as well as the constitutive SlYHB1 and SlYHB2 overexpression, on tomato fruit ripening and ethylene metabolism and signaling. Among the genotypes analyzed, Slphyb2 and Slphyb1b2 mutants displayed the most significant increments in ethylene emission rates during on-the-vine fruit ripening. In agreement, the climacteric peak of ethylene production in SlYHB1OE and SlYHB2OE fruits was attenuated and delayed, with the largest reductions identified in fruits from SlYHB2-overexpressing plants. The activity of aminocyclopropane-1-carboxylic acid (ACC) oxidase (ACO), a key enzyme in ethylene production, was reduced in ripening fruits of SlYHB1OE and SlYHB2OE plants compared to wildtype (WT) counterparts. Genes encoding ripening-associated ethylene biosynthetic enzymes, such as ACC synthase (ACS) and ACO, as well as ethylene signaling proteins, such as sub-class-E ERFs (SlERF-Es) and EIN3-binding F-box (SlEBFs) were significantly repressed in ripening fruits of SlYHB2-overexpressing plants. Moreover, ripening fruits from SlYHB2OE plants also exhibited significantly lower mRNA levels of genes encoding major ripening-related developmental regulators, such as Ripening Inhibitor (RIN), Non-Ripening (NOR), Colorless Non-Ripening (CNR), Tomato Agamous-like 1 (SlTAGL1) and Fruitful 1 (SlFUL1). Altogether, these findings indicate that light perception via SlPHYBs, particularly SlPHYB2, negatively impacts the expression of genes encoding key ripening-related transcription factors, consequently repressing ethylene biosynthesis and delaying the initiation and progression of tomato fruit ripening

SlAN1 is a limiting factor for the light-dependent anthocyanin accumulation in fruit tissues of purple tomato

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Anthocyanins are specialized plant metabolites with significant dietary value due to their antioxidant and anti-inflammatory properties. Extensive research has indicated that dietary intake of these phenolic compounds contributes to preventing various chronic diseases. Consequently, incorporating anthocyanin-rich foods into one's diet, particularly from natural sources, is highly beneficial. The tomato (Solanum lycopersicum) is the most consumed vegetable worldwide, making it an excellent candidate for anthocyanin-enrichment strategies. In tomato, activation of anthocyanin biosynthesis is light-dependent, but this mechanism has yet to be entirely characterized. We investigated the role of light in anthocyanin biosynthesis in fruits of the purple tomato, which is a near-isogenic line (NIL) derived from wild accessions into cv. Micro-Tom (MT). MT-Aft/atv/hp2 starts accumulating anthocyanin early during fruit development but is restricted to the peel (exocarp and epicarp). Manipulating light incidence in different fruit tissues determined that the absence of anthocyanin accumulation in the flesh results from the sun-blocking effect of the cyanic epicarp on the mesocarp, thus preventing light from penetrating deeper into the fruit. Transcriptional analyses of the fruit peel and flesh revealed that the bHLH transcription factor SlAN1 (Solyc09g065100) is the limiting factor for light-dependent anthocyanin accumulation in both tissues. This research enhances our comprehension of the genetic and environmental regulation of anthocyanin accumulation in fruit tissues, offering valuable insights into plant breeding for human nutrition.

STRUCTURE PREDICTION OF CATALASES FROM FABACEAE FAMILY

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Catalase is a crucial enzyme responsible for controlling reactive oxygen species in the form of H2O2 within peroxisomes. In plants, H2O2 serves as an important signaling molecule despite its toxicity, thanks to the robust antioxidant system present in plants. This system allows for rapid and flexible control of H2O2 concentration, making it a versatile signaling substance for various biological processes. Recent studies have shown an association between catalase and glycolate oxidase. The interaction between these two proteins helps regulate H2O2 levels and is linked to plant defense mechanisms against stress, highlighting the need for further research on these proteins. However, the Protein Data Bank lacks any plant catalase structures, hindering detailed studies on the structure and potential interactions between catalase and glycolate oxidase. To address this, AlphaFold2 was used to create protein models of catalase from the Fabaceae family and from Oryza sativa of the Poaceae family. These structures were validated using molecular dynamics and structural analysis. Additionally, they were compared to other catalase structures from the PDB to analyze similarities. The heme prosthetic group of each catalase was also examined to identify interacting residues conserved among the selected species.

STUDY OF METABOLIC PATHWAYS RELATED TO CELLULAR HOMEOSTASIS IN POPCORN LINES VIA SSR-EST MARKERS

Lavínia Santana Ladeira Gomes, Fernanda Vargas Valadares, Lilia Marques Gravina, Marcelo Vivas

The study of the maintenance of cellular homeostasis and adaptation to stress in popcorn is important for the development of more robust and efficient cultivars. This work aimed to identify polymorphisms in genes of interest using SSR-EST molecular markers in popcorn lines. Gene products related to metabolic and signaling pathways were investigated, including the manipulation and synthesis of keratosulfate, crucial for cell wall integrity; the synthesis of flavonoids and anthocyanins, which have activity against environmental stresses; the control of ABC transporters, important for the movement of ions and molecules; a MAPK signaling pathway, involved in the transduction of extracellular signals; and the role of BiP2 in the folding, sorting and manipulation of proteins in the endoplasmic reticulum, as well as in the control of the Sec61/SecY protein translocation channel. For the analysis, 172 popcorn lines from the UENF germplasm collection were selected. These lines were germinated and maintained in a greenhouse until the V2 stage of development. Samples of young leaf tissue were collected for DNA removal, according to the method described by Doyle & Doyle. After verifying the integrity and quantity of DNA, PCR analyses were performed with five microsatellite gene primers. The amplified samples were separated by 4% agarose gel electrophoresis, and the alleles were sequenced according to their position in the gel. The results demonstrated an average value of Polymorphic Information Content, according to the Botstein methodology. The heterozygosity of the lines was zero, and the number of alleles per loci ranged from 2 to 3. Thus, the study provided useful information for understanding the responses to adverse conditions, important for the genetic improvement of popcorn, allowing the selection of cultivars with greater accuracy.

Terpene synthases in wild and cultivated Coffea species: diversity, genomic density, and putative physiological implications

Douglas Silva Domingues, Thalita Pinheiro Resende, Romain Guyot, Laura Gonzalez-Garcia

Terpene synthases (TPS) catalyze terpenoid biosynthesis, producing diverse compounds fundamental to specialized plant metabolism and crucial for defense against stresses and ecological interactions. Recently, a limonene synthase was identified as the major contributor to the aroma of a special Arabica coffee.

The genus Coffea (Rubiaceae, approximately 130 species), significant for coffee production, exhibits specialized metabolite diversity, making it an intriguing model for studies on adaptive and metabolic variation.

In this study, we analyzed predicted proteomes from draft genomes of 14 Coffea species to identify monoterpene, sesquiterpene, and diterpene synthases. Enzymes were considered functional if they contained typical PFAM domains and were 500 amino acids or longer.

Average TPS numbers were 9.05 for monoterpene, 12.30 for sesquiterpene, and 7.55 for diterpene synthases. Coffea salvatrix had the highest TPS number, suggesting high adaptive capacity, while C. racemosa was the species with most monoterpene synthases. Conversely, C. homollei, C. ebracteolatus, and C. stenophylla had the fewest TPS, possibly reflecting different adaptive strategies.

Notably, C. racemosa and C. salvatrix synthesize higher concentrations of Coffea-exclusive diterpenes caveol and cafestol than cultivated species. Additionally, C. salvatrix seeds have higher oil content, exploitable in breeding programs for unique bean properties.

TPS density relative to genome size varied significantly among species. C. racemosa had the highest monoterpene (0.0145/Mb) and sesquiterpene (0.0197/Mb) synthase densities; the canephora subgenome in C. arabica cv. Bourbon had the highest diterpene synthase density (0.0120/Mb). The lowest densities were in C. ebracteolatus, C. stenophylla, and C. eugenioides cv. BUA, suggesting different selective pressures affecting TPS gene duplication or elimination.

These TPS variations among Coffea species provide insights into adaptive strategies in specialized metabolism and open possibilities for developing stress-resistant coffee cultivars with optimized metabolic profiles. This study enhances understanding of the central role played by terpenoids in specialized metabolism and their ecological and physiological implications.

The Brasiliopuntia brasiliensis (Willd.) A. Berger plastome shows strong evidence of import of cytoplasmic tRNA valine

Maria Carolina Silva, Amanda de Santana Lopes, Túlio Gomes Pacheco, Gleyson Morais da Silva, José Daniel de Oliveira, Marcelo Rogalski

Plastomes typically contain 30 tRNAs, trnV-UAC and trnV-GAC are the genes of valine tRNA isoacceptors. According to the wobble rules, the tRNAVal(UAC) encoded by the trnV-UAC gene would decode the two codons with a purine in the third codon position, GTA and GTG. In contrast, the tRNAVal(GAC) encoded by the trnV-GAC gene would read the two codons with a pyrimidine in the third codon position, GTC and GTU. The mechanism of superwobbling improves the reading capacity of tRNAs containing uridine (U) in the wobble position to four codons. In the cacti of the subfamily Cactoideae, the trnV-UAC gene is absent, whereas this gene normally occurs in the subfamily Opuntioideae. Here, we sequenced and analyzed the plastome of Brasiliopuntia brasiliensis (Willd.) A. Berger, a native cactus to Brazil, belongs to the subfamily Opuntioideae. The sequencing was performed in the Illumina MiSeq platform and de novo assembly in CLC Genomics Workbench and SPAdes. Annotation was carried out using GeSeq, BLAST, and tRNAscanSE. The codon usage was checked. The plastome was deposited in the GenBank under accession number OK448351. We identified a typical quadripartite circular molecule of 162,211 bp, containing a large (LSC) and a small single copy (SSC), with 87,186 bp, and 4,393 bp, respectively, separated by two palindromic repeats of 35,316 bp each. We detected 109 unique genes and three pseudogenes, ycf1, ycf2, and trnV-UAC. The trnV-UAC gene demonstrated various transversions (positions 12, 49, and 50), and a transition (position 42), impeding a correct pairing in the arms, and possibly resulting in non-functionality. The use of codons follows the same pattern found in other species containing a functional trnV-UAC gene. Our analyses suggest the existence of a possible import mechanism given that it is impossible, for stearic reasons, the decoding of the four valine codons without the tRNAVal(UAC).

The Brazilian pine miRNome: the post-transcriptional landscape of the early somatic embryogenesis

Leandro Francisco de Oliveira, Amanda Rusiska Piovezani, Mariana Mascaro Yazbek, Guilherme Ricardo Trentin Dias, Amanda Ferreira Macedo, Eny Iochevet Segal Floh

Previous transcript and proteomics studies in embryogenic cultures from Araucaria angustifolia, an endangered native Brazilian conifer with ecological and economic importance, have indicated a role for post-transcriptional regulation in this process. Genes encoding transcription factors (TFs), such as AUXIN RESPONSE FACTORS (ARFs) and ABA RESPONSIVE ELEMENT BINDING (AREB), play central roles in embryogenesis and might be under post-transcriptional regulation by microRNAs (miRNAs). Here, we profiled the miRNA expression pattern using small RNA sequencing technology in two embryogenic cell lines, Responsive- and Blocked- (non-responsive)-to-ABA, of A. angustifolia. We identified 165 mature miRNAs, of which 143 were novel and 22 were conserved plant miRNAs. Seven miRNA-conserved families were identified: miR156, miR169, miR394, miR482, miR536, miR1030, and miR1314. Most miRNAs were differentially expressed during the transition from proliferation to the maturation stage of somatic embryogenesis, suggesting that miRNAs play more important roles in early somatic embryo development. Sixteen were exclusively expressed in RP-RM and 13 in BP-BM transition, indicating that miRNAs are also associated with embryogenic potential. A total of 98 potential target genes were found for 89 miRNAs, involved in post-transcriptional processes, transporters, defense response, sugar regulation, stress, ABA and auxin controlling and signaling, cell-to-cell communication, maintaining suspensor cell identity, brassinosteroids signaling, and cell division. Negative correlations of expression patterns between miRNAs and their targets were detected for miR1030-PRL1, miR1314-ADR1-Like, and Aang34-LRR modules when analyzed by RT-qPCR. Additionally, we characterized two potential modules associated with auxin and abscisic acid: miR156-SPL/AREB3 and miR160-ARF, and correlated with IAA and ABA endogenous levels. Taken together, our findings provide new insights into the regulatory roles of miRNAs and their target genes in the somatic embryogenesis of Brazilian pine.

THE TOMATO SlBBX20 REGULATES RESISTANCE TO BIOTIC STRESS

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Plants have evolved complex molecular signalling networks to regulate growth in response to both biotic and abiotic cues. In recent years, a family of transcription factors known as B-box domain-containing proteins (BBX) have been described as pivotal factors in light signalling. Besides, BBX proteins have also attracted attention for their involvement in defence response against pathogens; however, the molecular mechanism involved in this response remains unclear. In a previous work, our group characterised the role of a tomato BBX protein (SlBBX20) as a positive regulator of light signalling, acting in multiple processes during plant development and fruit ripening. In order to better elucidate whether SlBBX20 is involved in the crosstalk between light signalling and pathogen defence, the present work aimed: i) to evaluate, by RT-qPCR analysis, the responsiveness of SlBBX20 to methyl jasmonic acid (MeJA) treatment; ii) to evaluate the resistance of Slbbx20 mutant to the necrotrophic pathogen Botrytis cinerea and the herbivore Spodoptera frugiperda; iii) to assess, by yeast-two-hybrid and bimolecular fluorescence complementation assays, the physical interaction of SlBBX20 with several defence-related proteins. Our survey first identified an increase in SlBBX20 mRNA levels in wild-type tomato leaves twenty-four hours after MeJA exposure. Then, we observed that while control plants showed reduced resistance to B. cinerea under shade conditions compared to normal light intensity, Slbbx20 mutant plants showed similar susceptibility to shaded control plants regardless the light conditions. Likewise, mutant plants challenged against S. frugiperda showed reduced resistance to herbivory. Furthermore, we found that SlBBX20 physically interacts with major defence-related proteins, such as SlMED25, SlCML39, SlDRW1, SlMYC2 and SlWRKY33. Therefore, our findings demonstrate that SlBBX20 is an important player in the crosstalk between JA-related defence and light signalling, and provide evidence that allows the development of uncoupling strategies to optimise both responses for crop yield and quality improvement.

Time for glyphosate: beyond the herbicide, a circadian agriculture tool?

Gustavo Akio Ogasawara, Felipe Marcelo Almeida de Jesus, Ana Paula Avelino dos Santos, Carlos Takeshi Hotta

We have explored the sensitivity of sorghum (*Sorghum bicolor* (L.) Moench) to low-dose glyphosate (N-phosphonomethyl glycine) applied at different times of day under both light/dark cycles and constant light conditions, using 10-day-old BRS Ponta Negra, IAC Santa Elisa, Btx623, and CMSXS652 varieties. The aim was to understand the effect of the circadian oscillator on the plant's response to herbicide. The research evaluated plant height, biomass, leaf area, and the expression of the *LATE ELONGATED HYPOCOTYL* (*LHY*), an important component of the central oscillator, and 5-*ENOLPYRUVYLSHIKIMATE*-3-*PHOSPHATE SYNTHASE* (*EPSPS*), glyphosate's target, via RT-qPCR. We found a significant interaction between the timing of glyphosate application and plant response, with larger responses during the morning. *LHY* and *EPSPS* levels decrease in response to glyphosate. They also are rhythmic, with *LHY* and *EPSPS* peaking at dawn. This highlights the importance of the circadian oscillator in optimizing herbicide efficacy and supports the emerging concept of chronoculture, or circadian agriculture, which leverages plant rhythms to improve management strategies. This study enhances understanding of how temporal factors and dosage influence plant responses, offering insights into sustainable agricultural practices like circadian agriculture.

TOMATO NUTRITIONAL ENHANCEMENT: THE INFLUENCE OF ANTHOCYANINS ON FRUIT QUALITY

Samuel Cruz Manzano, Agustin Zsögön, Diego Dias Rafael

Tomatoes are a natural source of nutrients and antioxidants, such as lycopene, ascorbic acid (vitamin C), phenolic compounds and carotenoids. Over the last few years the interest in enriching various fruits and vegetables with anthocyanins, water-soluble pigments that have strong antioxidant properties, has been growing. There are already tomato cultivars on the market with a high anthocyanin content, generated by transgenic breeding. An alternative is to generate anthocyanin-rich tomatoes through conventional breeding. Previously, we stacked three mutations (anthocyanin fruit, atroviolaceum and high pigment 2) in the VFNT cultivar ("VFNT-purple"), resulting in a plant with purple fruit due to greater anthocyanin synthesis and accumulation. However, the impact of this accumulation on plant growth and productivity has not yet been evaluated. In this study, we cultivated VFNT and VFNT-purple plants and determined the influence of anthocyanin on fruit weight, total soluble solids content and plant height and diameter. The average fruit weight of VFNT-purple was lower than that of VFNT (7.81 g and 10.22 g, respectively, $p = 0.000$). However, VFNT-purple showed less variability in weight than VFNT (standard deviation of 2.27 and 4.36, respectively, $F = 60,453$), equatorial diameter (24.06 cm and 25.94 cm, $F = 39.144$; $p = 0.000$) and polar diameter (22.14 cm and 23.28 cm, $F = 14.009$, $p = 0.000$), resulting in more homogeneous and regular fruit. The greater synthesis and accumulation of anthocyanins resulted in an increase in the total soluble solids content (5.85 and 4.97, respectively, $p = 0.006$), a parameter of commercial interest. Our results suggest that anthocyanins have a positive influence on the quality of tomato fruit, reducing variability in weight and size, as well as increasing the total soluble solids content.

TRANSCRIPTOMIC PROFILING OF THE MANGROVE TREE LAGUNCULARIA RACEMOSA IN RESPONSE TO SALINITY

Sofia Rengifo Del Aguila, Michele Fernandes da Silva, Guilherme Francio Niederauer, Anete Pereira de Souza

Soil salinization represents a significant agricultural challenge, adversely affecting the development and productivity of various crops worldwide. In nature, some organisms have evolved adaptive mechanisms to survive high salinity levels, serving as ideal models for studying the underlying dynamics and molecular response mechanisms to such stressful conditions. Mangrove trees, in particular, thrive in coastal ecosystems where they are exposed to high salinity, intense UV radiation, and low soil oxygen levels. The mangrove species Laguncularia racemosa is a key component of Brazilian mangrove ecosystems and is known for its rapid growth and high colonization capacity, acting as a pioner in perturbed areas. In this study, we employed RNA sequencing (RNA-seq) to analyze the transcriptomic responses of L. racemosa leaves, stems, and roots submitted to varying NaCl concentrations (0 g/L, 15 g/L, 30 g/L). Sequencing yielded a total of 1.8 billion 150-bp paired-end reads. Following quality filtering and trimming, approximately 1.5 billion high-quality reads were retained and subsequently mapped and assembled using a reference genome-guided approach. The assembled transcriptome exhibited a mean length of 1,855 bp, an N50 value of 1,243 bp, and successfully recovered 94.4% of conserved orthologs based on the Eudicotyledoneae database. We identified a total of 853, 1,600, and 354 differentially expressed genes (DEGs) in leaf, stem, and root tissues, respectively, under the experimental conditions. Several biological processes were significantly enriched among these DEGs, including "indoleacetic acid biosynthetic process," "response to water," "microsporogenesis," "microtubule-based movement," and "cell division". These findings can contribute to a deeper understanding of the adaptive responses of L. racemosa to salinity stress.

Uncovering a Regulatory Pathway Linked to Abnormal Flower Development in Coffea arabica L.

Gabriel de Campos Rume, Raphael Ricon De Oliveira, Isabel Marques, Ana Isabel Ribeiro-Barros, José Cochicho Ramalho, Antonio Chalfun-Junior

Coffea arabica L., is an autogamous and polyploid species with great economic and social and importance. Still, much is unknown about the molecular mechanisms directly related to coffee productivity, such as those responsible for the emergence of the “starlets”- anomalous flowers that are supposedly infertile. These abnormal flowers are often associated with heat and/or water stress events occurring in the initial development of the flower buds, circumstances that are expected to become more frequent in the coming years due to climate changes and global warming. In this study, it was conducted a comparative RNA-Seq data analysis aiming at identifying differentially expressed genes (DEGs) in samples of both normal and starlet flowers. For this purpose, the total RNA from floral buds at the first stage of development was extracted, isolated, and sequenced. The obtained raw data went through bioinformatic analyses to identify, quantify, and compare the global gene expression of the two flower phenotypes. Among the identified DEGs were several genes coding for Heat Shock Proteins (HSPs), conserved molecular chaperones that maintain protein homeostasis by assisting in protein folding, assembly and degradation mechanisms, playing roles in cell signaling, immunity, and stress tolerance. Most of the HSPs were downregulated in the anomalous samples relative to the normal ones, suggesting that starlet appearance might be related to a misregulation of the affected plant’s responses to environmental conditions present during the axillary meristems’ acquisition of a reproductive identity, underscoring the need for further investigation into these processes, especially considering the increase of stressful conditions (of drought and heat) in a context of predicted climate changes and global warming.

WATER AND SALINE STRESSES MODULATE GENE EXPRESSION IN A SYNTHETIC TRIPLOID OF LIPPIA ALBA L.

Moisés Henrique Almeida Gusmão, Vivian Caiafa Ferreira Paiva, Elyabe Monteiro de Matos, Juliana Mainenti Leal Lopes, Lyderson Facio Viccini

Abiotic stresses can affect all living organisms, including plants. Among them, water deficit and high saline concentration are environmental factors that can dramatically limit the plant development. Gene expression patterns, especially related to those stresses might be affected in response to extreme environmental conditions and can indicate plant tolerance or sensitivity under stress. Polyploid individuals have been associated with better performance under adverse conditions. Lippia alba is an aromatic shrub with medicinal properties. The species constitutes a polyploid complex been possible to associate the major constituent of the essential oil with the ploidal level. Therefore, the species becomes an interesting model to investigate stress conditions. This study aimed to analyse the gene expression in a synthetic triploid accession of Lippia alba under water deficit and high salinity condition. Explants of a synthetic triploid accession of Lippia alba were in vitro cultivated for 40 days in MS medium with or without 1% PEG-4000 (water stress) or 45 mM NaCl (saline stress). After this period, the leaves were collected, and the RNA immediately extracted to perform a RT-qPCR analysis. Four genes related to the terpene biosynthetic pathway, FPP, SLS, LINS1, GDS, and the housekeeping gene CIT were evaluated. All genes were affected by stresses conditions. When compared to the control, the LINS1 and SLS genes were more expressed in both conditions, while the FPP and GDS genes were less expressed under water stress and more expressed under saline stress. Considering the biosynthetic pathway of terpene production, the LINS1 and SLS genes are associated to the linalool production, and the higher expression of those genes might corroborate this relationship. The results reinforce the efficiency of the triploid in the linalool biosynthesis as it was observed in natural triploids, opening a new scenario to modulate the linalool production in correlated species.

Hydraulics and Plant Water Relations

Airborne communication in maize: well-watered plants reduce transpiration when neighbouring drought-stress plants

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To adjust their physiological state during biotic and abiotic stresses, plants have developed an airborne communication system with their neighbours based on volatile organic compounds (VOCs). A specific stress can cause the emission of a unique blend of volatiles by an emitting plant, and these can trigger different responses in plants detecting the VOCs. We aim to investigate whether plants under optimal water conditions may respond to the VOC emission of neighbouring plants that undergo drought stress. We hypothesise that plants under water deficit can change their VOC emissions and that well-watered plants can detect these VOCs via air. We also expect that the well-watered plants respond to the VOCs by slightly closing their stomata to avoid excessive water loss, even if that would not be required. To test our hypothesis, maize plants (Zea mays) were placed inside a growth chamber and subjected to two treatments: a well-watered condition and mild to severe drought. During the experimental period, leaf gas exchange was measured with an infra-red gas analyser and the gas composition inside the chamber was monitored using an electronic nose. With the electronic nose, it is possible to detect a pattern related to each sample odour composition, the identification of the VOCs involved in the communication will be performed in the next steps of this study. Our results showed that plants under well-watered conditions reduced their stomata conductance and transpiration by more than 30% when they were neighbouring plants under drought. In addition, the patterns detected with the electronic nose related to the gas composition inside the chamber differed depending on the treatment. This is the first evidence that maize plants can communicate under drought, with the stomata of well-watered plants closing even when they have enough water.

Algae-based biostimulant enhances water deficit tolerance of 'Ponkan' tangerine on 'Rangpur lime' rootstock

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Water deficit caused by irregular rainfall distribution results in the loss of citrus seedlings and increased costs for establishing orchards in regions prone to dry spells. Algae-based biostimulants show promise in mitigating the adverse effects of water deficit by enhancing plant drought tolerance. This study evaluated the effect of an algae-based biostimulant on 'Ponkan' mandarin seedlings grafted onto 'Rangpur lime' rootstock under water deficit conditions. The experiment was conducted in a greenhouse, applying three increasing doses of the biostimulant, along with a control dose (water only), under two irrigation levels: corresponding to 100% and 50% of pot capacity. The tested doses were 0, 0.5, 1.0, and 1.5 L/hectare. A total of 64 plants were used, with four repetitions for each dose, in a completely randomized block factorial design. Stomatal conductance (gs - mmol $m^{-2}s^{-1}$) was measured using a porometer on the abaxial leaf surface. Water potential (MPa) was measured pre-dawn (Max) and at midday (Min) using a Scholander-type pressure chamber. Evaluations were conducted at the end of the water suspension period (10 days) and during rehydration (10 days after the end of the water suspension). In water deficit conditions, Max and Min decreased regardless of the dose, while gs was affected by the dose concerning irrigation levels and rehydration, indicating that plants activated a stomatal adjustment mechanism to reduce water loss during water deficit. The doses significantly affected stomatal conductance but had no pronounced effect on water potential under the 50% irrigation level. The use of algae-based biostimulants can enhance seedling tolerance to water deficit by adjusting stomatal conductance, thereby reducing losses during dry periods. The primary benefit of this biostimulant is its ability to help plants control water loss rather than altering leaf water potential.

Changes in watering frequency stimulate differentiated adaptive responses in root of micropropagated plantlets of Bamboo

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In this study, micropropagated plantlets of Guadua aff. chaparensis were evaluated to determine the effects of irrigation frequency on adaptives responses in roots. For that, four irrigation intervals (0, 2, 4 and 6 days) were applied in acclimatization stage of plantlets. The experiment was conducted under completely randomized design. The clusters of shoots were initially cultivated in vitro for 60 days, pre-acclimatized and hardening. The treatments were applied to plants grown in pots under a greenhouse environment and kept close to field capacity. At 24 days of treatment imposition, the effect of irrigation frequency on root anatomy were evaluated. In general, Guadua aff. chaparensis used different anatomical strategies to modulate the water availability in substrate. Daily irrigation and every two days promoted greater formation of aerenchyma (aerenchyma/cortex and aerenchyma/root ratio) of the living area of the cortex in relation to the total area of the cortex, while greater thickness of the Casparian strip was observed in plants submitted to lower irrigation frequency. This study suggests that alterations in the formation of aerenchyma and in the thickness of the Casparian strip may provide an approach aimed at the development of bamboos that are more tolerant to lower water availability in the soil.

Comprehensive Assessment of Drought Resistance in Herbaceous Crops: Developing a Water Retention Index Model

Moab Torres de Andrade, Eduardo José Haverroth, Leonardo Araújo Oliveira, Amanda Ávila Cardoso

Drought is the main environmental stress that strongly limits crops and forest productivity and growth, and as the global temperature rises the drought occurrence will became more frequent. Efforts to predict drought resistance in trees are extensive, but such indexes models are scarce for herbaceous plants. Here we assessed data of embolism resistance, water potential at turgor loss point, (ΨTLP), maximum stomatal conductance (gsmax), residual conductance (gleaf-res) and total leaf area from five herbaceous crops: common bean, cowpea, soybean, sunflower and tomato (wild-type and three ABA-mutants: sitiens, notabilis and sp12). These traits were used to calculate a water retention index model (WRI) that was tested against the time plants take to reach 50% stem embolism (P50) during drought. We identified significant variations in physiological and hydraulic traits among species. The lowest ΨTLP values were found for soybeans (-1.11 ±0.08 MPa), while the other genotypes ranged from -1.05 ±0.02 to -0.80 ±0.05 MPa for notabilis and common beans, respectively. Additionally, all Fabaceae species exhibited a larger total leaf area (0.34 to 0.39 m^2), in contrast to the reduced leaf area in tomato genotypes. In the dry down experiment, we found that the time to P50 vary from 5 days to 12.8 ±1.98 days. In descending order of resistance: cowpea, sp12, common beans, wild type, soybean, sunflower, not and sit. The WRI aligned significantly with the time to P50 ($p < 0.01$, R2 = 0.63). We also found that the time to P50 only displays significant correlation with gsmax and gleaf-res, which suggests that avoidance-related traits possess greater importance in the onset of stress in herbaceous plants. Indeed, crops that show a combination of higher gsmax and gleaf-res also show reduced time to P50. The WRI index has a strong predictive capacity for drought resistance in crops.

Diurnal course of stomatal conductance in Humulus lupulus varieties cultivated in a greenhouse

TAYNA POPPE BOURGUIGNON, Joseane Santos da Silva, Eronilton Sena Filho, Eduarda Lessa de Araújo de Souza, Wayna Queiroz Trujillo, Fábio Pinto Gomes

Hop, a key ingredient in beer production, is gaining attention in Brazil to meet the growing demand from craft breweries. To understand stomatal function throughout the day, stomatal conductance (gs) was measured from 8:00 AM to 3:00 PM on the adaxial and abaxial surfaces of fully expanded leaves from four commercial hop varieties (Comet, Zeus, Cascade, and Saaz) cultivated in a greenhouse at the State University of Santa Cruz, Ilhéus, BA. As expected for a hypostomatous species, gs was higher on the abaxial surface, with variations throughout the day between varieties. On the adaxial surface, Cascade showed higher gs during all evaluations, significantly surpassing other varieties at 11:30 AM and 3:00 PM. For the other varieties, gs remained constant on the adaxial surface. No significant differences were found between varieties for gs measured on the abaxial surface between 8:30 AM and 10:30 AM, though Saaz had gs values 63% higher than Zeus. All varieties showed a decrease in gs until 11:30 AM, with values stabilizing until the end of the measurements for Comet and Cascade. Zeus and Saaz had significantly higher gs than Cascade and Comet at 12:30 PM and 1:30 PM. At 3:00 PM, Comet had the highest gs. In Comet, Zeus, and Saaz, gs measured on the adaxial surface, when expressed as a percentage of the abaxial values, increased during the morning. This increase was more pronounced in Cascade, reaching 75%, due to the higher gs on the adaxial surface. These differences among the varieties may reflect different adaptations to environmental conditions, with some varieties prioritizing photosynthesis while others focus on water conservation.

Diversity changes in an Atlantic Forest coastal habitat since the 2015 El- Niño drought

Maria Cecília Zorzanelli, Jehová Lourenço Júnior, João Pedro Zanardo de Andrade, Geraldo Rogério Faustini Cuzzuol, Rodrigo Teófilo Valadares, Gustavo de Souza Broetto

Drought periods can induce significant shifts in functional traits and the structure of plant communities, favoring species with high phenotypic plasticity (generalist species). Leaf traits are key indicators for understanding the impacts of climate change on tropical forests. This study assessed temporal changes in species and functional diversity of restinga plant communities almost a decade after the severe drought caused by the 2015-2016 El Niño. Leaf samples were collected from 80% of the most abundant tree species within a plant community at Paulo César Vinha State Park, Guarapari-ES, in 2016 and 2024. We measured leaf fresh mass (LFM), leaf dry mass (LDM), leaf thickness (LT), leaf area (LA), specific leaf area (SLA), succulence (SUC), leaf dry matter content (LDMC), and leaf tissue density (TD). Comparisons between the two sampling periods revealed subtle changes in community structure, attributed to mortality and the recruitment of individuals from dominant species and more pronounced changes in the traits of generalist species. The analysis of leaf traits indicated that, by 2024, plants exhibited reduced SLA, increased LT, and lower TD. These traits suggest enhanced efficiency in water retention and nutrient use, likely enabling plant survival under arid conditions. The results suggest that restinga plant communities are adapting to a scenario where water availability is the primary limiting factor, favoring drought-resistant and tolerant phenotypes, such as generalist species.

DOUBLE-EDGED SWORD OF POTASSIUM AND SODIUM FERTILIZATION IN XYLEM EMBOLISM RESISTANCE OF EUCALYPTUS UNDER DROUGHT

Nikolas Souza Mateus, Victoria Perez-Martinez, Jose Lavres, David T Tissue, Brendan Choat

Sodium (Na+) is a beneficial element for most plants and may replace potassium (K+) in osmoregulatory process to a certain extent, increasing plant water-use efficiency. Thus, understanding coordinated mechanisms underlying the combined use of K+ and Na+ in tree drought tolerance is a key challenge for forestry in dealing with productivity and water limitations. A pot experiment with three ratios of K/Na (K-supplied, partial K replacement by Na, and K-deficient plants) and two water regimes, well-watered (W+) and water-stressed (W-), was conducted on saplings of two Eucalyptus species with contrasting drought sensitivities. We evaluated the point of stomatal closure (Pgs90), xylem water potential at 12, 50, and 88% embolized xylem area (P12, P50, P88), hydraulic safety margin, leaf gas exchange (A, E, gs, and dark respiration), pre-dawn and midday leaf water potential (ΨPD and ΨMD), long-term water use efficiency (WUEL) and total dry mass. Partial K replacement by Na increased the leaf gas exchange, WUEL, and total dry mass, while Pgs90, P12, P50, P88, and ΨMD decreased (were more negative), compared with plants exclusively supplied with K and K-deficient plants of both species. Fertilized plants had narrower hydraulic safety margins than K-deficient plants, indicating that these Eucalyptus species adopt the functional adaptive strategy of operating close to their hydraulic limits to maximize carbon uptake while increasing the risk of hydraulic failure under drought stress.

EMBOLISM VULNERABILITY IN COFFEA GENUS

Gabriel Silva Pires, Luciano Pereira, Marcela T. Miranda, Masako T. Braghini, Julio C. Mistro, Eduardo C. Machado, Rafael V. Ribeiro

Water deficit is a primary driver of tree mortality and production losses, making vulnerability to embolism an indicator of drought resistance. The Agronomic Institute (Campinas, Brazil), renowned for its coffee breeding program, houses a Coffea germplasm bank under field conditions. However, there is no information about how embolism resistance varies in such collection. Here, we investigated whether vulnerability to embolism differs among seven Coffea species (C. arabica, C. canephora, C. liberica var. dewevrei, C. millotii, C. racemosa, C. salvatrix, and C. stenophylla) and two hybrids C. arabica x C. liberica (Piatã 387) and C. canephora x C. congensis (Congusta). Plagiotropic branches, with at least 30 cm, stem diameter thicker than 5 mm and containing 10 or more leaves, were collected to evaluate the curves of vulnerability to embolism (VCs) using the pneumatic method. From VCs, we estimated the xylem water potential at 50% of embolism (Ψ50). As reference, Ψ50 values below -5 MPa are found in species with high resistance to embolism. VCs revealed the variability in embolism resistance among species, with C. arabica and C. millotii presenting the less negative Ψ50, respectively, -4.24±0.74 and -4.53±0.63 MPa. On the other hand, C. stenophylla and C. liberica var. dewevrei exhibited the most negative Ψ50, reaching -6.57±1.28 and -6.30±1.12 MPa, respectively. When considering Ψ50, C. stenophylla and C. liberica var. dewevrei significantly differed from C. arabica. Despite C. arabica and C. millotii being the most vulnerable species in this study, we may consider that Coffea genus – in general – exhibits high embolism resistance.

Evaluating soybean resilience: hydraulic conductivity and xylem plasticity under water stress

Roberto Gomes Vital, João Vitor Ferreira dos Santos Silva, Jober Condé Evangelista Freitas, Paulo Eduardo de Menezes-Silva, Fernanda dos Santos Farnese

Water stress has a profound impact on soybean production, compromising crucial hydraulic parameters necessary for the efficient transport of water within the plants. This study aimed to evaluate the effects of drought on plant hydraulic conductivity (Kplant), leaf conductivity (Kleaf), and stem conductivity (Kstem), as well as to analyze vulnerability to embolism (P50 and P88) in soybean plants. The plants were subjected to three treatments: full irrigation control, one drought cycle (1DH), and two drought cycles (2DH). Drought was induced by reducing soil moisture to 45% of field capacity for 10 days. Plants subjected to one drought cycle were evaluated in the reproductive stage (R5), while those that underwent two cycles were evaluated in the vegetative (V5) and reproductive (R5) stages. The results showed that hydraulic conductivity (Kplant, Kleaf, Kstem) was significantly reduced in plants subjected to drought, regardless of whether they underwent one or two cycles. Control plants that received full irrigation exhibited higher hydraulic conductivity values, reflecting greater efficiency in water transport. Additionally, drought-stressed plants exhibited more negative P50 and P88 values, indicating increased resistance to xylem embolism formation. Although the 1DH and 2DH plants did not differ from each other in terms of embolism resistance, the plasticity exhibited by the xylem compared to the control is important for the plant's ability to survive drought. These results highlight the importance of developing strategies to increase soybean resilience to water stress in drought-prone environments, also considering hydraulic plasticity as a key factor in the plant's adaptation to adverse conditions.

FOLIAR WATER UPTAKE AND ITS ROLE IN SHAPING THE ECOHYDROLOGICAL DYNAMICS OF AMAZONIAN CANGA

Daniela Boanares, Cecílio Frois Caldeira, Markus Gastauer

Fog plays a pivotal role in the hydrological cycle of various terrestrial ecosystems. In addition to its contribution to ecosystem hydrology, fog serves as an essential alternative water source for vegetation via foliar water uptake (FWU). Understanding which species exhibit FWU is crucial for expanding our knowledge of water dynamics and the ecological niches within the Amazonian campo rupestre. This study posits that physiognomies with lower soil water availability will exhibit greater FWU capacity. To test this hypothesis, we evaluated the FWU ability of 44 species across three distinct canga physiognomies. Cangas, a unique type of ferruginous campo rupestre, form patchy ecosystems located on ironstone outcrops atop the Carajás Massif in the Eastern Amazon. These ecosystems are situated within the Carajás Mineral Province (CMP) in the state of Pará, Brazil. Our findings revealed that species associated with shrub and grassland cangas exhibited significantly higher FWU values compared to those from gallery forests. Notably, more than 80% of the studied species demonstrated substantial FWU capacity, underscoring the vital role fog plays in their hydration and survival. The integration of FWU as a key component in hydrological dynamics can greatly aid in strategic decision-making for the restoration of degraded landscapes and the conservation of vulnerable species. This study identifies species that are better suited for specific restoration areas and species translocation efforts within conservation programs. Moreover, it offers valuable insights into which species are more likely to withstand the impacts of climate change, particularly in the face of global warming, thus informing future ecological management and restoration strategies.

HIGHER SOIL NUTRIENT AVAILABILITY DECREASES HYDRAULIC SAFETY MARGINS IN TREES FROM SOUTHERN AMAZONIA

Raiane Gonçalves Beú, David Galbraith, Augusto Cesar Franco

The ability of plants to adjust and maintain the water balance in response to drought involves the integration of a highly diverse ensemble of traits. Here we seek to fill critical gaps about the relationships between soil fertility and growth strategies and how this can influence the water relations of tropical trees. We made use of a natural fertilization experiment in southern Amazonia to evaluate xylem hydraulic traits in response to higher availability of soil nutrients by studying trees species in a nutrient-poor oxisol (NDE) and in an adjacent nutrient-rich patch of Amazonian dark earths (ADE), both located within the same forest fragment. The ADE soil had higher levels of Ca and P, which was reflected in higher leaf Ca and P relative to trees in the NDE soil. The trees that occur in the ADE also achieved greater height and diameter. The ADE tree community had lower hydraulic safety margins (HSM) and more negative leaf water potentials in the dry period (Ψdry), probably a consequence of a more acquisitive growth strategy, while the greater HSM of NDE trees suggest a more conservative growth strategy. Species occurring on both ADE and NDE plots did not adjust their hydraulic architecture to the prevailing edaphic conditions and were closer to hydraulic failure in the ADE plot. Our study highlights the crucial role of soil fertility in affecting tree tolerance and vulnerability to drought in the southern edge of the Amazonia, contributing to a better understanding of tropical forest responses to the current climate warming trend that is exposing the Amazonia to major changes in precipitation regime.

HYDRAULIC CHARACTERISTICS IN RELATED C3 AND C4 SPECIES

Carolina Souza de Castro, Marcos Jose Barbosa de Oliveira, Pablo Henrique Nunes-Carvalho, Adriano Nunes-Nesi, Samuel Cordeiro Vítor Martins

C4 plants are known for maintaining high photosynthetic efficiency and greater water use efficiency than C3 species, due to its biochemical carbon cycle having been modified during evolution. However, little is known about differences in water relations between photosynthetic types, especially in species belonging to transitional groups between types C3 and C4. This work aimed to explore the hydraulic characteristics in related C3 (Tarenaya hassleriana (Th) and T. longicarpa (Tl)) and C4 (Gynandropsis gynandra (Gg)) species of the Cleomaceae family. Measurements of pressure-volume curves, leaf hydraulic conductance (Kleaf), and optic vulnerability curves were performed. In terms of water relations, the relative water content at the point of turgor loss was similar across the three species (0.89). The Th and Gg species presented similar values for the osmotic potential at full turgor (Ψs100, -0.80 MPa), water potential at the point of turgor loss (ΨTLP, -0.84 MPa), and capacitance at full turgor and turgor loss point (CFT, 1.30 mol m-2 MPa-1). However, C4 exhibited higher capacitance after the turgor loss point (CTLP, 6.28 mol m-2 MPa-1). Regarding leaf hydraulic conductance, all the three species had similar values, indicating that they are all considered efficient. However, the C3 species were more vulnerable to embolism compared to the C4 species, which had a greater hydraulic safety margin. We concluded that the C4 species can be considered an efficient and safe plant from a hydraulic point of view, suggesting that the known trade-off between safety and efficiency may be influenced by the photosynthetic type of plants.

PREMATURE DEATH OF Tachigali vulgaris MAY BE ASSOCIATED WITH ITS WATER RELATIONS BEHAVIOR.

ADLER SALOMON, FRANCISCO DE ALMEIDA LOBO, MOMADE JUMA ALIASSE, CYRO MATHEUS COMETTI FAVALESSA, MARIO TOMMASIELLO FILHO, CARMEN EUGENIA RODRIGUEZ ORTIZ

Tachigali vulgaris L.F. Gomes (common name tachi) is a pioneer wood species whit a short life span, however, it is not yet elucidated which factors affect its premature death. Over the past 10 years, the Brazilian Cerrado region has been experiencing successive periods of water scarcity and, apparently, this has intensified the tachi die-off events. Given these facts, this research aimed to evaluate variables related to the water relations of tachi, to identify possible variables that may contribute to the death of this plant. It was found that during the dry season, plants maintained their leaf hydraulic conductivity (7.10 mmol m-2 s-1 MPa-1) at levels statistically like those observed during the rainy season (8.02 mmol m-2 s-1 MPa-1). However, this occurred because transpiration rate also showed the same trend (1.98 mmol m-2 s-1 during the rainy season and 1.48 mmol m-2 s-1 during the dry season), so that both the leaf and stem water potential suffered significant reductions during the dry period (-1.46 MPa and -2.31 MPa for leaves and -1.26 MPa and -2.10 MPa for stems during rainy and dry seasons, respectively). Leaf water potential during the dry season was statistically like leaf osmotic potential at incipient plasmolysis (-2.36 MPa), which is evidence of a potential impending internal water stress. In this case, cell and tissues did not collapse immediately because of the high elasticity of the cell wall (volumetric elastic modulus of 3.01 MPa), that allow for the cell to maintain a positive pressure potential and high relative water content (79.95% at incipient plasmolysis). Further investigation is required to understand whether high leaf hydraulic conductivity may be the primary factor contributing to premature death in this species. It seems reasonable to assume that it could lead to hydraulic failure due to xylem cavitation and embolism.

PROMOTING BACTERIA OF PLANT GROWTH AS MITIGATING THE EFFECTS OF DROUGHT IN PLANTS

Ana Laura Topanott Nunes, Lucas Guilherme Bulegon, André Sarabia Zamarian, André Silas, Vandeir Francisco Guimarães

Water deficit is one of the main limiting factors for plant productivity, driving a constant search for biotechnological innovations to reduce the damage caused by water scarcity. This study aimed to review the effects of water deficit and the mitigation mechanisms provided by plant growth-promoting bacteria (PGBs). These bacteria can be applied to plants through seed inoculation, in the planting furrow, or via foliar spray, aiding in defense against water stress and other types of adversity. PGPB act through various mechanisms in plants, such as the production of plant hormones, the promotion of root growth, and increased antioxidant activity, which helps to eliminate or prevent the formation of reactive oxygen species. Additionally, they reduce ethylene concentration through the action of the ACC-deaminase enzyme, stimulate the production and protection of photosynthetic pigments, signal stomatal closure, and encourage the production of osmotically active compounds. These mechanisms operate in an integrated manner within the plant, mitigating the effects of water deficit and promoting plant growth. Considering all aspects presented and discussed in this review, it is evident that the use of PGPB has been effective in reducing production losses and increasing productivity in various plant species. Compared to control plants, those treated with PGPB exhibit a greater ability to maintain development throughout the growth cycle, resulting in better production outcomes. Recent studies indicate that the role of PGPB in agriculture, both nationally and internationally, is expanding, and new potential applications of these microorganisms are being identified, further reinforcing their importance to the agricultural sector.

RESISTANCE TO WATER STRESS IN THE obscuravenosa (obv) MUTANT OF TOMATO (Solanum lycopersicum L.)

Cássia Nayana da Silva Vitorino, Karla Gasparini, Caris dos Santos Viana, Lucas Maia de Aquino, Phelipe Henrique Costa de Miranda, Patrício Delgado Santibáñez, Rafael dos Anjos Rodrigues, Érica Lopes Batista, Agustin Zsögön

Water stress is a challenge for agriculture, and with climate change, research focused on the tolerance of cultivars to environmental changes is of utmost importance. The obscuravenosa (obv) mutant confers a leaf characteristic of opaque veins, due to the absence of bundle sheath extensions (BSEs). This homobaric leaf type results in greater hydraulic resistance in the lamina. Based on this observation, we conducted an experiment to analyse the behavior of obv plants under water stress. Wild-type (tomato cv. Micro-Tom) and mutant (obv) plants were grown in a greenhouse, and from the 30th day after germination, they were subjected to water stress for 15 days, recorded by daily weighing of the pots. The height of the plants was measured from the collar to the apical meristem, every second day, and the values used to calculate the relative growth rate. During the first three days of drought, the RGR for OBV was 0.037 (σ 0.017, $\pm$ 0.005), 0.039 (σ 0.028, $\pm$ 0.009) and 0.027 (σ 0.014, $\pm$ 0.004), with substrate water contents of 29%, 19% and 12%, respectively. Under the same water conditions, the RGR of MT was 0.031 (σ 0.020, $\pm$ 0.006), 0.028 (σ 0.018, $\pm$ 0.006) and 0.020 (σ 0.018, $\pm$ 0.006). There was a tendency for greater growth in obv in relation to MT, which visually appeared more vigorous. When rehydrated, the obv mutant showed better recovery and developed more shoots compared to MT. More detailed work will be performed to explain these differences.

Temporal Analysis of Leaf Water Potential: Implications for Water Use Strategies Classification in Tropical Specie

Deliane Penha, Mauro Brum, Luciana F. Alves, Rafael S. Oliveira, Tomas F. Domingues, Anderson Meneses, Rardiles Branches, Pedro Aurélio Pequeno, José Mauro S. Moura, Scott R. Saleska

Understanding and quantifying the water use strategies of tropical species is crucial for predicting how tropical ecosystems will respond to climate change. Using leaf water potential (**Ψ**) as a proxy to classify the degree of isohydry - the ability of plants to regulate their water status - is a common approach. Many studies estimate the degree of isohydry by measuring **Ψ** (minimum and/or the difference between pre-dawn and minimum: **Ψ**pd-min) only during the dry season, which limits our understanding of hydration dynamics across seasons. We aimed to investigate how measurements of **Ψ** across different time scales (daily and seasonal) may allow the classification of water use strategies in tropical species. We measured **Ψ** during pre-dawn and midday in both wet and dry seasons in species occupying different forest strata in the Tapajós National Forest, Brazil. Five species from the upper canopy and four from the understory were analyzed. Our results indicate that analyzing daily **Ψ**pd-min only during the dry season can bias the classification of water use strategies. Tall trees require a greater **Ψ** gradient to maintain water flow from the soil to the atmosphere, so greater **Ψ**pd-min or lower **Ψ**min does not necessarily indicate greater drought tolerance, as these patterns also occur in the wet season. In contrast, understory species tend to exhibit the opposite pattern: higher **Ψ**pd-min and reduced **Ψ**min are observed in the dry season compared to the wet season. Thus, the variation in leaf hydration in response to drought, which is widely used to estimate species' hydraulic strategies, can only be accurately assessed at a seasonal scale. Relying solely on **Ψ**pd-min and/or **Ψ**min metrics during the dry season compromises classification accuracy. These findings have important implications for ecological studies and modeling of tropical vegetation dynamics, highlighting the need for continuous measurements throughout the seasons.

Wood density varies more than leaf traits in response to water availability in Atlantic Forests

Ana Luíza Soares Araújo, Gustavo Viana de Freitas, Douglas Rodrigues Ribeiro, Jonatha de Sousa Reis, José Luiz Alves Silva, Julia Pereira Vicente, Angela Pierre Vitória

The Atlantic Forest is one of the 35 global biodiversity hotspots and one of the three most vulnerable to climate change. It comprises a variety of environments where different types of vegetation are established. Species deal with environmental conditions by adjusting their functional traits, which influence the survival and development of individuals. Studying functional traits helps to understand the consequences of human actions and predict ways to reduce damage to plant species communities. This study aimed to identify the differences in leaf and wood traits of tree species with evergreen leaf habit in two Atlantic forests in Rio de Janeiro: dense ombrophilous forest with humid conditions throughout the year, and seasonal semideciduous forest with a well-defined dry season in winter. Despite the short geographic distance between them (ca. 200 km), these forests differ markedly in water availability (around 1000 mm vs. 1800 mm), partly due to the "Falha de Campos" in northern Rio de Janeiro, which causes long periods of water scarcity in the semideciduous seasonal forest. Leaf density, leaf thickness, specific leaf area, and wood density were measured in five individuals per species per forest. Comparisons between forests were performed using One-way ANOVA, phenotypic variation indices, and Pearson correlations. Wood density was significantly higher in the semideciduous seasonal forest (0,73 vs. 0,49 $g.cm^3$, on average) due to the need for the species to withstand water stress. The phenotypic variation index did not show any significant difference between the forests (0,3 unitless for both). However, there was a tendency for greater phenotypic variation in the dense ombrophilous forest. Unlike what was observed for wood, leaf morphological traits did not show significant differences between the forests. This probably occurs because the wood organ is more conservative than leaves and, therefore, exhibits more predictive responses to water availability.

Plant Growth and Development

"IN SILICO" SELECTION OF TRANSCRIPTION FACTORS RELATED TO CELL WALL RECALCITRATION IN SETARIA VIRIDIS

Jennifer Eduarda Ibiapino Neves, Francisco Scaglia Linhares, Gabriel Luis Lima Soares Moreira, Maria Eduarda Pena Ferreira, Diego Mauricio Riaño-Pachón, Wagner Rodrigo de Souza, Renato Augusto Corrêa dos Santos

Setaria viridis has emerged as a model species for C4 grasses, advancing research on renewable energy sources such as second-generation bioethanol. The complex cell wall of grasses consists in an arrangement of polysaccharides, lignin, and proteins, which contribute to its recalcitrance, thereby hindering the efficient conversion of biomass into fuel by cellulose digestion processes. The present work aimed to deepen the understanding of the BAHD gene family (acyltransferase) involved in the modification of cell wall components in grasses, using system biology approaches (co-expression networks) and genomic analyses (motif finding and enrichment). Through "in silico" analyses, we selected potential cis-regulatory regions (motifs) where transcription factors (TFs) may potentially bind to regulate the expression of BAHD genes. To select motif-TF pairs with potential interaction, we identified highly expressed BAHDs and used functional annotation of TFs as well as co-expression networks of seven grass species (one C3 and six C4 plants) obtained from the CoNekT Grasses platform to identify highly correlated TF-BAHD pairs observed in at least two C4 species. Among the BAHD genes, our analysis highlights that BADH01 and BADH04 showed highest expression compared with other genes in the same family. For BADH01, we selected two TFs belonging to the AP2 family and three associated motifs. For BADH04, we identified one TF belonging to the bZIP and another from the AP2 family, associated with two and one motif, respectively. With the pre-selected data, we initiated yeast one-hybrid assays to experimentally validate TF-motif interaction "in vitro", in order to corroborate and validate the "in silico" approach.

A NOVEL RNA HELICASE REGULATES PLANT GROWTH AND FLOWER DEVELOPMENT

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We previously described the SCI1 (Stigma/style Cell-cycle Inhibitor 1) gene, which is a cell proliferation regulator in the upper pistil of Nicotiana tabacum and Arabidopsis thaliana. Recently, we demonstrated that SCI1 is expressed since floral meristem specification and in all floral organ primordia. We searched for its interaction partners to unveil how SCI1, a small protein without similarity to described proteins, regulates cell proliferation. Among the revealed proteins, we found a DEAD-box RNA helicase (NtDDX) not previously described in plants. We produced N. tabacum transgenic plants overexpressing and silencing NtDDX. The transgenic plants show a clear difference in growth, with the overexpression plants growing more and faster, while the silencing plants grow slowly and do not reach standard size. In a controlled growth experiment with homozygous lines of each type of transgenics compared to mock, a differential expression of 2 cell cycle markers was demonstrated: NtCYCB1;1 and NtCDKB1;1. Obtaining homozygous lines in plants where NtDDX is highly silenced was impossible. At least three lines of NtDDX silencing (Ri 31.1, Ri 54.1, and Ri 56.1) showed a negative drastic effect on floral development, which results in the abortion of most floral buds. Initially, the flower buds develop all whorls, which at a certain point degenerate, a process that seems to begin in the anthers and progresses to the petals and pistil. In the end, only the green and intact sepals of an empty bud remain. In addition, it was observed that the development of fertile whorls, and the spores appear to occur more rapidly in overexpression than in silencing plants. In a Y2H screening with NtDDX, we identified proteins of the splicing machinery and transcription factors, like 3 different TCPs. Our work revealed a novel RNA helicase controlling plant growth and especially flower development.

ABSCISIC ACID MODIFIES GROWTH AND INCREASE PRODUCTION OF RICE PLANTS (Oryza sativa L.)

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Plant hormones are important to control growth and physiological process in plants. Abscisic acid (ABA), one of the major plant hormones, is considered the stress hormone and recently has been related to the ability of increasing crop production. The aim of this study was to evaluate the effect of ABA on growth and yield of rice plants. Rice plants (IRGA 424 RI) were cultivated in 10-liter pots containing a mixture of commercial substrate and soil in a greenhouse. Forty days after planting plants were sprayed weekly with 50 mL of deionized (control) water, ABA (50 µM), fluridone (50 µM) or ABA + Fluridone. Rice plants were harvest at the heading and maturity stages to determine growth traits. The experiment followed the completely randomized design with six replications and data were submitted to Tukey's test ($P<0.05$). ABA treatment significantly reduced the height of rice plants compared to control. Moreover, ABA increased the number of tillers and leaves, resulting in greater leaf area. Treatment of rice plants with ABA had no significant effect on stem biomass, but increased leaf and root biomass compared to control, which led to increase total plant biomass. In general, fluridone and ABA+fluridone did not show a significant effect on growth traits, when compared to control. Rice plants treated with ABA displayed increased number of grains and panicles per plant compared with control, but with reduction in mass of grains per panicle and filled grains percentage. These results may explain why ABA increased the grain mass of rice plants. ABA resulted in a lower harvest index, but 1000-grain mass had no difference between treatments. The results show that ABA changes rice morphological pattern and increases production mainly due to the increase in the number of panicles.

ABSENCE OF ALUMINUM (AL) COMPROMISES THE DEVELOPMENT OF BORRERIA LATIFOLIA, AN AL-ACCUMULATING HERBACEOUS SPECIES

Elen Silma Oliveira Cruz Ximenes, Thaís Vida Catini, Carolina Souza de Castro, Fernanda Aparecida Ferrari Soares, Ana Paula Mitiko Fialho Toma, Wellington R. Clarindo, Cleberson Ribeiro

Aluminum (Al) is an element with ambivalent effects on plant growth. This study investigated how different concentrations of Al influence the development and physiology of Borreria latifolia. Seedlings of B. latifolia collected from Brazilian savanna soils in the Paraopeba National Forest were grown in nutrient solution and treated with 0, 250, 500, and 750 µM of AlCl3. Plant growth was evaluated based on the relative growth rate. Gas exchange parameters were measured with an infrared gas analyzer. After defining the best metal concentration, plants were grown in the absence or presence of Al. Samples of root tips, middle portion of the stem, and leaf blade were collected for analysis by scanning electron microscopy and microanalyses using an energy-dispersive X-ray spectrometer coupled with a scanning electron microscope. Root tips and young leaves were prepared for quantification of relative DNA content and endoreduplication using a flow cytometer. The results showed that the absence of Al compromises root growth and photosynthesis in B. latifolia. Plants grown in the absence of Al did not have a root cap at the root apices. On the other hand, in plants treated with Al, the presence of this metal was evidenced in the nucleus of the epidermal cells of the meristematic zone without any structural disarrangement. Despite the higher intercellular CO_2 concentration in the treatment without Al, the net photosynthetic rate was lower, indicating that metal depletion may be limiting some biochemical step of the photosynthetic process. Flow cytometry showed cells with 8C ploidy only in the absence of Al, suggesting that endoreduplication may be a response mechanism to stress due to lack of Al. Therefore, we conclude that the absence of Al compromises root integrity, growth, and photosynthesis in Borreria latifolia.

ACTION OF GIBBERELLINS ON PHYSIOLOGICAL RESPONSES RELATED TO LODGING IN SOYBEAN

Gisele Gomes Parnaiba Lopes, Raysa Mayara de Jesus Sousa, Amanda Tavares da Silva, Cleberson Ribeiro

Lodging is one of the factors that reduces the productivity of many crops, including soybean. Gibberellins (GAs) and cell wall molecules are related to resistance to lodging. This study aimed to investigate how the regulation of GA levels influences the growth of soybean (Glycine max). Plants of the UFVS 86B10 soybean cultivar were subjected to the following conditions: control water (H_2O); gibberellic acid (GA3 50 µM); paclobutrazol (PAC 1000 µM) and a combination of these (PAC + GA3). Growth, gas exchange, chlorophyll a (Chl a) fluorescence, biochemical and gene expression analyses were carried out. Highest plant length was obtained with the application of GA3 and the shortest with PAC. GA3 induced a reduction in the size of the leaf limbus cells and increased the intercellular space, while the presence of PAC increased the thickness of the mesophyll and spongy parenchyma. The photosynthetic yield was higher with the application of PAC and PAC + GA3. PAC increased the concentration of total chlorophylls, total amino acids and sucrose, and reduced the concentration of fructose and glucose. GA3 reduced sucrose content and increased fructose and glucose. In all treatments with GA3 there was an increase in the concentration of starch. The GA3 and PAC + GA3 treatments modified the stem and root anatomy. PAC increased the concentration of cellulose and reduced the levels of lignin in the shoots. Both PAC and GA3 treatments reduced the expression of the lignin biosynthesis intermediate gene Gm4CL. It is concluded that the regulation of gibberellin levels by the application of PAC favors resistance to lodging in soybean through morphoanatomical and physiological changes, culminating in a reduction in stem length and accumulation of cellulose in the cell wall, as well as improvements in photosynthetic efficiency and synthesis of primary metabolites.

AFRICAN MAHOGANY (Khaya grandifoliola): ESTABLISHMENT OF A CALLOGENESIS PROTOCOL AIMED AT SOMATIC EMBRYOGENESIS

Amanda Miranda de Souza, Edceu Batista da Conceição Junior, Filipe Sathler Meira, Evânia Galvão Mendonça, Leonardo Lucas Carnevalli Dias

African mahogany (Khaya grandifoliola) is highly valued for its organoleptic properties, such as durability and aesthetics, making it widely used in furniture and finishing materials. The increasing demand and intensive exploitation of the species have created a critical need to establish uniformity in forest plantations, aiming for more precise and sustainable management of the stands. This study aims to develop an effective protocol to induce callogenesis and somatic embryogenesis in Khaya grandifoliola, using different concentrations of 2,4-D (2,4-dichlorophenoxyacetic acid) and BA (benzyladenine). The MS culture medium was used, enriched with 30 g/L sucrose and 5.6 g/L agar, adjusted to pH 5.7, and autoclaved at 120°C for 20 minutes. The tested concentrations of 2,4-D and BA were 11.31 µM, 22.62 µM, 45.24 µM, 67.86 µM, and 90.48 µM. Khaya grandifoliola seeds were disinfected with 70% alcohol and 5% sodium hypochlorite, washed with distilled water, inoculated into flasks with the prepared medium, and kept at 25°C ± 2°C in the dark. The results showed that the 67.86 µM concentration of BA induced compact calli with greenish pigmentation, predominantly in the hilum regions of the seeds, suggesting potential organogenic characteristics. In contrast, the 67.86 µM concentration of 2,4-D resulted in friable calli, with a white to cream coloration, indicating possible embryogenic characteristics. These results confirm the effectiveness of the evaluated concentrations for the induction of callogenesis and present potential for somatic embryogenesis. The developed protocol may facilitate the creation of homogeneous clones and the production of synthetic seeds, promoting the conservation and sustainable management of Khaya grandifoliola.

APPLICATION OF A BIOSTIMULANT IN THE GERMINATION OF SOYBEAN SEEDS AND SEEDLINGS

Ana Júlia Souza Rodrigues, Lara Beatriz Resende, Lyriel Simozono Santos Silva, Layslla Nogueira Mota, Afonso Ricardo de Souza, Graciene Silva Mota, Fernanda Carlota Nery

Nanoparticles represent an innovative approach to enhancing plant-associated functions, such as growth, development, and seed germination, with the aim of improving crop quality. In germination, these nanoparticles can have stimulatory or inhibitory effects, depending on the concentration and species. The objective was to evaluate the effect of two nanotechnological biostimulant products provided by Krilltech Nanotecnologia Agro: Arbolina® and Carbon-dots, on the germination of soybean seeds and seedlings (cultivar 95R95IPRO, Pioneer®). Four concentrations were tested: 0.0 mL L-1 (Control-distilled water), 1.0; 2.0; and 3.0 mL L-1 for each product, with four replicates of 15 seeds each, using Germitest® paper substrate. Evaluations were conducted on the 5th day (first germination count) and the 8th day (final count), analyzing the germination percentage (%G), normal seedlings (%NS), abnormal seedlings (%AS), and germination speed index (GSI), following the Rules for Seed Analysis. Data were analyzed by ANOVA with Tukey's test at 5%. The results showed that the biostimulants did not affect %G among the tested concentrations compared to the control; however, there were differences between the biostimulants, with Arbolina showing a higher %G compared to Carbon-dots. Regarding %AS and %NS, significant differences were observed among the tested concentrations. For both biostimulants, concentrations above 2.0 mL L-1 were toxic, resulting in a lower %NS and higher %AS. Concerning the GSI, there were significant differences between the products, with the highest value obtained in seeds treated with Carbon-dots, and no significant differences among the tested concentrations. It is concluded that the biostimulant Carbon-dots has the potential to accelerate soybean seed germination. At concentrations above 2.0 mL L-1, both biostimulants studied have inhibitory effects on the germination and formation of normal soybean seedlings.

APPLICATION OF CHITOSAN NANOPARTICLES ON THE GROWTH OF ORNAMENTAL SUNFLOWER PLANTS UNDER WATER DEFICIT

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Chitosan nanoparticles (ChNPs) possess the characteristics of chitosan as well as the properties of nanoparticles, such as surface and interface effects, small size, and quantum size effects. Thus, they are a promising tool for controlling abiotic stress in plants. The objective was to investigate the effect of ChNPs on the growth of ornamental sunflowers under water deficit conditions. The ChNPs were prepared using ionic gelation of chitosan with tripolyphosphate (TPP) anions. Different concentrations of ChNPs (0.0-control; 0.5; 1.5; and 3.0 mg mL-1) were tested on ornamental sunflower plants without water restriction (90% water) and under water stress (60% field capacity), with applications at the V3 stage (18 days after sowing) and R1 stage (31 days after sowing). Plant height, number of leaves, inflorescence diameter, and fresh and dry weights of leaves, stems, roots, and inflorescences were evaluated. Variance analysis (ANOVA) was performed using SPSS software v.21, and means were compared using Duncan's test at 5%. The results showed that in plants not subjected to water restriction, there were no significant differences between the tested concentrations of ChNPs. However, under water restriction, plant height and dry weight of stems and roots showed significant differences. For plant height, the 0.5 and 1.5 mg mL-1 concentrations of ChNPs differed from the control, while the concentrations of 0.5, 1.5, and 3.0 mg mL-1 did not differ from each other for this parameter. Regarding stem dry weight, the concentrations of 1.5 and 3.0 mg mL-1 differed from the control and the 0.5 mg mL-1 concentration. Additionally, the root dry weight of plants at the 0.5 mg mL-1 concentration differed from the other tested concentrations. It is concluded that ChNPs induce favorable responses in ornamental sunflower plants subjected to water deficit.

ASSOCIATION OF *Bradyrhizobium japonicum* WITH THE VITAMINS THIAMINE AND NIACIN IN HYDROPONIC SOYBEAN

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The use of hydroponics can help in the search for suitable management of bioinputs for soybean crops. Therefore, the aim of this study was to evaluate the effects of the vitamins thiamine and niacin in the presence or absence of the inoculant B. japonicum in soybean crops grown in a hydroponic system. A randomized block design in a 2x4 factorial scheme with five replicates was used. Treatments consisted of inoculation with B. japonicum at a dose of 1 mL for 500 g of seeds (with and without) and foliar application of four solutions (water, niacin (0.1 g L−1), thiamine (0.1 g L−1) and niacin + thiamine (0.05 g L−1 + 0.05 g L−1)). Gas exchange and seed production per plant were evaluated. The interaction between vitamins and inoculation influenced intracellular CO2 content and stomatal conductance. The use of vitamins alone affected transpiration and water use efficiency, while inoculation significantly affected CO2 assimilation rate and carboxylation efficiency. The vitamins only affected transpiration and water use efficiency, with niacin standing out, which caused an increase of 21.66% and a reduction of 14.09%, respectively, compared to the control treatment. Inoculation with B. japonicum significantly increased transpiration characteristics, CO2 assimilation rate and carboxylation efficiency by about 20.52%, 18.92% and 20.00%, respectively. Grain production per plant was also significantly improved by 84.89% compared to the control group. It was concluded that inoculation with B. japonicum in soybean seeds enhances grain production, especially in combination with vitamin solutions. Niacin can be used alone or in combination with thiamine in hydroponic soybeans, with or without inoculation with B. japonicum. The interaction of inoculation and foliar application of vitamins can be utilized in hydroponic soybean production.

AUTOPHAGY PLAYS A CRUCIAL ROLE IN PREVENTING PLANT SENESCENCE TRIGGERED BY ACID STRESS

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Due to their sessile nature, plants are repeatedly subjected to various environmental stresses, such as drought, irradiance, ionic toxicity, etc. Acid stress is a limiting factor for plant development. This impact is primarily caused by increased H+ protons in the soil, which promotes nutritional disturbance, aluminum and manganese toxicity, leaching, metabolic changes, and the development of superficial roots due to the low availability of calcium (Ca2+). In plants subjected to various abiotic stresses, autophagy is one of the main proteolytic systems for mitigating damage. Autophagy, governed by autophagy-related genes (denominate ATG), is involved in the degradation and recycling of cytoplasmic constituents through their sequestration into the vacuole. Although the role of autophagy in response to acidic environment has been demonstrated in human cells, its involvement in plant responses to the acidic environment is much less understood. The results obtained here suggest that, in plants, the ATG5 gene actively participates in responses to the acid environment (pH 4.0), and its absence results in oxidative damage, compared to plants deficient in the ATG7 gene, which manage acid stress more effectively, in part through an increase in the expression of AOX (alternative oxidase). Additionally, the acidic environment caused a decrease in chlorophyll content and a significant increase in soluble sugars in autophagy-deficient mutants (atg5-1 and atg7-2). Taken together, our findings suggest that acidic pH induces senescence, particularly in mutant plants with a deficiency in the autophagic process. It is plausible to suggest that autophagy is associated with responses to acid conditions by mediating metabolic and molecular adjustments, thereby interrupting early senescence in Arabidopsis thaliana.

Azospirillum brasilense AND NICOTINAMIDE AS BIOSTIMULANTS IN THE HYDROPONIC CULTURE OF PUMPINS

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Biostimulants are used in crops as growth promoters that aim to increase productivity and have as an important feature the improvement of the sustainability of the growing environment. Therefore, the aim of the study was to evaluate the initial growth of pumpkin plants in hydroponic cultivation with isolated and combined use of nicotinamide and Azospirillum brasilense. A completely randomized design with six treatments and four replicates was used. Treatments consisted of a combination of nicotinamide (foliar cultivation) and A. brasilense (foliar cultivation or application in hydroponic solution). The treatment with A. brasilense in the hydroponic solution reduced the intracellular CO_2 concentration (Ci). The combined application of A. brasilense foliar and nicotinamide and A. brasilense foliar increased the stomatal conductance (gs). All treatments with nicotinamide and/or A. brasilense, regardless of the application method, positively increased the CO_2 assimilation rate. Treatments with isolated or combined application of nicotinamide and A. brasilense, foliar or via the nutrient solution, had a positive effect on carboxylation efficiency. Leaf area was positively affected by the application of nicotinamide, followed by the application of A. brasilense on the leaf and nicotinamide, A. brasilense on the leaf and A. brasilense in the solution. Nicotinamide application alone also resulted in a significant increase in plant length and stem diameter, which did not differ from the treatments with A. brasilense foliar and nicotinamide, A. brasilense applied to solution and nicotinamide for plant height and from the treatments with A. brasilense foliar, A. brasilense foliar and nicotinamide, A. brasilense applied to solution and nico foliar plus A. brasilense in solution for stem diameter. The use of nicotinamide and A. brasilense alone or in combination was found to increase the growth and gas exchange of pumpins plants grown in a hydroponic system, especially with foliar application of A. brasilense.

BEHAVIORAL ANALYSIS OF SOYBEAN DURING THE VEGETATIVE PHASE UNDER ABIOTIC STRESS AND APPLICATION OF ACETYLCHOLINE

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Occurrence of drought combined with high temperatures causes severe damage to the morphology and physiology of crops, affecting productive potential. One way to increase plant tolerance to abiotic stresses occurs through the application of bioregulators, including acetylcholine (ACh). ACh acts on plant physiological processes and plays an important role in their responses to stress. This work evaluated the effects of applying ACh to soybean plants under associated conditions of high temperature and water deficit. The plants were grown in a greenhouse and when they reached the V3 stage, part of them were taken to a growth chamber. During five days the plants were exposed to 38/28oC (day /night) and irrigation with 30% of field capacity. Gas exchange measurements were carried out during the period of stress imposition and after the plants returned to normal condition (sixth day). Growth parameters were then evaluated. The experiment was conducted in a completely randomized experimental design, with a 2 x 2 factorial arrangement (absence and presence of stress and ACh - 2mM), with 4 treatments and 9 replications. The application of ACh resulted in an increase in A and E in plants under stress conditions. In the measurement carried out after recovery, plants that were under stress and were treated with ACh showed higher values of A, gs, Ci, A/Ci and A/E. The application of ACh resulted in a decrease in the dry mass of the aerial part, both in control plants and in plants under stress. On the other hand, there was an increase in root dry mass in plants under stress and treated with ACh. It was concluded that ACh has potential for mitigating abiotic stresses in soybean plants in the vegetative phase, through optimization of gas exchange and reallocation of biomass from the aerial part to the root system.

BIOSTIMULANT IN THE GERMINATION OF ORNAMENTAL SUNFLOWER SEEDS, CULTIVAR VICENT'S CHOICE

Lara Beatriz Resende, Ana Júlia Souza Rodrigues, Layslla Nogueira Mota, Lyriel Simozono Santos Silva, Livia Carvalho Mendes, Graciene Silva Mota, Fernanda Carlota Nery

Sunflower is a versatile plant, used as an ornamental flower, in human and animal food, and primarily for oil extraction, which is rich in fatty acids beneficial to health. The advancement of nanotechnology has significantly expanded the application of nanomaterials in various fields. Arbolina® is a nanoparticle that provides carbon and nitrogen, promoting the productive and qualitative enhancement of agricultural crops, possessing stimulating and hormonal properties. Based on this, the objective was to evaluate the germination of ornamental sunflower seeds, cultivar Vincent's Choice, subjected to the application of Arbolina®, provided by the company Krilltech Nanotecnologia Agro. The seeds were pre-soaked in a solution containing: 0.0 (distilled water), 0.5, and 1.0 mL L-1 of Arbolina®. The germination test was conducted with four replicates of 25 seeds each, using Germitest® germination paper moistened with water, 2.5 times the weight of the paper, under constant light at 25°C, according to the Rules for Seed Analysis. The germination percentage (%G), percentage of normal seedlings (%NS) and abnormal seedlings (%AS), germination speed index (GSI), and activity of antioxidant enzymes in the seedlings, such as superoxide dismutase (SOD), catalase (CAT), and ascorbate peroxidase (APX) were analyzed. The results indicated no significant difference among the treatments studied, showing an average of 88% seed germination, 90% normal seedling formation, 10% abnormal seedlings, and a GSI of 20.65. No significant effect was observed on the activity of the analyzed antioxidant enzymes. It is concluded, therefore, that there was no biostimulant effect, at the tested doses, of Arbolina® on the germination and antioxidant system of ornamental sunflower seeds and seedlings, cultivar Vincent's Choice.

BUD DORMANCY AT TRANSITIONAL LATITUDES IS AFFECTED BY LOW PHOTOPERIOD CONDITIONS IN GRAPEVINE

Rodrigo Richard Rabello Fonseca Lucas, Lucas Xavier Rodrigues, Roberta Pena Paschoa, Vanildo Silveira, Ricardo Enrique Bressan-Smith

Woody perennial dormancy is a complex process involving genetic and environmental factors. Grapevine metabolism is affected by light and temperature regimes throughout the year changes the bud morphology giving rise to cold resistance under low temperatures climates. Literature often describes lower temperatures as a determinant factor for dormancy, as grapevines are originally from temperate climates. In tropical zones, the grapevines are devoid of lower temperatures to aid dormancy. The case of this phenomenon is vineyards at 21ºS latitude which includes the northern region of Rio de Janeiro state, where mild temperatures and photoperiod variations ranging from 13,1-10,7h throughout the year are supposed to cause morphological changes in buds and canes, resulting in dormancy. Through proteomics analyses during two contrasting pruning seasons (winter: minimum photoperiod, near winter solstice; summer: maximum photoperiod, near summer solstice), we aimed to identify proteins involved in bud dormancy release/establishment, identifying differences between regulated protein profiles. We identified 903 proteins, of which 109 were differentially accumulated proteins, so that 55 were regulated proteins in the summer, and 50 were regulated proteins in the winter. Five proteins were identified as unique, being three in summer and two in winter. The proteins identified as regulated in summer were related to glucose catabolism process, cell wall maintenance, and biosynthesis of secondary metabolites. In winter, the regulated proteins were primarily related to glycolysis/gluconeogenesis metabolic routes, sucrose synthesis, protein maturation, and photosynthetic metabolism. We conclude that, given the disparities between summer and winter pruning, the summer condition does not induce endodormancy because this season is devoid of signals to the dormancy establishment. In contrast, during the winter period, grapevine buds focus on conserving and availability of energy for the resumption of growth and maturation of protochlorophyllide molecules, as they transition out of endodormancy.

CAN NH4+ ABSORPTION BE STIMULATED IN TRANSGENIC RICE PLANTS OVEREXPRESSING THE BROMELIAD PIP1;2 AQUAPORIN GENE?

Joyce Gomes Falcão, Ítalo Vinícius Cantanhêde Santos, Gladys Flávia de Albuquerque Melo de Pina, Helenice Mercier

The epiphytic bromeliad Vriesea gigantea has a PIP1;2 type aquaporin that, in addition to transporting water, aids in NH4+ absorption. This is the most frequent form of nitrogen (N) present in the tank of this bromeliad, coinciding with the common nitrogen form found in flooded rice fields. So, could transformed rice plants expressing the aquaporin gene from Vriesea gigantea have an increased capacity for NH4+ absorption? Thus, the objective of this study was to analyze the development of transgenic rice plants that constitutively express the bromeliad VgPIP1;2 gene, cultivated at different NH4+ concentrations. Seeds of transgenic and wild-type plants underwent surface disinfection and were germinated for two days in a growth chamber. After germination, the plants were transferred to hydroponic cultivation with a modified Yoshida (1976) nutrient solution, supplemented with ammonium sulfate as the only nitrogen source at concentrations of 1.44 mM or 0.14 mM, where they remained for 10 days. The root system and aerial parts of the plants were used for morphological measurements. In addition, roots were collected for anatomical analysis. There were no significant differences seed germination rates, however, transgenic plants exhibited a higher number of seedlings at more advanced developmental stages compared to wild-type plants. Moreover, transgenic plants showed significantly greater averages in height, number and length of roots, regardless of the ammonium concentration. Furthermore, the dry mass of the root system in transgenic plants was significantly higher under the reduction NH4+ treatment. The results suggest that transgenic plants presented development and morphological characteristics that reflect a more efficient nitrogen absorption. Thus, the use of the V. gigantea PIP1;2 aquaporin gene indicates potential for future biotechnological studies. CNPq # 308054/2022-9

CAN SEED PRIMING WITH SMOKED WATER IMPROVE GERMINATION OF Diplusodon glaziovii?

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The fire is a natural disturbance present in open ecosystems like Campo Rupestre (CR), where species have adapted to and thrive in post-fire conditions. These ecosystems benefit from fire, as chemical substances from burning vegetation can stimulate seed germination. Diplusodon glaziovii Koehne (Lythraceae) is a native shrub of the CR, a fire-prone environment, critically endangered and rare. Therefore, propagation by seeds ensures the species' natural populations. In the context of revegetation and propagation projects, seed priming techniques can enhance germination and subsequent seedling establishment. Priming is a technique in which seeds are imbibed without allowing germination to occur, drying subsequently in a controlled manner, The objective of this study was to treat D. glaziovii seeds with hydropriming and two concentrations of “smoked water,” (5g of litter for 50ml of water and 10g to 50ml) which is extracted from the burning of the litter. The seeds were soaked in distilled water and “smoked water” for 11 hours, then dried in a germination chamber at 20°C with silica for 4 hours. Following this stage, germination tests were conducted in a germination chamber at 25°C with 12 hours of light at 40 μM photons m-2 s-1. Evaluations were performed daily until germination stabilized. D. glaziovii glaziovii showed a higher germination rate when treated with “smoked water” priming at the lowest concentration, although the final germination percentage was not significant distinct among the treatments. The germination of D. glaziovii was influenced by compounds in the smoke extract, suggesting that this could be an alternative method to improve the species' germination requirements for propagation purposes. Additionally, these results contribute to a better understanding of the role of fire in the CR vegetation and its effect on seed germination processes.

Carbon Nanocomposite-Stabilized Fertilizers affect photosynthetic activity in maize

Jardel de Moura Fialho, Hilda da Silva Cunha, Fabiane Carvalho Ballotin, Edson Marcio Mattiello, Juscimar da Silva

The use of nanocomposites in fertilizers can bring significant benefits, as they have the potential to enhance nutrient availability and utilization efficiency. The photosynthetic activity was studied in maize crops cultivated in two soil types fertilized with the 11-28-23 formulation, with and without the addition of nanocomposites. The formulation was prepared by mixing diammonium phosphate (DAP) and potassium chloride (KCl), doped with carbon nanocomposites (Nano_C1, Nano_C2, Nano_C3) and biochar, at proportions of 0.5% (w/w). The treatments were arranged in a 2 x 5 + 1 factorial design, comprising two soil types (medium texture and clayey); five NPK formulations, with four formulations containing additives (NPK 11-28-23_BC; NPK 11-28-23_Nano_C1; NPK 11-28-23_Nano_C2; NPK 11-28-23_Nano_C3) at a 0.5% C ratio (w/w), and one NPK 11-28-23 without additives (DAP + KCl). Additionally, a control treatment for each soil type without fertilizer application was included. A dose of 17.5 g/m of P was applied locally, 5 cm deep in the center of the pot. Treatments were distributed in randomized blocks with 4 replicates. The photosynthetic efficiency of the plants was measured using the MultispeQ device, which assessed parameters such as LEF, Phi2, PhiNPQ, PhiNO, SPAD, qL, vH, gH, and NPQt. Plants grown with nanocomposite-doped fertilizers exhibited distinct photosynthetic response patterns. In general, the effects of nanocomposites on plant photosynthetic efficiency varied depending on the soil type and the specific nanocomposite used, highlighting the behavior of the different nanomaterials and fertilizers in relation to the edaphic characteristics of the cultivation, which directly influenced the crop. Further studies are needed to elucidate the mechanisms of action involved in the nanocomposite-soil-plant relationship.

CARBONACEOUS NANOMATERIAL ENHANCES PHOTOSYNTHETIC EFFICIENCY AND FRUIT PRODUCTION IN MICRO-TOM TOMATOES

Renato Dantas Sabino, Mirella Pupo Santos, Daniel Basílio Zandonadi, Antonio Jesus Dorighetto Cogo

Tomatoes are an economically important vegetable consumed worldwide for their high nutritional value. However, their cultivation faces challenges, such as the excessive use of fertilizers, which can lead to environmental and human health risks. Nanomaterials have been shown to improve fertilizer use efficiency and boost agricultural productivity. This study aimed to evaluate the effect of applying a carbonaceous nanomaterial (C-Dot 02, Krilltech, Brazil) to the roots of Micro-Tom tomato plants on their growth and fruit production. A dose-response curve experiment was conducted to determine the optimal dose for these tomato plants. Six seedbeds with 40 wells each were used, and six different concentrations of the nanomaterial were tested through applications made over several weeks, totaling 12 applications. The study analyzed the fresh and dry mass of the shoot and root of the plants. The optimal dose identified was then used to study the effect of the nanomaterial on fruit production. The productivity of 12 tomato plants from the treatment and control groups was evaluated. The plants were grown in 1 L pots with adequate fertilization. Statistical analyses were performed using GraphPad Prism. The results showed that Micro-Tom tomato plants treated with C-Dot 02 had significantly higher fresh and dry mass compared to the control plants. The treated plants produced more flowers more quickly and generated twice as many fruits. Additionally, the fruits from the treated plants were heavier than those from the control plants. The treatment with C-Dot 02 also helped maintain the effective and potential quantum efficiency of photosystem II throughout the plants' development and delayed senescence compared to the control plants. Overall, C-Dot 02 proved to be an effective product in promoting plant health and increasing production, contributing to safe and sustainable agricultural practices.

CARBONACEOUS NANOMATERIAL REGULATES ROOT AND LEAF GROWTH OF *Arabidopsis thaliana*

Nathália Souza Teixeira, Antônio Jesus Dorighetto Cogo, Daniel Basílio Zandonadi

Nanotechnology is among the new approaches to improving nutrient use efficiency in agriculture. This study aims to investigate the effects of the carbon-based nanomaterial Arbolina® on the root and leaf development of Arabidopsis thaliana. A. thaliana Columbia-0 plants were treated with different concentrations of Arbolina® (0; 2.5; 5; 10 and 20 mg/L) in ½ strength MS medium and 1,5% agar, and evaluated for root and leaf growth. Germination occurred in a growth chamber with a 18h light/6h dark photoperiod at 22°C. After 14 days of treatment, the length of the main root, the number of lateral roots and the leaf area were analyzed using ImageJ™ software. Results from two independent experiments indicated that the number of lateral roots and leaf area increased significantly at 2.5, 5 and 10 mg/L of Arbolina®, while no difference was observed at 20 mg/L. The primary root length was not affected by the doses that increased the number of lateral roots, but it was reduced at 20 mg/L. Since the 2.5 mg/L concentration provides the highest lateral rooting among the concentrations and also increases leaf area, this concentration will be used for the next steps of this investigation: differential expression analyses and protein localization involved in mineral nutrition and plant growth pathways. The study demonstrates the potential of carbon-based nanomaterials in promoting root and leaf growth in plants, and the details of the mechanisms involved in the observed stimuli will be further investigated.

Challenges and Perspectives of Hops Cultivation in Brazil: A Systematic Review

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Hops cultivation in Brazil has been expanding in recent years, although it still faces significant challenges due to climatic conditions. Traditionally grown in temperate regions, hops need genetic adaptations to grow in areas with tropical and subtropical climates. It is estimated that the country has about 42 hectares of plantation, with 35 hectares belonging to producers associated with Aprolúpulo, the main entity of hop producers in Brazil (Agroclima). Among the main challenges is the high humidity, which favors the development of fungi, and the high temperatures, which hinder the growth of traditional hop varieties. However, studies suggest that the south of Brazil has a relatively favorable climate, comparable to that of European growing regions (Lamas Brew Shop). In addition, practices such as the use of controlled irrigation and the choice of more resistant varieties have shown promising results. Adopting sustainable agricultural practices, such as proper soil and water management, is key to increasing productivity and reducing environmental impact. In addition, the photosynthetic capacity of hops can be enhanced in conditions of increased CO_2, improving the production of lupulin, an essential compound for beer (Agroclima). With the support of specialized associations and consultancies, the sector is growing, attracting new producers and research aimed at adapting varieties to the Brazilian climate.

Changes in yield of peanut plants are interlinked with ethylene and planting depth

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Peanut (Arachis hypogaea L.) is an oilseed crop of great economic importance due to the high nutritional quality of its seeds. Seed germination and seedling emergence are critical stages for maintaining peanut yield in the field, which are regulated by factors such as soil moisture, aeration, and temperature. Furthermore, due to temperature variations in the soil profile, planting depth can affect ethylene production during germination, influencing post-germination growth and crop yield. This study evaluated root and hypocotyl growth, as well as the yield response of two peanut cultivars at different planting depths, with a focus on ethylene biosynthesis. The research was conducted at the Teaching, Research, and Extension Unit of Federal University of Viçosa, using peanut seeds of the cultivars 'Tatu-53' and 'IAPAR 25', sown at depths of 1.0, 2.5, 5.0, 10, or 15 cm. Ethylene production, gene expression, morphological, and anatomical characteristics as well as yield were measured. Shallow planting depths (1.0-2.5 cm) increased ethylene production but reduced the shoot/root ratio due to higher soil temperatures near the surface. Deep planting (10-15 cm) decreased ethylene production but increased the shoot/root ratio. In both cases, yield was lower than at a depth of 5 cm. Increasing planting depth increased hypocotyl cell length while decreasing the number of cells per area. The expression of ethylene-related genes decreased with increasing planting depth. The 5.0 cm depth offset the negative effects of shallow and deep planting, as ethylene levels at this depth allowed for a functional balance between shoot and root, promoting more evenly distributed growth and avoiding adverse effects on yield. It was concluded that ethylene alters the shoot/root balance in both shallow and deep planting, negatively impacting initial post-embryonic development and long-term peanut yield.

CHARACTERIZATION OF A MINIATURE MODEL FOR SOYBEAN (GLYCINE MAX) RESEARCH: MINIMAX

Hendril da Silva Lopes, Phelipe Henrique Costa Miranda, Caio Balarini, Gabrielli Marques, Karla Gasparini, Edgard Toledo Picoli, Maximiller Lamas Costa, Agustín Zsögön

Model organisms are extremely important for the validation of concepts, ideas, and research. The use of miniature plant organisms, such as Arabidopsis thaliana and Solanum lycopersicum cv. Micro-Tom, has greatly contributed to research in plant biology. However, this approach has not been followed in soybean research. Here, we demonstrate that the miniature soybean cultivar MiniMax has several valuable characteristics that make it a good model for soybean studies. We conducted bioassays in a greenhouse, comparing MiniMax with the established soybean model cultivar Williams 82. We found that MiniMax requires only 55 days to complete its cycle compared to Williams 82 (90 days). Additionally, plant height (29.26 cm ± 1.36 vs 44.24 cm ± 1.80), and stem diameter (2.64 mm ± 0.07 vs 3.35 ± 0.05), make the architecture of MiniMax favorable for soybean research. Moreover, photosynthesis rate (A) was very similar between MiniMax (21.24 ± 0.55) and Williams 82 (22.79 ± 0.43), and so was stomatal conductance (gs) (0.36 ± 0.01 vs 0.43 ± 0.03). Our results demonstrate that many of the expected architectural traits for a good physiological model are present in MiniMax, including earliness, small size and gas exchange parameters. We anticipate that our results will provide the foundation for the use of MiniMax in studies of gene regulation and characterization, as well as in the identification of new genes of interest for soybean cultivation. Thus, MiniMax is seen as a potential model for legume research.

Characterization of Theobroma cacao L. Leaves in Western Bahia

Carlos Thiago Ferreira da Silva Santos, Verônica Jayne Carvalho Idalino, Ana Maria Mapeli, Paulo Cesar Lima Marrocos

As the demand for Theobroma cacao L. (cacao) products increases, there is a growing need to extend cultivation to non-traditional regions, such as the Cerrado. However, there is limited research to guide cacao management in these novel environments. This study aimed to evaluate the performance of cacao cultivars in Riachão das Neves, Western Bahia. The research was conducted at BioBrasil farm from October 2022 to September 2023, involving cacao cultivars PS1319, PS40.7 and BN34, all grown under full sun. Growth characteristics, phenology, and leaf composition were evaluated monthly. Data analysis revealed that all cultivars exhibited larger stem diameters in May 2023. Leaf flushing, flowering, and fresh and dry leaf mass remained consistent throughout the rainy season, regardless of the cultivar. In July 2023, BN34 exhibited the smallest leaf area, while PS1319 and PS40.7 showed reduced leaf areas in August, which coincided with the period without precipitation. Regarding chlorophyll a, b, and total content, BN34 cacao leaves showed no significant differences among cultivars; however, carotenoid content varied during the dry season, with increases noted in PS1319 and PS40.7 during the rainy season. The highest levels of total soluble sugars, reducing sugars, and non-reducing sugars in the leaves were observed during the rainy season. In conclusion, the findings suggest that cacao cultivation in Western Bahia shows significant productive potential, allowing for the expansion of cultivation areas.

Chitosan hydrogel effects on germination and phenolic composition on Moringa oleifera

Mel Brandão e Franco, Fernanda Carlota Nery, Luiz Gustavo de Lima Guimarães, Graciene Silva Mota, Stephanne Yonara Barbosa de Carvalho, Rafaela Ribeiro de Souza

Recent studies had been developed to ensure the economic viability of plants secondary metabolites production, with procedures focused on enhancing the compounds biosynthesis. Chitosan is a biopolymer considered an important biologic elicitor with natural, non-toxic, biodegradable, biocompatible, antimicrobial and polycationic properties, besides biochemical features similar to plant cells. On that perspective, this study analyzed chitosan hydrogel effects on Moringa oleifera seeds germination and phenolic composition. The hydrogel synthesis methodology was determined by DIVYA et al. (2018). The seeds were collected from trees and pre-soaked with 0.5; 1.5; e 3.0 mg mL-1 chitosan hydrogel solutions for a 24 hours period, apart from the control, soaked with distilled and autoclaved water, for the same amount of time. Seeds were than induced to germination on Germitest® substrate paper at a 25ºC temperature. The treatments were constituted of 3 replicates with 10 seeds wich, being calculated the percentage of germination (%G), normal plants (%PN), abnormal plants (%PA) and germination speed index (IVG). Methanolic extracts were obtained from the plants and used to quantify phenolic composition by spectrophotometry method and expressed as equivalent acid gallic (EAG) mg g-1 per plant. As results, the chitosan hydrogel treatment did not presented significant effects on seed germination, achieving an average of 76.67±3.83%G, 46.67±4.81%PN, 25±2.88%PA and IVG of 0.42±0.11. Phenolic content was increased on the studied chitosan hydrogel concentrations, being the higher EAG 89.44±15.8 at 3.0 mg mL-1 concentration and the lowest EAG 64.10±5.3 at the control treatment. It is concluded that chitosan hydrogel acts as a potential elicitor for phenolic compounds synthesis on Moringa oleifera plants.

COMBATING REACTIVE OXYGEN SPECIES BY REDOX METABOLISM PROTEINS THROUGHOUT GRAPE BERRY RIPENING

Luan Cordeiro Corrêa, Eduardo Monteiro, Roberta Pena Paschoa, Vanildo Silveira, Ricardo Bressan-Smith

The ripening of grape berries leads to the decline of physiological functions in mesocarp cells, generating reactive oxygen species (ROS) primarily from aerobic respiration, resulting in oxidative damage and cell death. Cellular mechanisms mitigate the damage caused by ROS by means of enzymatic antioxidants such as catalase, superoxide dismutase, glutathione reductase and peroxidase (among others directly or indirectly), and non-enzymatic antioxidants (ascorbate, glutathione, polyphenols and carotenoids). Based on this, we aimed to study the accumulation profile and enzymatic activity and its antioxidant actions to understand how mesocarp cells face up to reactive oxygen species (ROS) in three stages of the berry development – pre-veraison, veraison and post-veraison. By means of proteomic analysis, we identified 1,434 proteins, from which 956 were differentially regulated through the different stages, each with distinct roles in biological processes. Specifically, Catalase (CAT), Aspartate peroxidase (APX), and Peroxidoredoxin (Prx) act against ROS at the initial stage of development. CAT increases its activity, just as Superoxide dismutase (SOD), both acting against ROS at the final stage of ripening. NADPH was constantly supplied at all stages of ripening, being generated by Glucose 6-phosphate dehydrogenase (G6PDH) and Isocitrate dehydrogenase (ICDH), helping to prevent oxidative damage due to the reducing power in antioxidant reactions of Prx at the initial stage of development. In the ripe berry, NADPH generated by 6-phosphogluconate dehydrogenase (6PGDH) was involved in the regeneration and maintenance of ascorbate cycling, through the activity of Glutathione reductase (GR) in the final stage. This allowed the cells of the berry mesocarp to preserve the redox activity throughout the ripening process, in which the generation of ROS did not cause relevant cellular damage in the advanced stages of ripening.

COMBINED EFFECT OF MICROORGANISM INOCULATION SEED TREATMENT OF EMERGENCE OF EARLY SOYBEAN PLANTS

Victor Vicentin Bentes, Daniela Carrijo, Larissa Correia, Navdeep Kaur, Manoj Paudel, Savannah Jean Harman

Planting soybeans early in Pennsylvania can be a strategy for establishing a second winter crop and the use of microorganisms or N fertilization could mitigate the adverse effects of low temperatures on seedling development. This study aimed to investigate the combined effect of microorganism inoculation in treated seeds and nitrogen (N) fertilization on the performance of soybean plants at two planting times. The soybeans planting the date 04/23/2024 with highest population-336000 seeds/acre of early maturing group. Treatments were a full factorial (20 treatments total) arranged in a split-plot design with five replications. Main plot was planting time with the first planting time (i.e., early planting) representing stressful conditions in which the air and soil temperatures were low, and the second planting time (i.e., normal planting) representing ideal conditions of air and soil temperature. The split-plot was a combination of six biological seed treatments, two N fertilizer sources, and two controls: I-absolute control (untreated), II-control (treated with fungicides and insecticides but not biologicals), III- Bradyrhizobium japonicum, IV-urea, 20 lb/ac N, V- AMS, 20 lb/ac N, VI-Protivate seed treatment, VII- Fertiactyl ST liquid, VIII- Biobuild Soy BioST+R, IX- Biotrinsic M34+N13+E13, X- Symvado ST split. Soybean seeds were treated with microorganisms before planting and N (ammonium or urea) was broadcast immediately after planting. Each block received one soil sensor for continuous temperature and moisture measurements. The soybean started germinating 14 days after planting, and emergence rate was monitored for 22 days after the first plants emerged. Emergence rates were not significantly affected by treatments.

DIFFERENT NITROGEN SOURCES AFFECT THE GROWTH AND METABOLISM OF CITRUS PLANT

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Nitrogen (N) influences chlorophyll biosynthesis and plant tissue growth. The form in which N is supplied [nitrate (NO3-) or ammonium (NH4+)] influences plant growth and metabolism. The literature reports that citrus plants are sensitive to high NH4+ doses, which can lead to lower biomass production and damage to the photosynthetic apparatus. The nitrate reductase (NR) is an important enzyme involved in the N assimilation, reducing NO_3- to nitrite (NO_2-). The objective of this study was to evaluate the effect of applying the N sources ammonium sulfate [$(NH_4)_2SO_4$] and calcium nitrate [$Ca(NO_3)_2$] on the growth and metabolism of Rangpur lime (Citrus x limonia) plants. We tested the hypothesis that the N supply, exclusively NH4+, can cause toxic effects in citrus plants. The study was conducted with Rangpur lime plants (1 month old), in a growth chamber, in a completely randomized design, with five treatments, varying the N sources: 100% NH_4^+, 75% NH_4^+ : 25% NO_3^-, 50% NH_4^+ : 50% NO_3^-, 25% NH_4^+ : 75% NO_3^-, and 100% NO_3^-, with four replicates, keeping the concentrations of the other nutrients constant. After 30 days of experimental conduction, analyses of the NR activity, SPAD index, and shoots and roots biomass production. The data were submitted to ANOVA and, in significant cases, were submitted to the Tukey test (a = 5%). The supply of 50% NO_3^- favored the NR activity and contributed to a higher shoot biomass production in relation to the other treatments. No differences were observed between the treatments for roots biomass production and the SPAD index. Therefore, the supply of 50% NH_4^+ : 50% NO_3^- may favor the NR enzyme activity and shoots biomass production in citrus plants. These results open the way for new studies on the effects of different N proportions and their impact on the citrus plants metabolism.

DOSES OF BIOSTIMULANT, Ascophyllum nodosum, ON THE GERMINATION OF Zea Mays

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Corn (Zea mays) is a crop of great socioeconomic importance in many regions of Brazil, and several strategies have been developed to induce plant development. One such strategy is the use of biostimulants, which not only promote plant growth but also increase nutritional efficiency. However, many products in Brazil lack proven bioactivity. Biostimulants derived from Ascophyllum nodosum are known to induce tolerance to environmental stresses and promote root development, but the optimal dose depends on the raw material source and industrial processing. The objective of this study was to evaluate the effect of different doses of a commercial Ascophyllum nodosum-based product on corn germination and development. The experiment was conducted in a B.O.D. germination chamber, following the Rules for Seed Analysis (RAS) in a completely randomized design (CRD) with 5 treatments and 4 repetitions of 50 seeds each. Doses tested were 0 (control), 15, 30, 45, and 60 mL kg^{-1} of seeds. On the fourth and seventh days, germination percentage, normal and abnormal seedlings, and the length of the epicotyl and primary root were evaluated. The Vigor Index was calculated using the formula: VI = (Epicotyl Length + Primary Root Length) x % Germination. Analysis of variance was performed, and means were subjected to polynomial regression analysis at a 5% error probability. There was a significant decrease in germination, radicle length, vigor index, and epicotyl length on the seventh day following a linear regression model. Epicotyl length on the fourth day required a quadratic model, and normal and abnormal seedlings required a cubic model. The study concluded that the evaluated doses of the Ascophyllum nodosum-based biostimulant inhibited corn seed germination and development. However, it is recommended to study doses lower than 15 mL kg^{-1} to possibly identify positive effects on corn germination and seedling formation.

Dynamics of carbon flux in a eucalypt plantation in the Brazilian Cerrado

José Darlon Nascimento Alves, Aristides Ribeiro, Yhasmin Paiva Rody, Rodolfo Araujo Loos

The dynamics of land use of the Cerrado has resulted in a larger degraded area, and recently there has been a significant increase in eucalypt plantations. This dynamic in land use promotes changes in carbon uptake rates. Despite the importance of analyzing these changes, few eddy covariance studies are dedicated to understanding these alterations in the Cerrado. Thus, the study's main objective was to analyze the magnitudes of carbon flux over the hydrological years. The experiment was carried out in a young commercial plantation of Eucalyptus urograndis clone (from 0.3 to 3.3 years of growth) during three hydrological years (2015-2018). An eddy covariance system (EC) was used to measure the CO2, and water vapor concentrations. Next, the carbon flux data was partitioning into gross primary production (GPP) and ecosystem respiration (Reco) by using the online tool REddyProc belongs to the Max Plank Institute for Biogeochemistry. Daily net ecosystem exchange (NEE) ranged from -30.4 to 7.9 g C m-2 d-1 with an average of -1.9 (± 3.3) g C m-2 d-1. During the three hydrological years, the eucalypt plantation acted as a carbon sink with accumulated NEE of -149.4 (±20), -1057.5 (±24), and -821.4 (±44) g C m-2, in the first, second, and third hydrological year, respectively. The maximum value of GPP was 34.7 g C m-2 d-1 with an average of 9.8 (±3.9) g C m-2 d-1. The accumulated total GPP over the entire experimental period was 10.764 g C m-2 d-1. Reco ranged from 1.1 to 20.4 g C m-2 d-1, with an average of 8.0 (±4.0) g C m-2 d-1 and the total accumulated over the three years of 8.376 g C m-2 d-1. In general, the replacement of degraded areas by eucalypt plantations has increased carbon fixation in biomass, contributing to reducing the climate change effect.

Ecophysiological traits of hop cultivars (humulus lupulus l.) with different leaf chlorophyll concentration

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Over the years, much has been discussed about reducing greenhouse gas emissions, with the aim of reducing the evolution of the effects of climate change. However, reducing the aerosol load in the atmosphere can lead to an increase in solar irradiance, which can cause the air to heat up and increase the evaporative demand of the atmosphere, a scenario that favors the occurrence of more frequent heat waves. Sustainable and effective strategies for managing solar radiation are therefore essential, such as increasing the surface albedo of geographical areas through the use of plants with low chlorophyll concentration. However, up to a certain limit, reduced concentration of total leaf chlorophyll in the leaves can cause a reduction in net CO_2 assimilation rate. This study aims to verify the difference between two hop cultivars with different green leaf color [pale-green leaf ('Comet') (SPAD index=44, chlorophyll (a+b) = 434.7 µmol $m^{-2}s^{-1}$)) and dark green-leaf ('Chinook')(Spad index=52, chlorophyll (a+b) = 560.9 µmol $m^{-2}s^{-1}$), on photosynthetic capacity, growth and yield grown. Thus, growth, leaf pigment and gas exchange analyses were carried out, as well as yield. The experimental design used was randomized blocks, with two cultivars, 4 blocks (each block containing 5 plants of each cultivar), and total of 40 plants. Both cultivars showed no difference in net CO_2 assimilation rate and yield. In addition, the 'Chinook' cultivar had higher gs values at midday, which led to higher E values, and 'Comet' had more water use efficiency. Thus, the reduction in chlorophyll content in the pale-green leaf 'Comet' is not enough to reduce net CO_2 assimilation rate and yield.

EFFECT OF "SOIL-PLEX ROOT™" ON RADISH (Raphanus sativus) GROWTH

MARCOS ANTONIO CEZARIO DIAS, André Lucas Reboli Pagoto, SARA DOUSSEAU ARANTES, BLIANE MOROZINI BACHETI, MARIA ESTER LENZI DE SOUZA

This study aimed to evaluate the effects of the biostimulant "Soil-plex Root™" on the growth and development of radish plants (*Raphanus sativus*), focusing on five different dosages. Various growth parameters were assessed, including the number of leaves, dry and fresh mass of leaves and roots, SPAD index (indicative of chlorophyll content), bulb diameter, and dry and fresh mass of the bulb, as well as root length. The experiment was conducted at the Capixaba Institute for Research, Technical Assistance, and Rural Extension (INCAPER), using 20 dm^3 pots with commercial substrate and a completely randomized design. The results revealed that specific doses of "Soil-plex Root™" significantly influenced plant growth, promoting a marked increase in vigor and overall development. The maximum leaf area was observed with a dosage of 0.0412 cm^3 per plant, suggesting enhanced photosynthetic capacity and potential biomass production. The fresh bulb mass reached 4.7511 g at a dosage of 0.048 cm^3 per plant, indicating a substantial positive effect on bulb development. Similarly, root dry mass increased to 0.3825 g at a dosage of 0.0477 cm^3 per plant, reflecting improved root growth and nutrient absorption capacity. Additionally, the SPAD index, which increased with higher doses of the biostimulant, indicated improvements in chlorophyll production and, consequently, in photosynthesis. While root length and bulb diameter showed no significant differences between dosages, the overall improvement in leaf and root biomass suggests that "Soil-plex Root™" effectively promotes radish growth under the tested conditions. This biostimulant may be a promising tool to optimize agricultural productivity and quality, with positive impacts on yield and potential for various cultivation conditions.

Effect of 2,4-D on Callus Induction in Immature seeds of Paubrasilia echinata

Mayla Bessa Scotá, Gustavo Fernandes Mariano, Aline dos Santos Bergamin, Claudete Santa-Catarina, Elias Terra Werner

Plant tissue culture is as a tool for the clonal propagation of threatened plant species such as Paubrasilia echinata (brazil-wood). An alternative for the conservation of this species is the induction of embryogenic callus, being the first step towards efficient indirect somatic embryogenesis for the regeneration of new somatic plantlets. The objective of this study was the in vitro induction of embryogenic callus from immature seeds. Brazilwood fruits with 5 weeks after flowering were washed with running water and neutral detergent, immersed in 70% alcohol for 1 minute, and then in 100% sodium hypochlorite (active chlorine: 2.5%) with the fungicide Manzate® (1g L-1) for 1 hour with constant agitation. Then, fruits were then washed 10 times with autoclaved distilled water in a laminar flow chamber. Following, fruits were opened, seeds were removed and halved, and the part containing the embryo was inoculated on

Petri dishes containing MS culture medium with different concentrations (0, 100 and 200 µM) 2-4,dichlorophenoxiacetic acid (2,4-D). After 15 days the inoculation, all seeds were subcultured onto Petri dishes in freshly MS culture medium. After 30 and 45 days, the percentage of contamination and callus induction were evaluated. The disinfection method used was highly effective, with contamination rates remaining below 7%. Callus induction was faster in culture media containing 100 µM 2,4-D, with an average of 50% and 76% at 15 and 30 days, respectively. Therefore, the combination of MS culture medium with a pulse of the 2,4-D for 15 days was efficient to inducing callus formation in a shorter period in P. echinata.

EFFECT OF A SYNTHETIC BACTERIAL COMMUNITY ON GROWTH PROMOTION IN SOYBEAN PLANTS (Glycine max L. Merr.)

Gabriela Azevedo Alves Souza, Gabriela Petroceli Mota, Rafael Ribeiro Chaves, Fabio Lopes Olivares

Brazilian agriculture is a crucial sector for the national economy, but it faces significant environmental challenges due to the intensive use of polluting and non-renewable chemicals. The search for more sustainable production systems has become urgent in order to mitigate the negative impacts caused by traditional practices. Although there is growing interest in co-inoculation, a technique that consists of combining two or more microorganisms in order to promote plant growth, there are still few studies exploring these combinations for joint application in the field. Understanding the complex interactions between microorganisms in communities remains a significant challenge. The general objective of this study is to analyze the effect of a bacterial consortium composed of Azospirillum brasilense, Herbaspirillum seropedicae and Paraburkholderia silvatlantica on the growth and development of BRS 7781 soybeans co-inoculated with Bradyrhizobium. The experiments were conducted at the Cell and Tissue Biology Laboratory at UENF. Four isolates of endophytic diazotrophic bacteria were used. The tests included analysis of in vitro compatibility, growth kinetics and the effects of inoculation on soybean plants, using morphometric and photobiological parameters. The data was analyzed using ANOVA. The results indicated compatibility between the selected bacteria, with no antagonism. The photobiological analyses showed that the parameters measured did not differ significantly between the treated groups and the control groups, except for the proton flow (vH+), suggesting a positive stimulus from the inoculated microorganisms. The analysis of different doses of the microbial consortium also highlighted the importance of the right dosage to maximize efficiency. The study concludes that microbial consortia have significant potential to promote plant growth and increase the efficiency of soybean plants. However, careful consideration of inoculation and dosing strategies is essential. This work contributes to the understanding of microbial interactions and paves the way for the development of more efficient biofertilizers.

Effect of Arbuscular Mycorrhizal Fungi on the Production of Cotton cv. BRS 416

Guilherme Keven Ferreira dos Santos, ANA MARIA MAPELI, Marisangela Viana Barbosa

The cotton crop (Gossypium hirsutum L.) is an important commodity in the agricultural scenario of the Western Bahia region. Therefore, it was necessary to explore alternative methods for the use and management of production areas to ensure soil sustainability and preserve the productivity of the crop. This includes the use of bio-inputs, such as arbuscular mycorrhizal fungi (AMFs), which establish a mutualistic symbiosis with most plants. Thus, the objective of this research was to evaluate the influence of AMF on the growth of cotton plants cv. BRS 416. To this end, cotton plants were cultivated in pots (5L) filled with different types of soil: 1- autoclaved soil; 2- non-autoclaved soil; 3- soil with native AMF multiplied with Brachiaria, both inoculated or not with commercial AMF (Rootella®BR ultra). The pots were kept in a 50% nursery for 60 days, with constant watering. After this period, the following characteristics were evaluated: number of leaves, stem diameter, height, dry mass, number of leaves, total chlorophyll content (SPAD) and total soluble sugar content (TSS). It was observed that height, diameter, number of leaves, number of bolls, shoot dry mass, and total soluble sugars showed no significant differences among treatments, with respective means of 49.8cm, 2.6cm, 8.0, 0.3, 18.1g, and 1.8%. For total chlorophyll content (SPAD) and root dry mass, soil multiplied with Brachiaria containing the inoculant increased chlorophyll content by 7.6% and root mass by 46.6% compared to the other treatments. These results highlight the importance of native soil microorganisms for ecosystem services, contributing to crop development and productivity. Therefore, soil multiplied with the inoculant stands out as the most suitable treatment, showing better results in development, which indicates higher productivity and sustainability of the crop.

Effect of biodigested vinasse on physiological and biometric parameters of sugarcane

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Conventional vinasse is one of the main by-products of the sugarcane industry, and its benefits for sugarcane development are well known. In recent years, vinasse has also been used in the biodigestion process for biogas production, generating a new by-product, biodigested vinasse. However, the effects of biodigested vinasse on the physiological and biometric parameters of sugarcane are still poorly understood. The objective of this study was to evaluate the effects of biodigested vinasse (BV) compared to conventional vinasse (CV) on the physiological and biometric parameters during the early development of sugarcane. The study was conducted under greenhouse conditions in a 2x2 factorial design with eight replications, evaluating two water conditions (irrigated and deficit) and two types of vinasse (conventional and biodigested). The RB975242 variety was used and grown in 20 L plastic pots for a period of 112 days. Three water suspensions were performed during the cycle. Physiological and biometric parameters were evaluated. Water deficit reduced net CO2 assimilation, transpiration, plant height, leaf area, and stalk biomass. Regarding vinasse management, no differences were observed between CV and BV in terms of leaf gas exchange. Under water deficit conditions, BV increased the soluble sugar content in leaves, as well as leaf length and width. Overall, sugarcane development was similar with the use of both conventional and biodigested vinasse, with biodigested vinasse emerging as a sustainable by-product for sugarcane cultivation. BV management showed a tendency to increase some biometric parameters (leaf area and stalk biomass); therefore, further studies are needed to deepen the understanding of BV's effects on sugarcane development.

EFFECT OF EXOGENOUS APPLICATION OF VITAMINS ON PEPPERS EXPOSED TO IRRIGATION WITH SALINE WATER

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The exogenous application of vitamins can help to promote plant growth and mitigate the effects of abiotic stress factors. Therefore, the aim of the study was to evaluate the effects of the application of B vitamins in peppers plants exposed to saline irrigation. A completely randomized design with five treatments and four replicates was used. The treatments were: Control; irrigation with water without vitamin addition; irrigation with saline solution without vitamin addition; irrigation with saline solution and application of vitamin thiamine (NaCl+B1); irrigation with saline solution and application of vitamin niacin (NaCl+B3); and irrigation with saline solution and application of vitamin pyridoxine (NaCl+B6). The use of saline water during irrigation had a significant effect on the traits of net photosynthesis, water use efficiency and instantaneous carboxylation efficiency compared to the control treatment irrigated with water, whereas there were no differences in the traits of transpiration and relative chlorophyll content. However, administration of thiamine, niacin and pyridoxine mitigated the effects of salinity on net photosynthesis and instantaneous carboxylation efficiency traits and significantly increased transpiration compared to the saline-water irrigated only treatment. For variable plant height, the control treatment outperformed the other saltwater-irrigated treatments. Although the same treatment also excelled in stem diameter and dry weight of the aerial part, it was found that in the saltwater-irrigated treatments, the application of niacin was superior to thiamine and pyridoxine, while there was no difference in the saltwater-only treatment without the application of vitamins. It was concluded that exogenous administration of vitamins mitigates the effects of saline irrigation in bell pepper seedlings by reducing the effects of stress on the photosynthetic mechanism and increasing leaf chlorophyll content. Niacin may be indicated to reduce weight loss in above-ground organs.

EFFECT OF GROWTH REGULATORS AND SUCROSE CONCENTRATION ON IN VITRO DEVELOPMENT OF CYRTOPODIUM FLAVUM (ORCHIDACEA)

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Plants of the genus Cyrtopodium (Orchidaceae Family) are propagated in vitro mainly by protocorm-like bodies (PLB), which allows their rapid and large-scale propagation. However, Cyrtopodium flavum, an orchid native to Brazil with ornamental potential, has a low rate of PLB differentiation in plants, which limits its micropropagation. This study aimed to evaluate the effect of the concentration of 6-benzylaminopurine (BA), 1-naphthaleneacetic acid (NAA) and sucrose on the differentiation of PLB in plants. For this, one PLB was inoculated in a tube with 15 mL of MS medium, 6 g/L of agar and 2 g/L of activated carbon. To evaluate the effect of plant growth regulators (PGRs), the culture medium was supplemented with 30 g/L sucrose and BA (0.00, 4.44 or 8.88 µM) combined with NAA (0.00, 5.37 or 10.70 µM), in a 3x3 factorial scheme. To evaluate the effect of sucrose concentration, the PGR-free medium was supplemented with 30, 15 or 7.5 g/L sucrose, in a completely randomized design. The cultures were maintained at 25ºC, in the dark for the first 7 days, and then subjected to 16 hours/light for 100 days. Both experiments had 5 replicates of 2 samples with the data submitted to ANOVA and the means compared by the Tukey test at 5% probability. Interaction between PGRs was observed. Increasing the concentration of PGRs reduced the number of PLB and the absence of PGRs was the best treatment (3.8 PLB), but there was no statistical difference in the number of plants produced (0.3 to 0.8). An increase in the number of PLB and plants was observed with decreasing sucrose concentration, with the best result being its lowest concentration (2.9 PLB and 0.9 plants). The treatments allowed the multiplication of PLB, but additional studies with other PGRs and carbon sources are needed to increase their differentiation in plants.

EFFECT OF HIGH CONCENTRATION OF CARBON DIOXIDE ON SIZE OF TOMATO FRUIT

Thaline Martins Pimenta, Genaina Aparecida de Souza, Lubia da Silva Teixeira, Agustin Zsögön, Dimas Mendes Ribeiro

Fruit growth is regulated by carbon availability, so the elevated atmospheric carbon dioxide concentration (eCO2) has the potential to alter tomato fruit size. The aim of this study was to test the hypothesis that eCO2 plays an important role in fruit growth by altering the expression of EXP genes during fruit development. Tomato seeds (Solanum lycopersicon L. cv Tetéia) were sown in pots containing commercial substrate and grown in open-top chambers under ambient (aCO2, 410 ± 20 µmol mol^{-1} air) or eCO2 (650 ± 50 µmol mol^{-1} air) conditions. The equatorial fruit diameter was measured every 3 days from 5 to 45 days after anthesis (DAA). To analyze the dynamics of fruit growth, three-parameter Gompertz functions were fitted on fruit diameter measurements. Transcript levels were analyzed by qRT-PCR in pericarp samples. Histological analyses of pericarp samples were conducted using light microscopy. The eCO2 increased the fruit diameter starting at 10 DAA compared with aCO2. Growth was associated with improved accumulation of EXPA3, EXPA5, EXPA6, EXPA8, EXPA12 and EXPA24 transcripts in tomato fruit pericarp tissues at 17 DAA. Growth analyses revealed that fruit diameter and maximal rate of fruit expansion increased by 20% in tomato plants grown under eCO2 compared with aCO2 at the end of experiment. However, the duration of fruit expansion was not affected by eCO2. Additionally, histological analyses indicated that pericarp cell area increased by 22% and cell number per area decreased by 21% in tomato fruit pericarp under eCO2 compared with aCO2. This study highlights the potential role of eCO2 in increasing fruit size by providing carbon for cell expansion, positively regulating the expression of EXP genes in fruits.

EFFECT OF NEIGHBORS AND ENVIRONMENTAL CHANGES ON SOYBEAN-CORN RELATIONSHIPS AND RESOURCE STRATEGIES

Luis Felipe Basso, Douglas Antônio Posso, Helena Chaves Tasca, Nicolas Xavier de Castro, Rafaela Nunes Deves, Gustavo Maia Souza

Plants are sessile organisms that have adapted to perceive a wide range of environmental stimuli to ensure their survival, modulating their responses when stressful factor are present, as well in the presence of plant neighbors. They constantly interact with their surroundings, sensing and interpreting cues, including from other plants, to optimize resource finding and allocation. Belowground, plants have sophisticated mechanisms to distinguish between their own roots (self-discrimination) and those from other plants (non-self-discrimination). Plants can identify genetic variations from neighbors and respond differently based on species surround them, considering whether they are clones, half-siblings, or from the same population. This study investigated the behavior of soybean and maize plants with conspecifics or heterospecific interactions under soil salinity conditions. Soybean and maize plants were cultivated in pots filled with sand supplied with nutrient solution. The treatments consisted of exposing plants to solitary, conspecifics, and heterospecific neighbors in interaction with either freshwater or saline solution stimulus. Key observations included shifts in biomass allocation between roots and aboveground parts, root proliferation, and physiological parameters related to photosynthetic efficiency and water status. The findings revealed that plant behavior is influenced by the presence of neighbors, regardless of environmental conditions. However, morphological and physiological parameters demonstrated significant differences for plants in the presence of neighbors and under the influence of salinity in comparison to solitary plants in the same condition. Furthermore, the interaction between soil salinity and the identity of neighboring plants was significant when observing the number of leaves in both species. Despite these insights, the parameters measured were insufficient to fully determine whether plants engaged in competition, cooperation, or facilitation in intra- and inter-specific interactions. Further research is needed to elucidate the complex strategies plants use when facing neighbors under adverse conditions.

Effect of osmopriming on the germination parameters of Rapanea ferruginea

Liliana Andrea Ramírez Franco, Milena Tales de Oliveira, Geovane da Silva Dias, Elisa Monteze Bicalho

Rapanea ferruginea is a pioneer tree of humid environment, it is indicated for reforestation programs. The use of priming can be used to improved abiotic stress tolerance. This technique is a controlled hydration treatment that allows pregerminative metabolism to proceed, improve seed germination. Some compounds that can be used for priming include methionine and salicylic acid. The aim of this study was to evaluate the germination parameters of R. ferruginea after osmopriming with salicylic acid and methionine. The treatments included control (C), hydropriming (HD), osmopriming with salicylic acid (AS, 1 mM and 2 mM), and methionine (Met, 0.25, 0.5, 0.75, and 1.0 g L^{-1}) applied to the seeds. The imbibition and drying times were 6 hours and 11 hours, respectively, for both hydropriming and osmopriming with AS and Met. After priming, the seeds were disinfected in and then placed in Petri dishes containing two sheets of germination paper. Later, the Petri dishes were placed in germination chambers at 25ºC with a 12-hour photoperiod and 40 μmol photons m^{-2} s^{-1} in a complete randomized design. Germination was assessed daily for 24 days, when the radicle protrusion was >2 mm. At the end of the experiment, the final germination percentage (%G), the germination speed index (GSI), were evaluated. The results indicated no significant differences between the control, hydropriming, and methionine concentrations in the parameters evaluated. However, for %G, there were significant differences between the Met 1.0 g L^{-1} treatment and the AS 1 mM and 2 mM treatments, with values of 99%, 85%, and 81%, respectively. Additionally, the control had a significant difference compared to AS 2 mM (81%). In conclusion, the application of Met 1 g L^{-1} enhanced germinability, unlike the use of AS. This way, the use of methionine can improve seed germination of R. ferruginea seeds by priming.

Effect of salinity on seed germination and seedling development of peanut

Anny Karolinny de França Soares, Deisy Johana Cuellar Lopez, Janaina Renata da Silva, Lubia da Silva Teixeira, Camila Cosenza de Assis, Carla de Souza Almeida, Dimas Mendes Ribeiro

Peanut (Arachis hypogaea L.) is an important legume, being the 13th most important food crop globally. In Brazil, peanut production has tripled in the last decade, with São Paulo accounting for 90% of national production. However, soil salinity can reduce peanut yield, due to its moderate sensitivity to salinity. Salinity can be caused by brackish waters, inadequate use of fertilizers and drainage. Understanding the mechanisms of action of salt stress in peanut under initial growth conditions would help to select more resistant cultivars and avoid the problems caused by salinity. This study evaluated the impact of salt stress on germination and seedling development of peanut cultivars IAPAR25 and Tatu-53. Germination tests were performed and the length and dry mass of the shoot and root, as well as the number of leaves, were evaluated. Seeds and seedlings were treated with NaCl at concentrations of 100, 150 and 200 mM. The results indicated that the germination of IAPAR25 seeds decreased by 8% and 12%, and the germination of Tatu-53 seeds by 45% and 74%, with 100 and 150 mM NaCl, respectively. The germination of Tatu-53 seeds treated with 200 mM NaCl reduced by 89%, while the same treatment promoted a 49% reduction in the germination of IAPAR25. The seedling development was less affected, with a significant impact only on the root length of both cultivars, and on the root dry mass and number of leaves of Tatu-53. It was concluded that the seed germination of both peanut cultivars is more affected by salinity than the seedling development, and the Tatu-53 cultivar is more sensitive to salinity than IAPAR25.

EFFECT OF SILVER NANOPARTICLES ON CALLUS PRODUCTION IN IN VITRO CULTURE OF YERBA MATE

Bruna Zanatta Pereira, Regina Caetano Quisen, Juliana Degenhardt, Ivar Wendling

Somatic embryogenesis is a technique that allows mass production of embryos without gamete fusion. However, despite being the most suitable in vitro technique for cloning Ilex paraguariensis, protocols for the production and regeneration of somatic embryos from explants of this species have not yet efficiently established. Silver nanoparticles (AgNps) have been investigated for their antimicrobial properties, potential to promote cell growth and induce callus formation in plants under in vitro conditions. In this study, it was evaluated the impact of different concentrations of AgNps (2 mg/L, 3 mg/L, and 4 mg/L) on callus formation in explants during in vitro cultivation of Ilex paraguariensis leaf segments. The chi-square analysis focused on the presence of normal and oxidized callus. Although no significant differences were found in the callus induction rate when comparing among treatments, the 4 mg/L AgNps treatment stood out for having the lowest proportion of oxidized callus (33.3%) when compared to the control (66.7%) ($p<0,05$). Thus, despite not significantly increasing the total amount of callus, the 4 mg/L silver nanoparticles treatment demonstrated a specific benefit in reducing callus oxidation, improving the quality of the formed callus.

Effect of the giberellic acid and melatonin on the germination and initial development of Phaseolus vulgaris

Jéssica Patrícia Borges da Silva, Eduardo Augusto Alves

Phytormones are molecules that play a crucial role in plant physiological processes, and the understanding of their action in crops of agricultural and economic interest is of great relevance to plant production. Gibberellic acid (GA3) is an endogenous gibberellin that has various functions in the plant, especially in stimulating seed germination, while melatonin (N-acetyl-5-methoxytryptamine) acts as an antioxidant under stress conditions, particularly in germination. The aim of this study was to evaluate the influence of gibberellic acid (GA3) and melatonin on the germination and initial development of bean seedlings (Phaseolus vulgaris). The experiment was conducted in a laboratory using a completely randomized design (CRD) with five treatments (distilled water, gibberellic acid at concentrations of 250 mg and 500 mg, and melatonin at concentrations of 250 µM and 500 µM) and four replications, with 50 bean seeds. The germination test was carried out for seven days in a germination chamber at 25 °C with a 24-hour photoperiod. Data on germination percentage, root length, shoot length, and seedling dry mass was subjected to analysis of variance (ANOVA), and the means were compared using Tukey's test at a 5% significance level. The use of gibberellic acid and melatonin did not show a significant effect on the germination percentage, root length, and dry mass of bean seedlings compared to the control. However, the application of gibberellic acid (250 and 500 mg) and melatonin (250 µM) to the bean seeds promoted greater shoot growth in the seedlings of this crop. Therefore, it is concluded that gibberellic acid and melatonin have an influence on the aerial growth of bean seedlings.

EFFECT OF THE PHOTOPERIOD ON THE GROWTH AND BULB FORMATION OF GARLIC CULTIVARS UNDER CONTROLLED CONDITIONS

Ketlyn Santos Sousa, Josiel Ferreira Lima, Emily Carolina Duarte Santos, Igor Eli da silva, Luciana Minervina de Freitas Moura, Alan Carlos da Costa, Isabel Rodrigues de Rezende, Caroline Müller, João Subtil da Silva Neto

Garlic, originally from Asia, is a crop adapted to cold climates and long days, where temperature and photoperiod are key factors in its development. Despite being one of the most widely consumed vegetables in Brazil, garlic cultivation faces challenges due to varying climatic conditions. In temperate regions, vernalization is crucial for stimulating garlic bulb formation. This study aimed to characterize the physiological and morphological responses of four garlic cultivars under two different photoperiods, to evaluate the influence of photoperiod on growth and bulb formation, and to investigate the feasibility of cultivation in short-day regions. The experiment was conducted in a growth chamber with photoperiods of 11/13 hours (light/dark) and 13/11 hours (light/dark). The temperature was maintained at 22/18°C (day/night) during the vegetative stage and at 20/16°C near the bulbing stage. Two common garlic cultivars (Amarante and BRS Hozan) and two superior cultivars (Chonan and Ito) were tested. Physiological and morphological analyzes were performed on the plants on the 73 days after planting. The results indicated that the common cultivars had higher values for photosynthesis, stomatal conductance, transpiration, and Ci/Ca ratio under the 11/13 hour photoperiod. However, the 13/11 hour photoperiod resulted in more vigorous sprouting, particularly in the superior cultivars, with increased bulb weight and diameter. The study suggests that further research is needed to evaluate the profitability of growing different garlic cultivars in short-day regions, as temperature also plays a crucial role in bulbing production and quality.

EFFECTS OF A PHYSIOACTIVATOR ON COTTON PLANT GROWTH AND METABOLISM UNDER WATER DEFICIT CONDITIONS

Ana Caroline Pinto Martins, Samuel Gomes de Abreu, Levi Araújo Pinto, Vicente Thiago Candido Barros Alencar, Cesar Marcos Cavalcante Filho, Alexandre Cabral Craveiro, Danilo de Menezes Daloso

Cotton (Gossypium hirsutum L.) is a globally important crop due to its fiber, which is widely used in the textile industry. Brazil, the third largest producer in the world, harvested approximately 3.2 million tons in the 2022/2023 season, with production concentrated mainly in the Cerrado of the Midwest and the Semi-Arid Bahia, where cotton shows adaptability to water deficit (WD). However, climate change has intensified drought periods, challenging agricultural production.

In this context, the present study aimed to evaluate the impact of exogenous application of the product FT-Cotton (Fertsan®) on the acclimation of young cotton plants to water deficit. The study was conducted in a greenhouse located at the Federal University of Ceará. Under controlled greenhouse conditions, plants of the DP1949B3RF genotype were subjected to two water regimes (irrigated and WD), with the application of FT- Cotton or distilled water. After 18 days of WD, the plants were evaluated for biomass accumulation and metabolite profile.

Although no significant difference was observed in the level of primary metabolites between control and FT-treated plants, FT-Cotton promoted significant changes in plant growth under WD. It significantly increased both stem and root dry mass, compared to the control. The percentage of biomass allocated to the leaves was significantly higher in FT than control plants, including under WD. Additionally, the shoot-to-root ratio was significantly lower in plants treated with FT-Cotton under WD compared to the control.

These results indicate that FT-Cotton is effective in optimizing the partitioning of photoassimilates to the roots of cotton plants under WD, which may favor plant acclimation to this condition, given the important role of roots in water uptake.

Effects of combined selenium and cytokinin application on rice grain yield and micronutrient composition

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Cytokinin and selenium (Se) can modulate yield and alter the micronutrient composition of rice grains. However, it is not clear how the combined application of cytokinin and Se affects the yield and nutritional quality of rice grains. This study aimed to evaluate the impact of combined Se and cytokinin application on the reproductive growth and nutritional composition of rice grains. Rice seeds (Oryza sativa L. ssp japonica cv 'Oochikara') were germinated on germitest paper moistened with distilled water to obtain seedlings. The seedlings were then cultivated in plastic pots containing a mixture of commercial substrate and soil. The plants received the following treatment solutions: 0 µM sodium selenate + 0 µM 6-benzyladenine (control), 0 µM sodium selenate + 50 µM 6-benzyladenine, 10 µM sodium selenate + 0 µM 6-benzyladenine, and 10 µM sodium selenate + 50 µM 6-benzyladenine. The sodium selenate solution was applied to the soil once a week, and the 6-benzyladenine solution was sprayed every two weeks on leaves of plants, throughout the experiment. The results revealed that cytokinin increased the net photosynthesis rate and improved key yield parameters of rice, such as the number of grains per panicle, number of grains per plant, grain biomass, and harvest index, regardless of Se availability. Additionally, cytokinin exerted a strong inhibitory effect on micronutrient accumulation in rice grains, and this effect was not reversed by Se fertilization. However, Se accumulation in rice grains was maintained even with cytokinin treatment. This study opens new perspectives for future research on the role of cytokinin and Se in rice grain development and quality.

Effects of explants, benzyladenine and light spectra on in vitro shoot development in Paubrasilia echinata

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The intense deforestation of the Atlantic Forest biome, currently considered one of the five global hotspots, has resulted in the threat of the extinction of several plant species. Among these species, Paubrasilia echinata is threatened with extinction due to intense exploitation over the years to extract its wood and sap. Compared with classical propagation methods, in vitro plant culture can be a viable alternative for producing plantlets and can be applied to conserve the studied species. We aimed to evaluate the effects of explants, cytokinin concentrations and light spectra on the in vitro development of P. echinata shoots and on the change in the profile of polyamines (PAs) and plant hormones. Seedlings from 60 days of in vitro germination were used to obtain apical and cotyledonary nodal segments. The segments were transferred to MS culture medium with different concentrations (0, 0.1, 0.5 and 1 µM) of benzyladenine (BA) and incubated under fluorescent lamp as a control and LED lamps with different combinations of light spectra: white (W), medium blue (mB), blue low (lB), high blue (hB), red (R) and far red (fR). The 0.1 µM BA treatment resulted in greater elongation of shoots, however without significant differences from shoots incubated on control treatment. The W/mB/R/fR LED lamp, with far-red (fR) spectra, resulted in greater shoot elongation, which was related to the highest content of total free PAs and putrescine, as well as the highest content of abscisic acid, 1-aminocyclopropane acid-1-carboxylic acid and BA, and lower salicylic acid content. These are the first results for in vitro propagation of this species using nodal segments, making it possible to obtain in vitro shoots of P. echinata using a combination of light spectra and its interaction with PAs and hormones to stimulate greater shoot elongation.

EFFECTS OF EXPLANTS, IBA, AND ORGANIC COMPOST FROM SEWAGE SLUDGE ON THE DALBERGIA NIGRA ROOTING

Yasmim Almeida Gomes, Renan Carrari-Santos, Gonçalo Apolinário de Souza Filho, Yrexam Rodrigues de Souza Ribeiro, Vanildo Silveira, Claudete Santa-Catarina

Dalbergia nigra is a native species that has been heavily exploited and is currently endangered. The use of biotechnology tools offer significant potential for propagating endangered species. An in vitro propagation system has already been developed for D. nigra, but further research is needed to understand how the position of shoots used as explants affects rooting, as well as the role of auxin and substrates. The organic compost (OC) derived from sewage sludge has been proposed as a potential substrate for rooting. This study aimed to evaluate the effects of explant position, indole-3-butyric acid (IBA), and OC on shoot rooting. Forty-five-day-old shoots (± 6 cm) grown in WPM culture medium supplemented with 2.5 µM benzyladenine were divided into three microcuttings (apical, intermediate, and basal), each ± 2 cm long. The bases of the microcuttings were treated with IBA (0 or 2.5 µM) for 10 s and then transferred to the following treatments: forest substrate + vermiculite (SFV; 1:1; v/v), SFV + OC (3:1; v/v) or SFV + OC (1:1; v/v). After 55 days, the survival (%), the number of roots, the length (cm) of roots, the number of leaves, and the shoot height (cm) were assessed. The shoots from cotyledonary nodal segments showed greater elongation compared with apical shoots. Compared with intermediate and basal microcuttings, apical microcuttings presented higher survival rates (90–95%), greater numbers and lengths of roots, more leaves, and greater shoot heights. These findings are novel for D. nigra and improve the production of plantlets for this valuable species.

Effects of foliar boron application on growth, physiological performance, and antioxidant activity in highbush blueberry (Vaccinium corymbosum) cv. Cargo under Al toxicity

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Boron is essential in blueberry cultivation, promoting cell formation, pollen germination, and pollen tube growth—processes vital for optimal development and fruiting. However, in acid soil this element is deficient affecting the production. Otherwise, aluminum (Al^{3+}) increased in acid conditions and inhibits root growth and nutrient absorption. Blueberry is cultivated in acid soils and a specie commercial and nutritional important, due to its high antioxidant content and health benefits. This study explores the influence of foliar B application on growth, photosynthetic performance, and antioxidant activity of the 'Cargo' blueberry cultivar under Al3+. The experiment included B treatments of 0, 100, 200, and 400 mg L^{-1} at three flowering stages, using a control soils (without Al) and with Al toxicity (≈60% Sat Al). Parameters such as net photosynthesis (Pn), stomatal conductance (gs), transpiration (E), , growth, lipid peroxidation (LP), and total antioxidants (AA) in leaves were evaluated. The results indicated a dose-dependent increase in Pn in control plants in all treatments of B, whereas in Al soil a notable improvement of Pn at 200 mg L^{-1} B was found. Also, growth in stem diameter and large branches was also positively affected, particularly at 200 mg L^{-1} B in Al3+ soil, showing a general improvement in all B treatments in control soil. Meanwhile, total AA in the 'Cargo' cultivar decreased with B application across all treatments, as well as LP, with a significant reduction in 200 and 400 mg L^{-1} of B, showing a decrease of 45% and 32%, respectively. Based on the study results, appropriate boron application, especially at doses of 200 to 400 mg L^{-1} of B, improves growth, photosynthesis performance, and reduces oxidative stress in blueberries grown in soils with Al toxicity.

Effects of selenium and zinc fertilization on the nutritional quality and yield of rice grains

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The deficiency of selenium (Se) and zinc (Zn) in the human diet is a global health problem that can be mitigated by enriching staple crops, such as wheat and rice, with these minerals. However, it is still unclear how the combined fertilization with Se and Zn affects the nutritional quality and grain yield of rice. This study aimed to evaluate the impact of fertilization with Se and Zn on the reproductive growth and nutritional composition of rice grains. Rice seeds (Oryza sativa L. ssp japonica cv 'Oochikara') were germinated on filter paper moistened with distilled water to obtain seedlings. The seedlings were then cultivated in pots containing a mixture of commercial substrate and soil. The plants received the following treatment solutions: 0 µM sodium selenate + 0 µM Zn-EDTA (control), 0 µM sodium selenate + 250 µM Zn-EDTA, 10 µM sodium selenate + 0 µM Zn-EDTA, and 10 µM sodium selenate + 250 µM Zn-EDTA. The sodium selenate solution was applied once a week and the Zn-EDTA solution every two weeks throughout the experiment. Results indicated that Zn application increased the expression of the nitrate transporter OsNRT1.1B, associated with Se transport, in both roots and flag leaves, resulting in higher Se concentration in rice grains. On the other hand, Se supplementation positively affected N, S, Mg, Ca, Fe, and Cu concentrations in the grains, regardless of Zn supply. Additionally, Se fertilization increased cytokinin concentration in panicles, which was accompanied by an increase in the number of grains per panicle, grain biomass, and harvest index. Treatment with Se also modulated the action of cytokinin in the roots, alleviating Zn-induced root growth repression and partially reversing root biomass reduction. Overall, the study revealed that Se and Zn act synergistically to improve the nutritional composition of rice grains and grain yield.

ENHANCEMENT OF COTTON SEED VIGOR THROUGH THE USE OF A PHYSIOACTIVATOR MODULATING THE METABOLIC PROFILE

Alencar, Gomes, Filho, Craveiro

The combination of attributes that enable seeds to establish rapidly and uniformly in the field is known as vigor. Enhancing the vigor of seeds from major crops, such as cotton, remains a significant challenge in agriculture, especially under abiotic stress conditions. Thus, there is a need for new tools that can influence plant physiology to produce more vigorous seeds even in adverse conditions. This study aimed to analyze cotton seeds (Gossypium hirsutum L.) derived from plants that received three foliar applications of the physioactivator FT COTTON®, composed of marine-derived biopolymers, under field conditions. As a control, plants without product application were used. Seeds were collected at the end of the crop cycle, delinting, and subjected to vigor tests and metabolite analyses using gas chromatography (GC). Cotton seeds from plants treated with FT COTTON® exhibited a higher germination and emergence index compared to the control, in addition to demonstrating high germination rates in the accelerated aging test. Metabolomic analysis revealed an increase in crucial metabolites such as glutamate, GABA, proline, and glucose, which are essential for germination, initial growth, and stress response. Therefore, this study indicates that FT COTTON® significantly improves the cotton plant's ability to produce seeds with enhanced vigor, despite the reduction in protein content. Although lipid content remained unchanged, the observed reduction in protein content suggests a redirection of nitrogen towards processes that enhance seed vigor. These findings demonstrate that FT COTTON® is an important tool for improving the production of high-quality cotton seeds by increasing vigor, which consequently leads to higher yields under adverse conditions.

EPIGENETIC AND PROTEOMIC MODULATION DURING SOMATIC EMBRYOGENESIS IN SUGARCANE (Saccharum spp.)

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Sugarcane (Saccharum spp. hybrid) is a crop of significant economic value, widely cultivated for its high sucrose and biomass yield. In this context, somatic embryogenesis represents a valuable approach in sugarcane biotechnology, facilitating efficient micropropagation and enabling genetic transformation. The induction of somatic embryogenesis involves the complex interaction of auxin signaling, stress responses, epigenetic regulation, and metabolic reprogramming. In this study, we present a temporal proteomic analysis combined with Global DNA Methylation (GDM) profiling to investigate the protein-protein networks and GDM changes driving embryogenic callus induction in sugarcane. Immature leaf rolls were collected from 60-day-old plants and used as explants for callus induction with 20 µM 2,4-dichlorophenoxyacetic acid. DNA and protein extractions were performed in triplicate before treatment (explant) and at 7, 14, and 21 days after callus induction. Proteomic profiling identified 1,011 proteins that were differentially accumulated at least at one of the four time points analyzed. These proteins were categorized into different clusters based on their accumulation profiles. Proteins involved in photosynthesis and starch metabolism were down-regulated during callus induction. Conversely, proteins related to embryogenesis, epigenetic regulation, hormone responses, and post-translational modifications were up-regulated during callus induction. Predicted protein-protein networks revealed associations between the TOPLESS protein and auxin response proteins (SKP1, CUL1, and CAND1) in sugarcane somatic embryogenesis. Additionally, auxin response proteins were found to interact with histone deacetylase during embryogenic callus initiation, highlighting the crosstalk between hormone signaling and epigenetic mechanisms. Our results demonstrate an increase in GDM levels during somatic embryogenesis induction. This rise in DNA methylation, observed alongside the changes in protein expression, underscores its crucial role in regulating the embryogenic process and further supports the interaction between hormonal and epigenetic factors. Our study advances the understanding of the molecular mechanisms underlying somatic embryogenesis and identifies targets for improving genetic engineering and micropropagation in sugarcane.

Evaluation of by-product yield and technological applications of wastes from different varieties of mangoes

Eder Dutra de Resende, Alan José Corrêa Manso, Ana Clara Caetano Menditi

The industrial processing of mangoes generates a huge amount of peels and seeds. The use of these by-products can provide economic gain for industries. The peel is source of pectin and the kernel is rich in starch and oil for applications in food industries. This study evaluates three mango varieties most used in agro industries (Tommy Atkins, Palmer and Ubá) with respect to these chemical components of technological interest and the yield of coproducts from peels and seeds. Sixty ripe mangoes of each variety were harvested in a commercial plantation of Laranja da Terra-ES. The fruits were weighed and peeled; removing the pulp adhered to peel and seed, to quantify the proportion of these components. The kernels were quantified after removing the tegument with the aid of scissors. These materials were processed in a tray dryer at 50°C for 24 h and ground in a mill with a 50 Mesh sieve to obtain peel and kernel flours. Yield analyses were performed with 60 replicates, while analyses of peel pectin and starch and lipids in the kernel were performed on composite samples of 12 mangoes, according to the AOAC methodology. The yields and chemical compositions of the peel flour were 2.1 %db, containing 17% pectin (Ubá mango); 1.4 %db, containing 9% pectin (Palmer mango); 1.0 %db, containing 14% pectin (T. Atkins mango). The yields and chemical compositions of the kernel flour were 4.9 %db, containing 48.6% starch and 12.0% lipids in the Ubá mango; 3.7% db, containing 48.1% starch and 7.8% lipids in Palmer mango; 3.0% db, containing 44.3% starch and 8.7% lipids in T. Atkins mango. It is concluded that Ubá mango has greater potential for adding value to industrial by-products due to the higher yield and higher pectin content in the peel and starch and lipids in the kernel.

Evaluation of growth and physiological activity of Hymenaea stigonocarpa Mart., under the influence of arbuscular mycorrhizal fungi

Marisângela Viana Barbosa, Edivânia Muniz De Souza Santos, GRAZIELE DIAS BRITO, CARLOS THIAGO FERREIRA DA SILVA SANTOS, Ana Maria Mapeli

Jatobá-do-cerrado (Hymenaea stigonocarpa Mart.) is a native tree species of great ecological and successional importance, found naturally in the Cerrado vegetation. Represents an important alternative in the diversification of species (seedlings) in programs for the recovery of degraded areas. Seedling production can be enhanced when associated with biotechnology, such as inoculation with arbuscular mycorrhizal fungi (AMF). Thus, the objective of this research was to evaluate the influence of AMF (native and commercial) on the growth and physiological activity of H. stigonocarpa. For this purpose, H. stigonocarpa plants were grown in pots (3.5 L) containing soil: autoclaved; non-autoclaved; and soil with native AMF multiplied with Urochloa, both inoculated or not with commercial AMF (Rootella®BR ultra), in a 2x2x2 factorial scheme with a randomized block design (RBD) and ten replications. Study was conducted at the Federal University of Western Bahia (UFOB), at the Reference Center for Recovery of Degraded Areas (CRAd), Barreiras-BA. Pots were kept in a nursery with 50% shade and 60% field capacity for 180 days. After this period, the following were evaluated: number of leaves, stem diameter, height, dry mass, total chlorophyll content (SPAD) and total soluble sugar content (AST). Data were subjected to analysis of variance and the means compared by the Tukey test at 5%, using the SISVAR program. Observed that the soil with multiplication of native AMF (without inoculation) and the soil with inoculation (not autoclaved) provided the best results for most variables. Except for number of leaves and stem diameter, however, higher values were observed for the total soluble sugar contents for the treatment of the multiplied soil and inoculated with AMF. Result highlights the relevance of native soil AMF, which can alleviate environmental stresses and enhance the establishment of seedlings in degraded areas.

EVALUATION OF STOMATAL CONDUCTANCE IN TWO TREE SPECIES: POROMETER X IRGA

Joseane Santos da Silva, Tayna Poppo Bourguignon, Eronilton Sena Filho, Eduarda Lessa de Araújo de Souza, Wayna Queiroz Trujillo, Fábio Pinto Gomes

Stomatal conductance to water vapor (gs) is a fundamental variable for studies involving leaf gas exchange and its responses to the environment. To measure it, porometers and infrared gas analyzers (IRGA) are used. While IRGA offers accuracy and environmental control, porometers are a practical and affordable alternative. Studies show discrepancies between the methods, especially in unfavorable environmental conditions, suggesting the need for specific calibrations for each species and environment. In order to compare the two equipments, the stomatal conductance was evaluated in fully expanded leaves of two tree species, Inga fagifolia (Ingá) and Jatropha curcas L. (Jatropha curcas) (Jatropha), cultivated in a greenhouse. Measurements were taken between 07:00 – 11:00 in the morning. The equipment used was the IRGA LI6400XT (LICOR, USA) and the SC-1 diffusion porometer (Decagon devices, USA), the latter on the abaxial surface. The evaluations with the porometer were performed during the period of stabilization of the readings with the IRGA, both connected to the same sheet. In both species, the stomatal conductance measured with the leaf porometer (gsPor) was higher than that measured with the IRGA (gsIrg). In Inga fagifolia plants, the values were less than 200 mmol m^2 s^2 and Jatrofha curcas raised values above 300 mmol m^2s^2. The discrepancy between the equipment observed suggests the need for correct calibration of the equipment, and care in the interpretations of the data obtained with them.

EXPLOITATION OF GRAFTING TECHNIQUE ON TOMATO PRODUCTION UNDER WATER SHORTAGE CONDITIONS

Nicolas Al Achkar, Hajer Ben Ammar, Luca Ciccarello, Donata Arena, Giulio Flavio Rizzo, Gresheen Garsia, Agustin Zsögön, Ferdinando Branca

Sustainable production of vegetable crops in Europe is mainly focused on water economy and conservation techniques due to limited access to fresh water for agriculture. Grafting on vegetable crops, such as tomatoes (Solanum lycopersicum), is likely an interesting technique for tolerating water shortage regimes. In this study, we evaluate the performance of four commercial tomato rootstocks under water stress (WS) conditions, combined with three scions: two Italian landrace “Pizzutello” and a breeding line “101MVS”, during the winter production season under greenhouse, in a split-plot design with two irrigation regimes: full irrigation (100%) and induced WS of 40% (60 % irrigation). At the physiological level, the water retention in leaves under WS was reduced and leaves showed a reduced capacity of water stocking in both grafted and non-grafted combinations compared to plant under full irrigation regime. A decrease of estimated chlorophyll content (SPAD) was also noted in WS plants independently of the rootstocks/scion combination, except for the “DynaFort” rootstock, which produced a stable SPAD measurement for the three varieties and under both irrigation regimes. The grafting effect by itself was noted by the variation between the two controls (autografted and non-grafted scions), where a delay in fruit set and maturation was noted in the grafted plant. Rootstocks showed effects on plant vigor reduction rate under WS. “KS4” rootstock showed to induce lateness in fruit maturity under WS compared to other rootstocks. “OptfortF1” allowed to reach the same yield under both irrigation regimes with a marginal earliness for the plants grown under WS. The highest production by plant under WS regimes was registered with “DynaFort” rootstock for the three scions. Findings in this study showed an interesting potential for grafted tomato plants to be used under deficit irrigation regimes by the selection of the adequate rootstock to increase the productivity.

Exploring variations of grapes cv. BRS Carmen: a physical, physical-chemical and bioactive analysis in different pruning periods

Leonardo Arenas Cavadas Buaiz de Lima, Cássio Vinícius de Souza, Lucas Pimentel Pereira, José Aires Ventura, Diolina Moura Silva

The study aimed to investigate the effects of different pruning times on the quality characteristics of table grapes from the BRS Carmen cultivar, in the municipality of Guarapari, ES. To this end, physical, physico-chemical attributes, the concentration of bioactive compounds and the antioxidant capacity (by the FRAP - Ferric Reducing Antioxidant Power and DPPH - elimination of the 2,2-diphenyl-1-picrylhydrazyl radical methods) were evaluated in two pruning times - summer (P1) and winter (P2). The results revealed that pruning period had a significant influence on the variables studied. For physical characteristics, P2 resulted in longer and heavier bunches, with averages 15% and 51.8% higher, respectively, associated with the greater number of berries per bunch, which was also higher (57%) in this pruning season. For the total soluble solids content (°BRIX), grapes from P1 presented significantly higher values (50%) than those observed in P2, and indicates the potential influence of the pruning season on fruit maturation. In addition to the physical and physico-chemical characteristics, the analysis of the bioactive aspects of the grapes of this cultivar showed higher concentrations of phenols and anthocyanins in P2. These results indicate a higher potential antioxidant activity of grapes subjected to this practice, which was corroborated by the greater antioxidant capacity determined by the FRAP and DPPH methods in P2 (5% and 107%, respectively), and suggest that harvested grapes present better physical and bioactive attributes after winter pruning.

First time description of Bixin in Cochlospermum regium: Impact of leaf age and anatomy

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The species Cochlospermum regium (Mart. ex Schrank) Pilg. (Bixaceae), known as “algodãozinho do cerrado”, is a plant native to South America with outstanding medicinal properties in its vegetative and reproductive parts. In addition, it is a potential source for bixin production. Given the bixin use by numerous industries, alternative sources of this molecule, such as in C. regium, are interesting. We hypothesized that bixin production in C. regium is responsive to developmental stages, as observed in annatto (Bixa orellana). C. regium seeds were germinated in commercial substrate and grown in the greenhouse. The third leaf of plants with four and eight phytomers was used for morpho-anatomical analysis and for bixin quantification via LC-MS. Heterophilly was observed, where plants with four phytomers had trilobed leaves, while those with eight phytomers had pentalobed leaves and extrafloral nectaries was also observed. Such structures suggest the transition of vegetative phases, from juvenile to adult. Plants with four phytomers have fewer pigmented glands on the central vein, with a greater presence on the leaf edges. The number of pigmented glands in plants with eight phytomers is greater in both leaf regions, especially at the leaf edges. In both groups, the pigmented glands are arranged between the palisade and lacunose parenchyma. In addition, the glands showed the presence of red pigment, which could be a sign for bixin presence. LC-MS analysis showed eight-phytomer plants had 25% more bixin than four-phytomer plants, marking the first report of bixin in C. regium. These results demonstrate a new bixin-producing species and its dependence on the development stage for greater production, as observed in B. orellana. In future studies we hope to find the genetic-molecular basis of the compound's production in C. regium.

FREE AND ENCAPSULATED ESSENTIAL OIL OF CITRUS SINENSIS IN WEED CONTROL

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Synthetic herbicides, when incorrectly used, harm the environment and human health. As a sustainable alternative, Citrus sinensis essential oil shows promise as a bioherbicide. This is because essential oils have mainly of volatile terpenes, with possibly phytotoxic properties and affect the growth and development of weed plants. However, the essential oil’s volatility and field application challenges require technological solutions. Such an approach is encapsulation, which allows sustained release of the compound. Polylactic acid (PLA) polymer is oil-compatible and biodegradable, which can be used for weed management. Thus, this study aimed to evaluate the phytotoxic potential of free and encapsulated Citrus sinensis essential oil. For this, two experiments were conducted. Initially, the free C. sinensis essential oil was diluted and applied to the seeds of the weed species (Cenchrus echinatus and Bidens pilosa) and in the crops (Triticum aestivum and Cucumis sativus). Posteriorly, different concentrations of free and encapsulated C. sinensis essential oil were applied to the seed of species with contrasting results in the first experiment. Experiments were conducted in the germination chamber under optimal temperature and photoperiod conditions for each species. There were evaluated germination percentage, germination speed index, root, and shoot length. Free C. sinensis essential oil inhibited weed germination at a 6% concentration and reduced germination and growth of T. aestivum at higher concentrations but did not affect C. sativus. In Experiment 2, encapsulated oil reduces weed growth without affecting the cultivated species of interest. Both showed phytotoxic action on weed species. Furthermore, comparing free and encapsulated oil, only free oil inhibited germination at high concentrations, proving being more toxic than encapsulated oil under laboratory conditions. In conclusion, Citrus sinensis essential oil has phytotoxic properties, and encapsulation technology represents an efficient innovation that requires further field testing to develop a new bioherbicide.

Gas exchange rate and sucrose concentrations affect morphophysiology and acclimatization in hop grown in vitro

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Microporous membranes have been used to facilitate gas exchange and consequently improve the development of micropropagated plants of several species. Additionally, with increased gas exchange, sucrose levels in the culture medium can be reduced or even eliminated. The experiment was conducted using a completely randomized design in a 2×3 factorial arrangement, evaluating the gas exchange rate, without (14 μL L−1 s−1 CO2) and with a gas-permeable membrane (21 μL L−1 s−1 CO2), and three sucrose concentrations (5, 15, and 30 g L−1) with six replicates, each consisting of three plants. Following 45 days of in vitro cultivation, morphophysiological parameters were assessed. Subsequently, after 30 days of ex vitro acclimatization, the percentage of survival (%) and dry weight (g) of plants were analyzed. Plants cultivated with higher gas exchange (21 μL L−1 s−1 CO2) and sucrose concentrations (15 and 30 g L−1) showed significant enhancements in growth parameters such as shoot length, leaf area, and root development. Hop plants were photosynthetically active when grown with 30 g L−1 sucrose, regardless of the type of seal. However, at low sucrose concentrations, it only occurred with increased gas exchange. The use of membranes also allowed for better regulation of transpiration, resulting in greater survival of these plants during the acclimatization stage. Plants with gas-permeable membranes exhibited higher photosynthetic pigment content, especially when grown with 15 g L−1 sucrose. Chlorophyll fluorescence analysis revealed improved PS II performance in plants with greater gas exchange. Therefore, for photomixotrophic in vitro culture of H. lupulus, the use of permeable membranes and 15 g L−1 sucrose benefited the plant growth and potentialized ex vitro acclimatization.

GROWTH AND FUNCTIONAL CHARACTERISTICS OF YOUNG Hevea brasiliensis PLANTS SUBJECTED TO PHOSPHATE FERTILIZATION AND BIOSUPPLEMENTS

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The use of biotechnologies that enhance plant growth and development is increasingly recognized. This reduces the reliance on synthetic fertilizers, which can have adverse effects on the soil. In this context, the use of soil microorganisms holds significant potential, as they can solubilize and mineralize phosphorus, which is poorly mobile in the soil. Furthermore, these microorganisms possess mechanisms that promote the production of phytohormones, which stimulate plant growth. The objective of this study was to investigate the combined use of phosphate fertilization and phosphate-solubilizing bacteria (PSB) on the growth and physiological attributes of young Hevea brasiliensis plants. The experiment was conducted at the Federal Institute of Education, Science and Technology of Amazonas, Humaita Campus. Evaluations were carried out on plants that were uniform in height, diameter, and in adequate phytosanitary conditions, and were subsequently subjected to the following treatments: control (natural soil), soil+liming, natural phosphate, soluble phosphate, PSB, PSB+natural phosphate, and PSB+soluble phosphate. The experimental design was completely randomized with five replications. Two bacterial strains were inoculated in the bacterial treatments: Bacillus velezensis and Lysinibacillus xylaniticus. To achieve the objectives, relative and absolute growth, biomass accumulation, and four measures of photosynthetic performance were assessed monthly, using the IRGA – (CIRAS-3, PPSytsem). Following analysis of variance and Tukey's test (5%), significant results ($p<0.05$) were observed in the PSB treatment for absolute growth in diameter (0.032±0.001) and height (0.31±0.041) compared to the control. The same was observed for plant biomass, with an average of 84.91±5.1 for PSB and 65.9±6.8 for the control. On the other hand, while control and PSB treatments showed similar maximum photosynthetic rates, combining PSB with a natural phosphate source significantly increased this rate, where PSB+NP = 9.9 ± 1.5, and the control = 6.7 ± 0.9, suggesting that adding natural phosphate enhances photosynthesis in the species.

GROWTH PROMOTION AND SAPONIN METABOLISM IN Quillaja lancifolia D. DON PLANTS USING RHIZOBACTERIA Streptomyces spp.

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Quillaja lancifolia D. Don, commonly known as soap tree, is a native species in South America. This species presents high levels of saponins in the leaves. These saponins are promising for use as immunoadjuvants in vaccines. This study aimed to enhance the growth and saponins content in Q. lancifolia by applying rhizobacteria Streptomyces. Seeds of Q. lancifolia (Morro Reuter/RS) were germinated in vitro (MS/2 medium) for 75 days. Then, seedlings were transferred and acclimatized in a substrate (vermiculite:sand:soil 2:1:1) for 45 days in a culture room. After that, the plants remained in the greenhouse for another 15 days, totaling 60 days of ex vitro condition. The bacteria CLV374, CLV381, and CLV382, were grown in ISP2 liquid medium (5 days) and then maintained for 7 days in sterile peat moss. The Colony Forming Units (CFU) were analyzed, and the inoculated peat moss was used for soil treatment. Each treatment consisted of 48 plants, with each plant receiving 1 g of peat moss. Control treatment consisted of sterile peat moss without bacteria. Shoot and root lengths, fresh and dry mass, and total saponin content in Q. lancifolia leaves were evaluated. To evaluate the total saponin content, the vanillin-perchloric acid colorimetric technique (560 nm) was used. The analysis was carried out in triplicate. Plants treated with CLV374 and CLV381 showed an increase in shoot and root mass and shoot length, compared to the control. The saponin content was higher in plants inoculated with CLV374, CLV381, and CLV382 compared to the control. In conclusion, CLV374 and CLV381 have demonstrated the ability to promote both plant growth and terpenoid saponin content in Q. lancifolia, positioning them as strong plant growth-promoting rhizobacteria candidates for bioinoculant applications.

HALOPRIMING AS A TOOL FOR ESTABLISHING SEEDLINGS UNDER SALINE STRESS

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Sunflower (Helianthus annuus L.) is a very productive oilseed for food and biofuel purposes. This species is characterized by its high stress tolerance, however, salinity can negatively affect germination and seedling establishment of sunflower. Thus, techniques have been developed in order to promote greater viable seedlings development under these conditions. We aimed to understand the morphophysiological responses induced by the application of halopriming in sunflower seeds during seedling establishment in saline conditions. For this, sunflower seeds were subjected to osmopriming in 50µM NaCl. Primed and control seeds (without conditioning) were sown in soil containing NaCl at concentrations of 0mM, 60mM, 120mM and 240mM. There were quantified dry matter in roots and shoots, the activity of the antioxidant enzymatic system, the content of the malondialdehyde - MDA, the synthesis of proteins and sugars, as well as the osmoregulator proline in sunflower seedlings. The data were subjected to a two-way ANOVA test, and, in case of normal distribution, the Tukey mean test was selected at a 5% level of significance. It was observed that seedlings from halopriming treatment showed different responses to stressful conditions, presenting enzymatic and non-enzymatic responses. Greater activity for the SOD and APX enzymes was observed, and increased concentration of sugars, and proteins regarding higher salinity, being 120mM and 240mM. Priming acted positively by increasing the length and roots dry matter at the highest saline concentrations. Thus, it is concluded that halopriming was efficient in increasing tolerance to salinity at the concentrations analyzed both through the synthesis of osmoregulators and through enzymatic action.

HARVEST TIME AND PHYSIOLOGICAL POTENTIAL OF JACK BEAN SEEDS

Tuane Reis de Souza, Victor Augusto Forti, Patrícia Marluci da Conceição

The jack bean is a legume used as green manure in various regions of Brazil. However, despite its great importance and high potential for use, the low availability and high cost of certified seeds are significant barriers to the diffusion of this technology. The objective of this work was to determine the best harvest point for jack bean seeds based on the morphological marker "pod coloration," as well as to characterize the seed maturation process. To this end, a field was established at the Agricultural Sciences Center of the Federal University of São Carlos for seed production. The treatments were: green pods (P1), yellowed pods (P2), and brown pods (P3). After harvesting, which was carried out when the pods reached each of these coloration points, they were evaluated for color (analyzed in a colorimeter), mass, and length. Subsequently, the seeds were extracted from the pods, and their length, width, and thickness were measured, followed by assessments to determine their physiological potential, including: mass of 1000 seeds, moisture content, dry matter mass, germination, seedling emergence, emergence velocity index, seedling length, dry matter mass of the root and aerial part, and electrical conductivity. There were no significant differences in the biometric parameters of the seeds and pods. An increase in water loss due to the maturation process was observed, with the highest dry matter mass occurring at the yellowed coloration stage. No germination occurred at the green pod stage, unlike the yellowed pods, which resulted in higher germination rates and better vigor parameters compared to the other stages. It is concluded that the physiological maturity point for jack bean seeds can be morphologically characterized by yellowed pods. However, due to the moisture content of the seeds, the recommended harvest point is likely the intermediate stage between yellow and brown pods.

HEAVY METAL ACCUMULATION IN RIPARIAN TREES FOLLOWING THE FUNDÃO DAM COLLAPSE

André Araújo da Paz, Diego Shimizu Aleixo, Astrid de Oliveira Wittmann, Florian Karl Wittmann, Ricardo Ildefonso de Campos, Daigard Ricardo Ortega Rodriguez

Following the collapse of the Fundão tailings dam in Mariana, MG, in November 2015, mining tailings contaminated the Doce River, significantly affecting riparian vegetation. Before the disaster, rivers like Gualaxo do Norte had Fe, As, and Mn. Post-disaster, concentrations of these and additional metals (Cd, Pb, Cu, Cr, Ni, Hg) exceeded legal limits. Over six years, some tailings were washed away from the upper Doce River basin. Potentially toxic elements (PTEs) in tailings can harm ecosystems when concentrations surpass tolerance limits, stressing or limiting plant growth. Our study aimed to understand how tree species responded to metal concentrations in soil and whether they stored them. We tested three hypotheses: i) higher metal concentrations in growth rings post-disaster, ii) higher concentrations in trees from affected areas, and iii) higher concentrations in plant tissues compared to soil. We sampled riparian forests near Paracatu de Baixo in affected and unaffected areas, collecting nine composite soil samples from each. We selected three tree species: Anadenanthera peregrina, Piptadenia gonoacantha, and Nectandra oppositifolia. Using a Pressler auger, we extracted two cores from approximately 30 trees per species, analyzing growth rings and heavy metal incorporation. Samples were collected from before (2001-2008) and after the disaster (2015-2022). ICP-MS measured concentrations of Cu, Fe, Mn, Zn, As, Cd, Pb, Cr, and Ni. Statistical analyses using t-test assessed differences in metal concentrations by soil type and time. We calculated translocation factors (TF) for metal accumulation in plant tissues. Bioavailability of PTEs was higher for Mn and Ni in affected areas but lower for Zn and Pb. No significant difference was found for most elements between pre- and post-disaster growth rings, except for Cu in Piptadenia and Pb in Nectandra. Species-specific differences in metal accumulation and TF values suggest potential for phytoremediation using these species in contaminated areas.

Histolocation and adaptive mechanisms of Mimosa skinneri var. carajarum: a species adapted to iron.

keila Jamille Alves Costa, Joana Patrícia Pantoja Serrão Filgueira, Cecílio Frois Caldeira Júnior

Cangas are economically important environments due to their iron ore-rich substrate, which makes them a target for mining. Species that establish themselves on cangas have adaptive mechanisms that enable them to survive in this environment, especially characteristics that promote tolerance to high levels of iron. This study aimed to histolocalize iron accumulation sites in Mimosa skinneri var. carajarum Barneby, which is endemic to the Serra dos Carajás region. The species was grown in Hoagland's nutrient solution at different concentrations of iron, in the form of Fe-EDDHA (control [0.1 mM], 5x [0.5 mM], and 25x [2.5 mM]) for 17 days. To detect the presence of iron, samples of the root, stem and leaves were fixed in Karnovsky's solution, embedded in historesin, sectioned on a rotary microtome and incubated for 48 hours in a solution containing 4% potassium ferricyanide and 4% hydrochloric acid. In the root, the periderm was positive for iron in all treatments. In the 0.5 mM and 2.5 mM treatments, iron also accumulated in the cortex cells, including the intercellular space. At the highest concentration (25x), a higher concentration of iron was detected in the xylem vessels. In the stem, at the highest concentrations (5x and 25x), the reactions were more intense in the idioblasts with phenolic compounds located in the cortex. In the leaves, iron was observed in the spongy parenchyma in the control treatment, but also in the other treatments in the palisade parenchyma and, in the 25x treatment, iron accumulation sites were observed in intercellular spaces between the palisade parenchyma cells and the adaxial epidermis. The M. skinneri species has potential adaptive mechanisms associated with tolerance to excess iron concentrations, because of allocating absorbed iron in intercellular spaces such as the cortex and palisade parenchyma regions.

HORMONAL REGULATION DURING SOMATIC EMBRYOGENESIS IN SUGARCANE (Saccharum spp.):THE ROLE OF ETHYLENE SIGNALING

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Somatic embryogenesis is a critical micropropagation technique in sugarcane (Saccharum spp.), facilitating applications such as synthetic seed production and genetic engineering. Somatic embryogenesis is typically induced via the synthetic auxin 2,4-D, which is associated with the modulation of indole-3-acetic acid (IAA) and ethylene biosynthesis, although the underlying molecular mechanisms of action of these hormones have not been completely elucidated. This study aimed to evaluate the effects of inhibiting ethylene signaling and biosynthesis via silver nitrate ($AgNO_3$) and cobalt chloride ($CoCl_2$), respectively, on somatic embryo production and the endogenous hormone balance during the maturation of somatic embryos. Embryogenic calli were induced on MS media supplemented with 10 µM 2,4-D. After three subcultures in the same media, the induced calli were subjected to prematuration treatment with 0, 0.5, or 5 µM $AgNO_3$ or $CoCl_2$. These calli were subsequently transferred to growth regulator-free maturation medium. After 42 days of maturation, somatic embryo production was evaluated, and significant treatments were analyzed via targeted metabolomics for hormone quantification at the beginning and after 14 days of maturation. The 0.5 µM $AgNO_3$ treatment increased somatic embryo formation by 32%, increasing the mean from 47 to 70 of embryos per callus. Conversely, the 5 µM $AgNO_3$ treatment hindered embryo development, increasing callus oxidation. $CoCl_2$ treatments did not significantly affect somatic embryo production. At the beginning of maturation, both $AgNO_3$ treatments elevated 1-aminocyclopropane-1-carboxylic acid (ACC) levels, with the 0.5 µM treatment also increasing abscisic acid (ABA) content, contributing to greater dry mass. After 14 days, both $AgNO_3$ treatments significantly reduced residual 2,4-D levels, with the 5 µM $AgNO_3$ treatment also resulting in lower IAA levels, potentially impairing somatic embryo development. These findings highlight the complex role of ethylene signaling in modulating somatic embryogenesis, suggesting that fine-tuning ethylene perception could optimize somatic embryo production in sugarcane.

HOW DOES CLIMATE VARIATION AFFECT WOOD FORMATION IN A SEASONALLY DRY FOREST IN THE CERRADO DOMAIN?

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The growth of trees in seasonally dry tropical forests is a key factor in global carbon-cycle dynamics, driven by the seasonal activation of the vascular cambium. During the wet season, tree growth and cambium activity vary across multiple temporal scales (daily to monthly). Currently, we do not know how climate drives within-season and between-season differences in dry forest tree growth and phenology patterns, which precludes understanding the fate of those trees in future climates. We assessed the effects of climate on leaf phenology and xylem development by exploring: (1) What time lags exist between precipitation, leaf flushing, the onset of xylem sap flow and radial growth? (2) How do climatic variables affect radial increment and sap flow dynamics? We related local vapor pressure deficit (VPD) and soil moisture to leaf phenology, xylogenesis, sap flow, and radial increment at sub-hourly to monthly scales using high-resolution sensors in Cedrela fissilis in a tropical dry forest (Mata Seca). Cedrela spp. are widespread across the neotropics and widely used to compare interannual climate-growth relations using tree-ring studies. Precipitation, a positive water balance, and low VPD drive the development of new leaves and xylem cells. Leaf flushing began after the first rains on the transition from the dry to wet season (September). Sap flow lagged leaf flush by ~1 month and daily cycles were tightly coupled with VPD except during the dry-wet transition when they were closely linked to soil water availability. Radial stem dynamics were initially modulated by water absorption (rainfall events during the dry-wet transition) and later by wood deposition. Wood deposition started after the leaf flush, and was confined to the wet season (October to April). Our study offers key insights into the drivers of tropical tree growth, which can improve the representation of wood formation dynamics in global vegetation models.

Hydroquinone and methyl hydroquinone function as urease inhibitors of agricultural interest and root growth promoters

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Urea is one of the most used nitrogen fertilizers worldwide. Soil ureases, however, speed up urea hydrolysis, which negatively impacts the environment due to emission of pollutants and decreases the fertilizer efficiency. The use of urease inhibitors constitutes a strategy to minimize such losses. Therefore, hydroquinone (HQ) and methyl hydroquinone (MHQ), previously determined by our group as urease inhibitors, were individually applied to soil in association with urea for the growth of Pennisetum glaucum (millet) seedlings under greenhouse conditions. Roots and leaves were harvested 35 days after soil treatment for the analysis of nutrients and biomass. N-(butyl) thiophosphoric triamide (NBPT) was used as the reference inhibitor and urea only as control. The use of urea plus HQ (0.5% m/m) resulted in 60% more Fe in leaves in comparison to those from plants grown in urea only. The treatment with HQ, MHQ or NBPT did not affect the amount of the N, P, K, Ca, Mg, S, Cu, Mn, Na and B in leaves or roots, regardless of the concentration used. The presence of urea plus MHQ (0.5% m/m) caused an increment of Zn in roots by 22% in comparison with the treatment with urea only. The biomass of millet roots grown in the presence of urea plus HQ or MHQ (0.06 to 1.0% w/w) was 35% higher (on average) than that of roots treated with urea. Besides acting as urease inhibitors, HQ and MHQ proved to be good root growth promoters, a desired feature to improve water and nutrients uptake by plant from soil. The ability to improve Zn and Fe uptake makes the combination of HQ and MHQ an interesting approach for plant biofortification. Further studies with HQ and MHQ in field conditions will be valuable to evaluate the extent of their use as additives in urea fertilizers formulations.

IDENTIFICATION AND CHARACTERIZATION OF EARLY FLOWERING ACCESSIONS OF Capsicum chinense PEPPERS

Camily Rodrigues Oliveira, Caris dos Santos Viana, Paulo Mafra de Almeida Costa, Rodrigo Alves Rodello, Agustin Zsögön

Variation is essential for the genetic improvement of Capsicum chinense, as it allows the selection of desirable characteristics, such as early and productive plants. Morphological characterization makes it possible to differentiate accessions using descriptors that detail their characteristics, while agronomic characterization helps to identify the earliest and most productive accessions. The aim of this research was to identify and characterize the earliest and most productive accessions of C. chinense in a panel of different geographic origin. We selected six accessions Panca, PI15225, BGH1741, BGH6233, BGH4721, Cheiro, and grew them along two control cultivars (Habanero and Biquinho), measuring descriptors according to the International Plant Genetic Resources Institute and agronomic characteristics, days until flowering, number of leaves until the first inflorescence, weight of fresh fruits (g), and number of fruits per plant). Three accessions exhibited green coloration with purple stripes on the stem, while the others were green. Only Cheiro pepper had purple nodal coloration. The control cultivars had cylindrical stem shapes, while the others were angular. Only BGH4721 had intermediate stem pubescence, while the others were densely pubescent. PI15225 had a compact growth habit and sparse branching, while the others were erect with intermediate or dense branching. The leaf shape varied from deltoid (Panca, BGH6233, BGH1714), lanceolate (PI15225), and ovoid (Cheiro, Hab R, and Biq R), with dense to intermediate pubescence. The earliest accessions were bgh4721 and Cheiro, but Biq R had the highest production (1,495.29g) with the largest number of fruits per plant (1,178.34), indicating that these accessions are important for breeding programs.

Impact of Biostimulant Use on Tomatoes' Photosynthetic Activity

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The use of biostimulants represents an alternative for reducing the impact of abiotic stresses, such as thermal and water stress, while enhancing nutrient use efficiency, ultimately leading to increased agricultural productivity. Understanding the effects and mechanisms of action of these products has been a subject of study. In an experiment conducted in a controlled environment at the Universidade Federal de Viçosa, a hybrid Italian tomato group was treated with different biostimulants to calibrate measurements of photosystem II (PS-II) quantum efficiency using the MultispeQ device. The experimental design involved randomized blocks with three blocks in a 5x6 factorial scheme, where 5 denotes different measurement times in hours after biostimulant application (HAA): 3, 6, 24, 30, and 48; and 6 denotes the treatments: T1 (Arbolina), T2 (Arbolina+Borolina), T3 (Arbolina+Fosforina), T4 (aqueous extract of microalgae), T5 (ethyl extract of microalgae), and T6 (control, with water). Different variables were assessed, including Quantum Efficiency of Photosystem II (Phi2), Linear Electron Flux (LEF), SPAD index, Non-Photochemical Energy Dissipation in Photosynthesis (PhiNPQ), Proportion of Open Reaction Centers in Photosystem II to Total Reaction Centers (qL), and Non-Photochemical Quenching of Chlorophyll Fluorescence (NPQt). Additionally, yield parameters such as the number of clusters, flowers, fruits, and fruit set rate were evaluated. During the experiment's evaluation period, treatments did not show significant differences in any of the assessed variables. However, HAA, influenced by climatic factors, directly impacted the plant's photosynthetic metabolism. The number of fruits was higher in T4, showing a trend towards a higher fruit set percentage. Future studies are needed to assess longer intervals after application, different concentrations, and extended cultivation periods to evaluate other production components.

Impact of nanoelicitation on the production of betalains and specialized metabolites in Alternanthera sessilis

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The increased use of synthetic, often toxic substances in the 20th century has driven the search for natural alternatives. Nanomaterials have gained prominence by enabling cellular manipulation to produce secondary metabolites, such as betalains. Alternanthera sessilis, a medicinal and edible plant, stands out for its betalain production, but its natural yield is insufficient for viable extraction. Therefore, this research aimed to optimize betalain production using natural techniques, such as iron oxide (Fe_3O_4) nanoparticles, to explore the medicinal and food potential of these substances. The focus was on identifying more economical sources and producing higher-quality pigments for use as natural dyes. The experiment used A. sessilis plants from the Plant Tissue Culture Laboratory (UFPel), which were maintained in half-strength Hoagland solution and rooted in a hydroponic system for 30 days. The plants were treated with different concentrations of Fe_3O_4 nanoparticles (0; 0.01; 0.1; 1 and 10 mg L^{-1}) through weekly foliar application. After 28 days, growth parameters such as root and shoot length, number of shoots, leaves, and nodal segments were analyzed. Samples were stored at –80°C for subsequent biochemical analyses, including the quantification of betalains, phenolic compounds, and the evaluation of antioxidant activity (ABTS and DPPH assays). No significant differences in plant height or the number of nodal segments were detected between treatments. The number of leaves was significantly reduced at 1 mg L^{-1} compared to the other treatments. In the PCA biplot, the 1 mg L^{-1} treatment remained isolated in its quadrant due to its distinct deleterious effect on all growth parameters of A. sessilis. In summary, growth parameters were generally more favorable at lower concentrations of Fe_3O_4 nanoparticles, whereas higher concentrations may have detrimental effects, particularly on root length. Fe_3O_4 nanoparticles at the tested concentrations did not have a positive impact on the growth parameters of A. sessilis.

IMPACT OF PGPR AND FOLIAR STIMULANTS ON MAIZE YIELD AND PHYSIOLOGY UNDER REDUCED NITROGEN IN BRAZIL

Luiz Gustavo Moretti de Souza, Carlos Alexandre Costa Crusciol, João William Bossolani, José Roberto Portugal, Amine Jamal

Maize (Zea mays L.) is a staple cereal globally, but its cultivation accounts for approximately one-third of all nitrogen-based fertilizers produced. Overuse of these fertilizers leads to significant nitrogen losses to the environment, resulting in soil acidification, water eutrophication, and biodiversity decline. Plant growth-promoting rhizobacteria (PGPR), such as Azospirillum spp., can enhance agronomic efficiency and crop growth, thereby boosting productivity. The application of foliar stimulants complements conventional fertilization, optimizing nutrient management and promoting sustainable agricultural practices. Foliar fertilizers containing phosphorus and nitrogen enhance nutrient use efficiency and crop yields, contributing to more sustainable farming. This study aimed to evaluate the impact of PGPR and foliar stimulant fertilization on maize physiology and yield under field conditions across six regions in Brazil (PR, SP, GO, BA, and two regions in MT). The experimental treatments included base fertilization with monoammonium phosphate (MAP) or triple superphosphate (TSP), combined with foliar inoculation during the V2 to V4 stages and Nutridrop MAP (12-61-00; 5 kg ha^{-1}) application during the R1 to R3 stages. These treatments were compared under full nitrogen fertilization and a 25% nitrogen reduction. Results demonstrated that treatments with 75% nitrogen fertilization combined with Azospirillum brasilense and soluble MAP (T8) produced grain yields (8948 kg ha^{-1}) comparable to those of the control with full nitrogen fertilization (T1, 8902 kg ha^{-1}). Moreover, T8 maintained similar net photosynthetic rates (27.0 μmol CO_2 m^{-2} s^{-1}) and water use efficiency (1.85 kg m^{-3}) as T1, indicating that a 25% reduction in nitrogen can be effectively compensated by the use of these bio-stimulants, ensuring balanced nutrition and satisfactory yield outcomes.

IMPACT OF SEAWEED BIOFERTILIZERS ON THE COMPOSITION OF α-ACIDS AND β-ACIDS IN CULTIVATED HOPS (Humulus lupulus L.)

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Bitterness, aroma, and foam stability in beer are directly related to the α-acids and β-acids present in hops (Humulus lupulus L.). Seaweeds have increasingly been used as biofertilizers because they can enhance secondary metabolites by stimulating the production of these acids, contributing to the sensory and functional quality of the cultivar. This study evaluated the amounts of α-acids and β-acids present in dried hop cones treated with commercial seaweed-based biofertilizers. Three commercial extracts were used (Acadian® - Ascophyllum nodosum; NETUNO Agro® - drift seaweeds; and AlgaFert - Kappaphycus alvarezii), in two concentrations (2% and 5%) and two application methods (foliar and root), totaling 12 treatments plus a control. The quantification of α-acids and β-acids was performed using High-Performance Liquid Chromatography (HPLC). An International Calibration Extract (IEC-4) was used as the reference sample for calculating acid concentrations. All four acids present in the standard - co-humulone, n+ad-humulone, co-lupulone, and n+ad-lupulone - showed statistical differences in at least one treatment compared to the control. For co-humulone, increments were observed in four treatments, ranging from 0.080 to 0.140 mg/mL; for n+ad-humulone, five treatments ranged from 0.178 to 0.340 mg/mL; for co-lupulone, five treatments ranged from 0.077 mg/mL to 0.013 mg/mL; and for n+ad-lupulone, three treatments showed values between 0.0778 and 0.100 mg/mL. Plants treated with Netuno biofertilizer did not show statistically significant increases compared to the control for any of the four acids analyzed. Biofertilizers can differentially influence the production of α-acids and β-acids in hops, highlighting the need for further studies to clarify the specific mechanisms of action for each biofertilizer, considering different conditions and cultivars.

Impact of selenium and elevated CO_2 on the root anatomy of rice seedlings

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Selenium (Se) at low concentrations can influence the root growth of rice seedlings, but its effects under elevated atmospheric carbon dioxide (eCO_2) conditions are still not well understood. Additionally, the role of roots in plant development often receives less attention compared to aerial tissues. Thus, understanding how these environmental conditions alter root characteristics can provide valuable insights into how rice plants adjust their growth and development. In this study, we investigated the effects of combining two levels of CO_2 (ambient: 410 μmol CO_2 mol^{-1} air and elevated: 750 μmol CO_2 mol^{-1} air) and Se (0 and 10 μM) on the anatomy of rice seedlings cultivated in a hydroponic system. Seedlings germinated on moistened paper and transferred to a half-strength Hoagland nutrient solution at pH 5.5, with or without sodium selenite (Na_2SeO_3), were exposed to the two CO_2 levels for five days. Se treatment increased the area and length of root cortex cells, when assessed longitudinally, compared to seedlings not treated with Se under both CO_2 conditions. Additionally, Se reduced root diameter under ambient CO_2 conditions compared to roots not treated with Se under ambient CO_2. In contrast, eCO_2 increased the area of cortex cells, root diameter, vascular cylinder diameter, and epidermal thickness in both Se-treated and non-treated seedlings. Our results demonstrate that the combination of Se and eCO_2 alters the anatomy of the differentiation zone in rice seedling roots, suggesting potential advantages for plant development under eCO_2 conditions. Further studies are needed to validate and expand knowledge on cultivation strategies using low concentrations of Se and longer exposure periods to eCO_2.

IMPACT OF THIOHYDANTOIN DERIVATIVES ON SOIL UREASE ACTIVITY AND LACTUCA SATIVA SEED GERMINATION

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Plants rely on nutrient absorption from the soil to grow properly, with urea being the most commonly used nitrogen fertilizer worldwide. However, urea efficiency is notably decreased on tropical soils because of nitrogen losses via ammonia volatilization, driven by extracellular soil ureases. The urease inhibitor N-(butyl) thiophosphoric triamide (NBPT) has been used together with urea to minimize ammonia volatilization. The NBPT, however, exhibits limited efficiency in acidic soils and undergoes rapid degradation, underscoring the need for the development of more effective urease inhibitors.

This study aimed to evaluate the potential of two thiohydantoin derivatives synthesized by our group (namely ST9 and ST10) as non-phytotoxic urease inhibitors. The ST9 and ST10 inhibited ureases from a Red Yellow Argisol by 35% and 27%, respectively, when used at 500 µM. Importantly, none of the synthetized substances adversely affected the germination of Lactuca sativa (lettuce) seeds, a plant species used as a model to assess the phytotoxicity of substances. Instead, the treatment of lettuce seeds with ST10 at a concentration as low as 100 µM for seven days boosted the seedlings' root growth by 80% yielding roots 11.1 cm longer than those of control seedlings, devoid of ST10.

Overall, these findings point the substance ST9 as a promising urease inhibitor for agricultural applications, while ST10 emerges as an outstanding promoter of root growth. Both substances demonstrate significant potential as combined additives in urea formulations, warranting further testing within the soil-plant system to develop a more efficient urea-based fertilizer. This research offers promising avenues for enhancing agricultural productivity by improving the efficiency of nitrogen utilization in soils, particularly under tropical conditions.

IN VITRO CALLUS INDUCTION IN ANCHIETEA PYRIFOLIA

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Anchietea sp is a liana plant belonging to the Violaceae family, known as Cipó-suma in Brazil. This species is native to South America and widely distributed across Brazilian biomes. Traditionally, it is used in folk medicine as a depurative and for the treatment of skin diseases. Recently, it has attracted the attention of researchers due to the presence of cyclotides, specialized metabolism molecules with various biological activities, such as uterotonic, antimicrobial, anthelmintic, molluscicidal, and antitumor effects, among others, highlighting its great importance. For the production of active compounds, a frequently used technique is tissue culture, specifically the cultivation of calli. This study aims to establish callus culture for the production of specialized metabolites from Anchietea pyrifolia in vitro. For this purpose, explants from proximal leaf sections of plants already established in vitro were used. The explants were inoculated in culture medium supplemented with different treatments: T1 - 2,4-D at a concentration of 10 mg/L, T2 - BA 10 mg/L, and T3 - BA 5 mg/L + 2,4-D 5 mg/L. The culture medium contained MS salts, sucrose (30 g/L), and inositol (100 mg/L). After 31 days of incubation in the dark at 24°C, the treatment that showed the highest frequency of callus formation was T3, presenting friable calli along the entire edge of the leaf, not restricted to the petiole as observed in treatment T2. The anatomical characterization of callus is in progress. Further studies for the characterization of the produced metabolites, as well as quantification, will be conducted as the experiment progresses.

In Vitro Establishment of 'Flordaguard' and 'Seleção NR0170301' Prunus Rootstocks

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Rio Grande do Sul accounts for approximately 65% of Brazil's peach production, which requires a continuous supply of grafted seedlings. Currently, most of these seedlings are produced on seedling rootstocks with undefined genetic identity, which can compromise plant quality and uniformity. On the other hand, in vitro propagation techniques allow to produce cloned rootstocks with superior genetic and sanitary quality, ensuring greater consistency and quality of the seedlings. However, in vitro establishment of peach rootstocks is a critical phase due to challenges such as contamination, explant oxidation, and high recalcitrance of the species. This study aimed to compare the in vitro establishment potential of 'Flordaguard' and 'Seleção NR0170301' Prunus rootstocks. Mother plants were maintained in a greenhouse, receiving phytosanitary treatment with Agrimicina® 2 g L^{-1} and Manzate® 1.6 g L^{-1} twice a week. Nodal segments were collected in November 2021 and 2022, followed by disinfection and inoculation on complete MS medium containing 3% sucrose, 7 g L^{-1} Agar, 1.5 mg L^{-1} Benzylaminopurine, and pH 5.8. The explants were kept in the dark for seven days and then transferred to a photoperiod condition of 16 hours of light (48 µmol m^{-2} s^{-1}), at a temperature of 24ºC ± 2ºC, and evaluated 30 days after inoculation. In 2021, 'Flordaguard' achieved 81.8% established explants, 5% contamination, and 13.2% oxidation, while 'Seleção NR0170301' had 64.58% established explants, 31.26% contamination, and 4.16% oxidation. In 2022, 95% and 65% of explants were established, with 5% and 26.7% contamination for 'Flordaguard' and 'Seleção NR0170301', respectively. The results highlight the importance of sanitary control of mother plants prior to in vitro establishment. Moreover, 'Flordaguard' demonstrated a better response to the explant introduction process in tissue culture. This study represents a significant advance toward adopting more effective practices for producing high-quality genetic and sanitary Prunus rootstocks in Brazil.

In vitro germination of Paubrasilia echinata: Overcoming Initial Challenges

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Paubrasilia echinata (brazil-wood) is a native tree species threatened with extinction from the Brazilian Atlantic Forest. Micropropagation is a plant tissue culture technique available for the conservation of thereatned species, such as P. echinata. In vitro establishment of explants is the first hurdle to be overcome, especially explants such as fruits and seeds. The objective of this study was to improve the disinfection of the immature fruits to obtain in vitro seedlings asseptic for use in micropropagation. Brazil-wood immature fruits with 5 and 8 weeks after flowering were washed with running water and neutral detergent, immersed in 70% alcohol for 1 min, then in 100% sodium hypochlorite (active chlorine: 2.5%) with the fungicide Manzate® (1g L-1) for 1 h under constant shaking. Then, fruits were washed 10 times with autoclaved distilled water in a laminar flow chamber. The fruits were opened to extract the seeds, which were inoculated into MS culture medium. After 15 days, they were replaced into freshly MS culture medium. After 30 and 45 days, the germination (%), contamination (%) and length (Cm) of the aerial part were evaluated. The results indicated that the disinfection used was efficient to obtained asseptic seedlings, as the contamination rate of seeds were lower, 6.6 and 10% for 5 and 8-week-old fruits, respectly. Germination was faster and higher in fruits aged 8 weeks, with an average of 75%. The length of the aerial part was also higher in seeds from 8-week-old fruits, reaching an average of 50,21 mm after 45 days in vitro. Therefore, the disinfestation protocol described here is recommended for brazil-wood immature fruits and will provide suitable seedlings to be used for micropropagation in P. echinata.

Induction of Adventitious Rooting in Melanopsidium nigrum via Different Vegetative Propagation Methods

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Melanopsidium nigrum Colla is an endemic species of restinga, classified as vulnerable due to its restricted distribution and anthropogenic action. The plant is dioecious and, although it is propagated by seeds, environmental agencies mandate that in areas of restinga vegetation suppression, all individuals should be transplanted, which is not always effective. Therefore, vegetative propagation becomes an essential strategy for its conservation, generating clones from the parent plants. To assess the adventitious rooting capacity of this endangered plant, a pioneering experiment was conducted using different vegetative propagation techniques. For cuttings, powder IBA (indole-3-butyric acid) was tested on cuttings from all individuals subjected to the species suppression in the area (first experiment). The second cutting experiment evaluated rooting capacity based on the cutting diameter using five aqueous concentrations of IBA. Mini-cuttings were made from 1 year and 6 months old seedlings from the first experiment. For root induction, H_2O_2 and IBA were tested. Seedlings from cuttings of sprouts obtained by bending branches were also evaluated. Finally, air layering associated with IBA was tested in the field. Adventitious root formation was observed in all experiments. One of the most promising techniques was mini-cuttings, which allowed for approximately 80% rooting for all treatments. However, this technique requires that the plant be initially propagated by cuttings, which have a rooting rate of about 10% (branch segments) and 36.7% (sprouts used as cuttings). Air layering can be used despite the difficulty in finding branches with the characteristics suitable for this technique. It was found that the younger the propagule, the greater the success rate for vegetative propagation of this species.

INFLUENCE OF CYTOKININS ON THE PHOTOCHEMICAL PERFORMANCE AND IN VITRO GROWTH OF *Piper nigrum* L.

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Piper nigrum is a very important agricultural crop, and is the target of studies focused to optimize its in vitro propagation. Cytokinins, such as 6-benzylaminopurine (BAP) and 6-furfurylaminopurine (KIN), are fundamental in tissue culture studies, influencing physiological processes. The study aimed to evaluate changes on the photosynthetic apparatus of P. nigrum exposed to BAP and KIN in vitro. Combinations of BAP (0, 2, and 4µM) and KIN (0 and 0.5µM) were tested and after 45 days, photosynthetic performance was measured in plants dark-adapted, using a portable Handy-PEA fluorimeter (Hanstech, UK). The treatments with 0µMBAP+0.5µMKIN, 2µMBAP+0µMKIN, 4µMBAP+0µMKIN, and 4µMBAP+0.5µMKIN altered the energy flux per reaction center (RC), with increases in absorption flux (ABS/RC) (+70%, +34.1%, +53.1%, and +17.2%, respectively), captured energy flux (TR_0/RC) (+36.8%, +21.4%, +23.8%, and +14.9%, respectively), and dissipated energy flux (DI_0/RC) (+142.9%, +62.6%, +117.2%, and +22.3%, respectively). High DI0/RC values indicate lower energy transfer to electron transport/photochemistry, expressed by an increase in ABS/RC as a compensatory mechanism. Reduction of photosystem II performance index (PIABS) (-85.8%, -49.2%, -53.2%, and -46.9%, respectively) evidences the low efficiency of the photosynthetic apparatus. No change was observed in energy fluxes values when the plants were treated with 2µMBAP+0,5µMKIN, except in the photon flux absorbed per cross-section (RC/CSM), which increased by 36%. The growth observed in the plants submitted to 2µMBAP+0.5µMKIN and 4µMBAP+0.5µMKIN treatments (+121.3% and +259.9%, respectively), indicates that the combination of these two cytokinins is favorable for inducing growth in the species. In conclusion, the use of 2µMBAP+0.5µMKIN combination is suitable for in vitro cultivation of P. nigrum, being promising for inducing growth and maintaining unchanged the photochemical capacity of plants.

INFLUENCE OF DIFFERENT EXOGENOUS PLANT GROWTH REGULATORS CONCENTRATIONS IN OPUNTIA STRICT (HAW.) HAW.

Judith Alcalde, Maria Eduarda de Castro Mendes, Marco Aurelio Ribeiro Schuffner, Yasmin Paixão, Josimar dos Santos Ladeira, Thamires Fernanda Gomes, Diego Ismael Rocha

The Opuntia stricta (Haw.) Haw, forage cactus, stands-out of great economic importance as an efficient food option during dry periods in northeastern Brazil. Therefore, the objective of this study was to assess morphogenesis variables of O. stricta plantlets performance submitted to plant growth regulators concentrations, individually or in combination. The experimental design used was completely randomized, with 5 treatments (25 µM 6-benzylaminopurine (CK) and 25 µM gibberellic acid (GA); 25 µM CK and 25 µM paclobutrazol (PBZ); 50 µM GA; 50 µM CK and 25 µM PBZ) and a control treatment. Each treatment consisted of with 20 uniform young plants, which were sown directly in plastic tubes with potting soil. After 45 days, we assessed length (cm), width (cm), thickness (cm), area (cm2), the number of sprouts, presence of glochids (%), length of glochids (cm), fresh and dry mass (g) of racket formation. The treatment supplemented with GA (CK+GA) showed synergistic activity in the thickness (0.55 cm) and presence of glochids (91.3%) of the stem. Likewise, the treatment with GA alone showed greater thickness (0.59 cm) and presence of glochids (83.8%) of the stem. Regarding the length of glochids, the treatments CK+GA (1.96 cm), CK+PBZ (1.51 cm) and GA (1.78 cm) showed greater length of glochids on the stem. The treatments CK+GA (5.45 cm) and CK (6.95 cm) showed a greater number of shoots. In the parameter stem width, the treatments CK+GA (2.31 cm), GA (3.56 cm), CK+PBZ (3.56 cm) and the control (3.53 cm) showed greater response compared to PBZ and CK. However, the others parameters evaluated did not show significant differences. Likewise, the fresh and dry mass of the palm seedlings. In summary, we showed exogenous application of GA and CK mainly are critical regulators of architecture of O. stricta plantlets in a synergistic way.

INFLUENCE OF LEAF FERTILIZER ON THE REPRODUCTIVE PHASE OF SOYBEAN

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The soybean crop is currently productive, however the productive potential could be even greater, being limited by the assimilation of nitrogen by the plant and so this work aims to increase the efficiency of the physiological processes of the plant and nitrogen with the use of leaf fertilizers in the reproductive phase of the plant. The experimente was carried out in a greenhouse in the plant physiology sector of the Universidade Federal de Lavras. The soybean cultivar is 69x169 the plants were grown in 10-liter pots. The leaf fertilizer was applied in the reproductive phase R1 and has in its composition urea, ammonium nitarte, water and complex agente aminoacid 3%. Supremo (Prime agro). The applications were in the reproductive phase R1, the treatments were as follows: beign T1, T2, T3 and T4 at doses of 0 L, 2L, 3L e 5 L per hectare respectively. The experimental design was completely randomized with four replications, with each sampling unit composed of one plot. The evaluations were with seven anf fourteen days after the application of the product. The variables evaluated were plant height (H), number of leaves (NL), number of total flowers (NTF) and number of aborted flowers (NAF), number of pods (NP), stomatic conductance (SC), FV/FM ratio, chlorophyll A (CLO A) and chlorophyll B (CLO B). The use of Supremo did not cause a difference in H, SC and FV/FM demonstrating that the product does not cause damage to the physiological processes of the plant, because there were benefits in the reduction of NFB, and increased NF and NV, chlorophyll A and B allowing to conclude th best benefits in the growth and development of soybens were in the doses of tree and five liters.

INFLUENCE OF NITRATES ON GERMINATION AND INITIAL DEVELOPMENT OF PAPAYA

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The state of Espírito Santo leads national papaya (Carica papaya L.) production, but factors like slow and irregular seed germination hinder seedling production.In this context, nitrates are included, which play a crucial role in initial plant development. The calcium nitrate ($Ca(NO3)2$) strengthens cellular structures, while potassium nitrate ($KNO3$) regulates osmotic balance, aids protein synthesis, and facilitates nutrient transport. This study aimed to evaluate the influence of different $Ca(NO3)2$ and $KNO3$ concentrations on papaya initial plant development. Conducted between July and September 2023 in Linhares, northern Espírito Santo, the experiment employed a fully randomized, 2x6 factorial design with 720 seedlings divided into in 4 replicates of 15 plants. 'Aliança' cultivar papaya seeds were immersed for 12 hours in six concentrations of $Ca(NO3)2$ (0; 0.1; 0.2; 0.3; 0.4; 0.5%) and six concentrations of (0; 0.1; 0.2; 0.3; 0.4; 0.5%). The seeds were planted in 50 cm^3 tubes containing Bioplant® substrate enriched with Osmocote® 3M. Plant emergence was monitored daily to calculate emergence velocity index (EVI) and emergence percentage (%E). Seedling quality was evaluated after 55 days, measuring stem length (SL), root length (RL), and stem diameter (SD). Data were analyzed using ANOVA, comparing means of treatments and doses via Tukey's test ($p < 0.05$). Evaluating the interaction between products, there were no significant differences among nitrates for %E, RL, and SD. However, $KNO3$ showed a greater impact on ESI and SL. When comparing dose interactions, $KNO3$ was more significant, particularly at concentrations of 0.2% and 0.5% for %E; 0, 0.1, and 0.4% for ESI and SL; 0.1 and 0.3% for RL; and 0.1 and 0.4% for SD. The results obtained suggest that the use of nitrates can enhance the germination and initial development of the papaya tree, however, further studies must be carried out in order to generate a more precise technical recommendation.

INFLUENCE OF PRUNING SEASON ON FRUIT QUALITY ATTRIBUTES OF THE NIAGARA ROSADA CULTIVAR IN GUARAPARI, ES

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In grape cultivation, the use of double pruning has proven to be an important strategy for increasing productivity and the quality of the final product. In the state of Espírito Santo, Brazil, this technique has been implemented as a potential means for continuous table grape production, allowing for two harvests in one year. In this context, this study evaluated the variation of different attributes of grape clusters and berries of the cv. Niágara Rosada subjected to two pruning periods, winter and summer, in the municipality of Guarapari, ES. The number of berries per cluster, cluster weight, soluble solids content, titratable acidity, antioxidant capacity (using Ferric Reducing Antioxidant Power - FRAP and 2,2-diphenyl-1-picrylhydrazyl radical scavenging - DPPH methods), and anthocyanin concentration were evaluated. Analyses were performed using ANOVA and the Scott-Knott test with a significance level of 1%. The results showed significant differences between the two pruning periods. Winter pruning resulted in higher cluster weights and a greater number of berries per cluster compared to summer pruning. However, the soluble solids content (ºBrix) did not show significant differences between the pruning periods. The titratable acidity of the berries was higher in winter pruning (0.56%) compared to summer pruning (0.35%). These increases led to significantly higher antioxidant capacities associated with winter pruning by both methods evaluated, 49% and 32% for FRAP and DPPH, respectively. The concentration of anthocyanins was also higher in winter pruning compared to summer pruning. The results indicate that the cv. Niágara Rosada performed better with winter pruning, suggesting that this period was more favorable for grape production, improving its physicochemical and antioxidant characteristics due to greater thermal amplitudes and lower rainfall during the period.

INFLUENCE OF THE ENCAPSULATION MATRIX FOR THE PRODUCTION OF SYNTHETIC SWEET POTATO SEEDS

Natalia Verissimo, Luciano Bueno dos Reis, Willian Rodrigues Macedo, Caroline de Oliveira Timoteo

The sweet potato market has grown in recent years.The use of synthetic seeds, combined with nutrients and growth regulators, can be an interesting strategy to optimize propagation and obtain seedlings with high production and phytosanitary potential. This study evaluated the influence of adding growth regulators to the encapsulation matrix of synthetic sweet potato seeds. Nodal segments were encapsulated in sodium alginate solution (4%) with MS salts (50% strength, without calcium and sucrose) and CaCl2 (100 mM) for complexation. The treatments included concentrations of 0, 0.5, 1.0 and 2.0 µM of tryptophol (Tol) or indole-3-butyric acid (IBA), with or without 4.5 µM of 6-benzylaminopurine (BAP). Germination was assessed in vitro on MS medium, agricultural substrate and perlite. Germination speed index (GSI), germination percentage (%G) and morphometric evaluations were carried out. The GSI was calculated up to the 15th day, with the highest value (1.15) obtained with 0.5 µM Tol + BAP and the lowest (0.36) with 1.0 µM IBA + BAP. After 15 days, the highest %G was observed in the treatment with 0.5 µM Tol + BAP (93.33%). The lowest %G averages were obtained in treatments containing 2.0 µM Tol, 0.5 µM IBA + BAP and 1.0 µM IBA + BAP (33.33%) and 1.0 µM IBA (26.67%). At 30 days, most of the treatments showed between 80 and 100% %G, except for 2.0 µM Tol (53.33%). The best morphometric averages occurred with 0.5 µM IBA and 1.0 µM IBA + BAP. We conclude that the combination of 0.5 µM Tol + BAP showed greater homogeneity in germination, while 0.5 µM IBA or 1.0 µM IBA + BAP showed higher morphometric averages. No germination was observed in synthetic seeds, when these were cultivated in agricultural substrate or perlite.

Influence of water season on the physicochemical properties of Ficus carica L. fruits

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This study evaluated the physicochemical characteristics of 'Roxo de Valinhos' fig fruits harvested during the rainy and dry seasons (between July 2023 and May 2024) in the Cerrado-Amazon transition region. The plants were four years old and grown in an orchard in a randomized block design with five plants as replicates. All fruits were harvested throughout the 23/24 harvest, and six ripe fruits were evaluated per replicate. The following physical evaluations were performed: fresh fruit mass, internal diameter (ID), longitudinal diameter (DL) and equatorial diameter (ED), ratio of external measurements and color by the CIELAB method. To evaluate the chemical properties, the fruits were crushed and homogenized, and the total soluble solids (TSS), pH, titratable acidity, phenols, antioxidant potentials (DPPH and ABTS), vitamin C, anthocyanins, sugars and flavonoids were determined. The data were subjected to an analysis of variance and a Tukey test of 5%. The fig fruits did not present significant differences in morphometric variables, ensuring the same harvest pattern. For TSS (14.70 °Brix), pH (7.6) and the color parameters a* and b* (16.38; 19.12, respectively), the fruits grown during the dry season obtained higher quality indexes, being sweeter (6.04 g 100 g-1) and with a purple color, desired for the Roxo de Valinhos variety, in addition to presenting higher levels of phenols (125.49 mg 100 g-1) and anthocyanins (125.49 9 mg 100 g-1). Those harvested in the rainy season presented greater antioxidant activity (DPPH 192.53 trolox mol g-1) and Vitamin C (12.16 mg 100 g-1). Ripe fruits grown and harvested in the dry season in the Northern region of Mato Grosso are the best option for industry and fresh consumption

INSIGHTS INTO ANNATTO'S ADAPTATIVE RESPONSES TO DROUGHT STRESS: IMPLICATIONS OF JUVENILITY

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As global temperatures are projected to rise up to 4°C in the near future, drought periods are expected to intensify, particularly in regions of Brazil where annatto (Bixa orellana L.; Bixaceae) is cultivated. Annatto, an unique source of bixin dye used globally, may face challenges due to its physiological responses to drought. Our study investigated the drought tolerance of juvenile annatto plants, focusing on transgenic lines overexpressing miR156 (miR156ox) and those with reduced miR156 activity (STTM156). Plants were subjected to a water deficit (up to 30% field capacity for 20 days). Physiological parameters and bixin content were assessed before, during, and after the drought. Under control conditions, STTM156 plants showed higher CO_2 assimilation (A) compared to miR156ox plants. However, during drought, A was significantly reduced in miR156ox plants. STTM156 plants maintained higher stomatal conductance (gs) than non-transformed (Nt) and miR156ox plants under drought, suggesting better water management. Post-drought recovery revealed that Nt and STTM156 plants could restore gs values, likely due to the need for CO_2 to regrow structures lost during drought. STTM156 plants also demonstrated higher water use efficiency (WUE) under control conditions. During drought, miR156ox and Nt plants exhibited improved WUE compared to well-watered conditions, possibly due to better transpiration regulation. All plants showed similar WUE upon recovery, though approximately 50% lower than under well-watered conditions. Regarding bixin production under well-watered conditions STTM plants had nearly 10 times more bixin than Nt and miR156ox plants. During drought, STTM plants maintained higher bixin levels compared to Nt, which reduced its bixin content. Bixin is an important carbon drain and seems to have ceased production during drought in Nt plants. In conclusion, our findings offer insights into the drought responses of annatto and their implications for bixin production under climate change.

INTERACTIONS BETWEEN ETHYLENE SIGNALING AND TEMPERATURE AFFECTING THE TOMATO GERMINATION

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The tomato (Solanum lycopersicum L.) is a model plant, and the cultivar Micro-Tom (MT) has been one of the most used. The Never ripe (Nr) mutant genotype presents a mutation that reduces the perception of ethylene, a phytohormone involved in several physiological processes, including the germination. Therefore, here we tested the interaction between ethylene and temperature affecting the germination of the wild type (WT) and Nr genotypes. Germination of tomato seeds were evaluated in the different genotypes (WT and Nr) and six temperatures, where they were subjected to three constant temperatures: (i) 20 ºC; (ii)25ºC; (iii) 30 ºC, and at three variable temperatures between day and night: (iv) 30-20 ºC; (v) 30- 15°C; (vi) 35-15 ºC, totaling 12 treatments (two genotypes x six temperatures), where calculating the germination percentage (%) and the Germination Speed Index (GSI). There was a difference in the germination percentages of the Nr mutant in relation to the WT at constant temperatures, while there were no occurrences in the variable temperatures. This result is possibly a consequence of the interaction of ethylene with abscisic acid (ABA) to control dormancy. Variable temperature 30-20° C showed better germination in the WT and Nr genotypes, in relation to the other two, for account of its smaller range of thermal amplitude. The GSI of Nr was lower in relation to WT, demonstrating a delay in seed germination of this genotype, showing an influence of ethylene on the germination process. Therefore, additional studies are necessary, to specifically identify where ethylene acts in the germination process and what are the mechanisms that cause the Nr mutant to have a delay in germination of its seeds.

Interactions between selenium and elevated CO_2 concentration in the regulation of root architecture in rice

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Rice (Oryza sativa L.) is an essential crop for a large part of the global population and serves as a model for monocotyledon studies. Elevated concentration of carbon dioxide (CO_2) and low concentration of selenium (Se) can alter the root development pattern in rice seedlings. However, the interactions between Se and eCO_2 in the regulation root growth remain underexplored. This study evaluated the effects of two CO_2 concentrations (aCO_2, ambient CO_2, 410 μmol CO_2 mol^{-1} air, and eCO_2, elevated CO_2, 750 μmol CO_2 mol^{-1} air) and Se (0 and 10 μM) in rice seedlings grown in a hydroponic system. Rice seeds were germinated on filter paper moistened with distilled water to obtain seedlings. Afterwards, seedlings with a 2-cm-long radicle were selected and transferred to boxes containing half-strength Hoagland nutrient solution at pH 5.5, with or without sodium selenite (Na2SeO3). The nutrient solution was renewed daily, and the seedlings were placed in open-top chambers in a greenhouse supplemented with CO2 for five days. Se increased the length of the primary root and the concentration of soluble sugars in root but reduced root volume at the different CO_2 concentrations evaluated. Moreover, Se treatment decreased the length and number of lateral roots as well as the auxin concentration in seedlings grown under aCO_2. Conversely, eCO_2 increased root volume, concentrations of auxin and soluble sugars in roots of both Se-treated and untreated seedlings. The combination of Se with eCO_2 increased primary root length, lateral root number and length, and auxin concentration in the roots. It is concluded that Se regulates root architecture by inhibiting auxin biosynthesis, while eCO_2 stimulates root growth by increasing auxin production in the roots. The combination of Se and eCO_2 improves root architecture in rice seedlings compared to individual treatments, through interactions between soluble sugars and auxin.

Kalanchoë laxiflora AS A MODEL SYSTEM TO UNDERSTAND STOMATAL BIOLOGY OF CAM PLANTS

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The Kalanchoë genus has around 125 species that present great diversity in their photosynthetic lifestyle. Most species like K. laxiflora or K. hildebrandtii employ CAM metabolism, while other like K. gracilipes use primarily C3 photosynthesis. Therefore, the Kalanchoë genus has great potential to comparatively understand stomatal form, function and development in related CAM and C3 plants. Using K. laxiflora, we established and applied different methodologies to study stomatal development and physiology. Stomatal complexes in K. laxiflora present kidney-shaped guard cells, common in dicotyledonous species such as A. thaliana, but also three subsidiary cells of different sizes that are commonly seen in CAM plants. To better understand how these stomatal complexes are formed, we imaged developing stomatal complexes of plasma membrane reporter lines. We observed that during stomatal development in K. laxiflora, protodermal cells undergo more asymmetric divisions compared to A. thaliana, three subsidiary cells. We then determined if we indeed observe CAM physiology under our growth conditions. Thus, we performed gas exchange measurements over a 24-hour period using an infrared gas analyzer (LI-6800, LI-COR) on leaf pair 6 (LP6). Those measurements revealed that LP6 in K. laxiflora shows typical CAM signatures with most of the CO2 assimilation conducted at night. Finally, to understand the role of the closely connected subsidiary cells, we applied a treatment to observe potassium shuffling in the stomatal complex. We indeed observed that potassium ions shuffle between guard cells and subsidiary cells during stomatal opening and closing, respectively, suggesting an active role of subsidiary cells during stomatal movements. This result is reminiscent of subsidiary cells in grasses, where they were shown to play an essential role in fast stomatal kinetics. Together, we could show that K. laxiflora is an excellent model for studying stomatal development and physiology, with new and exciting avenues to be explored.

LACK OF TRADE-OFF BETWEEN TRAIT VARIATION AND INTEGRATION IN ATLANTIC FOREST TREES ACROSS ENVIRONMENTAL GRADIENTS

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The Atlantic Forest is a vegetation domain with high plant diversity, and trait-based studies have helped to understand the species and ecosystem functioning. Functional traits are measurable characteristics of individuals that modulate how they live and cope with different resources and abiotic conditions. Studies have reported that more restrictive environments promote greater integration among functional traits, while milder environments promote greater trait variation. However, in which cases this functional trade-off is valid remains an open question. This research evaluated the variation and integration among leaf and wood traits and how they change in time (dry and rainy seasons) and space (three restored areas that differ in irradiance levels). Areas with shaded, intermediate, and sunny understories were studied in the Reserva Biológica União - RJ. Leaf area, specific leaf area, leaf density, leaf thickness, total chlorophylls, chlorophyll/carotenoids ratio, and wood density were measured for seven individuals of nine species in all areas in the dry (July 2022) and rainy (December 2023) seasons. Statistical analyses were performed to test differences in trait variation and integration among the three light treatments. The variation index did not differ among the shaded, intermediate, and sunny areas or dry and rainy seasons for any trait. However, the integration index differed among areas and seasons, with higher values in the sunny area in the dry season (shaded: 0.18 unitless; intermediate: 0.38, and sunny: 0.47). The correlation network analysis corroborated this pattern. Therefore, there was no functional trade-off between trait variation and integration. We conclude that the forest canopy heterogeneity influences traits and restricts the strength of trait integration, although not their variation, likely due to the type of abiotic gradient.

LEAF PHOSPHORUS SPRAYING ENHANCES SUGAR TRANSPORT, NUTRIENT ALLOCATION, AND SEED YIELD IN COMMON BEAN

matheus dalllo laira, Fernando César Bachiega Zambrosi, Tamires da Silva Martins, Rafael Vasconcelos Ribeiro, Sara Adrian Lopez de Andrade

Phosphorus (P) deficiency impairs carbohydrate metabolism and transport, reducing nutrient allocation to developing flowers and decreasing seed yield. Leaf P spraying presents an alternative management strategy for crops facing P deficiency. We hypothesized that leaf P spraying would improve sugar transport to the flowers of common bean plants. The experiment was conducted under growth chamber conditions, with plants supplied 20 μmol P L-1every 3 days, leading to P deficiency. Leaf P spraying was applied as a single pre-anthesis supplying of 0.2 mol P L-1 (+P), using KH_2PO_4. The reference group (-P) was sprayed with 0.2 mol K L-1 solution, using KCl. Phloem sap and flowers were collected two, four, six, and eight days after leaf P spraying. Compared to the reference group, phloem P concentrations increased by 66% and 70% after four and six days post-spray, respectively. Similarly, sucrose levels in P-sprayed plants increased by 23% and 35% on the fourth and sixth days when comparing with plants from the reference group. Flower P, soluble carbohydrates, and starch content also progressively increased following P spraying. In conclusion, leaf P spraying effectively enhanced P and sucrose levels in the phloem, improving nutrient allocation to reproductive structures. This enhancement led to increased pollen viability, improved pod set, and higher seed yield. Leaf P spraying offers a promising strategy to sustain sucrose supply during floral development, especially under stressful conditions – an issue to be further explored.

Light spectra influence Gallesia integrifolia shoot development in vitro and change proteomic and polyamine profiles

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The light spectrum is a relevant factor for in vitro plant propagation. The aim of this study was to evaluate the effect of the spectral quality of light on the in vitro propagation of G. integrifolia, a native woody species with pioneering characteristics and potential for the recovery of environmental areas impacted by deforestation. Cotyledonary and apical nodal segments were inoculated in MS culture medium with 0.5 µM benzyladenine and incubated at 25 ± 2 °C under 16 h light, at intensity of 55 µmol m-2 s-1 and three different types of LED lamps: white with medium blue (WmB); white with medium blue and red (WmBR); white with medium blue, red and far red (WmBRfR); and a fluorescent lamp. The greatest shoot length was obtained with the WmBR LED lamp treatment in both nodal segments. Shoots grown under the WmBR LED lamp presented higher contents of total free PAs and free putrescine than shoots grown under the fluorescent lamp. Proteomic analysis enabled the identification of 312 proteins, 39 of which were differentially accumulated. Shoots incubated under the WmBR LED lamp presented a greater abundance of a set of chlorophyll a/b-binding proteins related to photosynthesis and aconitate hydratase, a protein associated with the TCA cycle. The photosynthetic pigments and Fv/Fm were greater in the shoots maintained under all the LED treatments than in those maintained under the fluorescent treatment. Leaves of shoots grown under the WmBR LED lamp presented greater thickness of the spongy parenchyma and less thickness of the palisade parenchyma than did leaves of shoots grown under the fluorescent lamp. These results contribute to the understanding of shoot growth under different light spectra, especially red light, and may lead to the optimization of large-scale propagation protocols for this species.

Loss of S-nitrosoglutathione reductase leads to extensive transcriptional and metabolic rewiring during tomato fruit ripening

Jessica Naomi Motobu Ueda, Patricia Lopes de Oliveira, Rafael Zuccarelli, Magdalena Rossi, Luciano Freschi

Nitric oxide (NO) plays a wide range of physiological roles in plants, influencing developmental processes from seed germination to plant growth and senescence. Up to now, information about the influence of NO on fruit ripening is largely confined to data from the exogenous application of NO and its agonists and antagonists, especially during the postharvest storage of climacteric fruits. As a modulator of transnitrosylation equilibrium between S-nitrosoglutathione (GSNO) and S-nitrosylated proteins, the enzyme GSNO reductase (GSNOR) plays a central role in NO homeostasis and signaling in plants. Here, we performed an in-depth characterization of the concomitant changes in tomato (Solanum lycopersicum) fruit composition and quality traits in response to endogenous GSNO/NO changes. Isoprenoid profiling in ripening fruits of SlGSNOR-overexpressing and -silenced lines (SlGSNOR-OE and SlGSNOR-RNAi, respectively), as well as Slgsnor knockout plants, revealed that excessive fruit GSNO/NO levels significantly limit carotenoid and tocopherol accumulation by down-regulating key biosynthetic genes such as SlGGPS1, SlPSY1, SlPDS, SlDX1 and SlVTE2. In contrast, ascorbate and flavonoid levels were significantly promoted in SlGSNOR-RNAi and Slgsnor ripening fruits compared to wildtype counterparts. In agreement, increments of up to five times in the transcript levels of major flavonoid biosynthetic genes, such as SlCHS1, SlF3H and SlFLS, were detected in early ripening fruits of Slgsnor plants. Extensive transcriptional reprogramming was observed in early ripening Slgsnor fruits compared to the wildtype counterparts, including changes in transcript abundance of key ripening-associated developmental regulators, such as RIN and TAGL1, and genes associated with ethylene biosynthesis and signaling. In contrast, very limited impacts of SlGSNOR-overexpression were detected in tomato fruit composition and quality traits. Altogether, our findings indicate that changes in endogenous GSNO/NO levels trigger extensive transcriptional and metabolic rewiring at the early tomato ripening stage, significantly modifying the antioxidant composition of ripe tomato fruits.

MATURATION AND SUGAR SIGNALING IN FLORAL INDUCTION OF CONTRASTING SUGARCANE CULTIVARS FOR FLOWERING

Vitor Luciano Costa da Silva, Manoel Viana Linhares-Neto, Antônio Chalfun Júnior

One of the biggest challenges faced in increasing sugarcane productivity is the flowering, a process in which sucrose stored in the stalk is used in the development of floral organs. Concomitantly, the dehydration of the internodes (isoporization) intensifies, resulting in production losses. There are cultivars with frequent and rare flowering, even with similar maturation time and cultivated under the same photoperiod. Nevertheless, studies in the literature are scarce that elucidate biochemical and molecular mechanisms responsible for such physiological properties and how to best explore them. Evidence shows that mechanisms related to the interaction between photoperiod and carbohydrate metabolism may be involved in floral induction. Therefore, the objective of this research was to evaluate the physiological profile of maturation and development of isoporization of two cultivars contrasting to flowering. Additionally, we aimed to evaluate the expression of ScTPS1/ScTPS6 under different photoperiods using RNA-seq analysis. The cultivars CTC9003 (rare flowering) and RB966928 (frequent flowering) were used. Isoporization and maturation analyzes were done under field conditions, during the photoperiodic induction period, with monitoring until the end of the harvest. Cultivar RB966928 only flowered in 2023, allowing two different maturation and isoporization accumulation profiles to be obtained. In 2022, there was no statistical difference in the average accumulation of sugar over time, while in 2023 there was. Furthermore, isoporization levels varied little in 2022, while in 2023 they decreased over time. In silico analysis demonstrated the influence of shortening the photoperiod on the ScTPS1/ScTPS6 expression. The results obtained demonstrated that the sugar status may have influenced floral induction through the photoperiodic pathway and the ScTPS6 gene may act as a possible signal for photoperiod reduction. In this case, inhibition of ScTPS6 may significantly contribute to the repression of floral induction in sugarcane.

Morphological and physiological alterations in Arabidopsis thaliana exposed to TORC1 inhibitor

Mayra dos Santos Gomes, Samara Alves Azeredo, Letícia Cespom Passos, Antônio Jesus Dorighetto Cogo

The TORC1 protein complex acts as a regulatory center that translates environmental information into responses that can inhibit or promote plant cell growth, since it can be activated by nutrients and growth factors. Recent studies suggest that plasma membrane H + -ATPase is involved in the activation of TORC1, although the mechanisms still remain elusive. Thus, we sought to investigate the effect of pharmacological inhibition of TORC1 complex on the morphology and physiology of Arabidopsis thaliana (Col-0) and in the activity of H + -ATPase plasma membrane. To do this, the seedlings were germinated in a Murashige & Skoog (MS) medium containing increasing concentrations of Torin-2, a potent pharmacological inhibitor of TORC1. Additionally, seedlings with 4 days after germination were also transferred and grown vertically in plates containing or not increasing concentrations of the inhibitor. The morphological and physiological parameters were analyzed after 7 and 14 days. We detected that A. thaliana seedlings germinated in Torin-2 showed reduction in the germination rate and plant development from the concentration of 250 nmol L -1 , characterized by reduction in the number of seedlings and leaves and leaf size. On the other hand, seedlings with 4 days after germination exposed to the inhibitor showed reductions in concentrations of photosynthetic pigments, including carotenoids, fresh and dry mass of the aerial part from the concentration of 100 nmol L -1 of Torin-2. Changes in root architecture, hair number and rhizosphere pH were also found in plants exposed to the inhibitor. Thus, we observed that the inhibition of TORC1 significantly alters the morphology, physiology and development of A. thaliana. As a next step, we hope to associate it with modulations in the primary proton transport system during the polarized growth of plant cells.

Morphological and physiological changes in Arabidopsis thaliana inoculated with Herbaspirillum seropedicae

Samara Alves Azeredo, Mayra dos Santos Gomes, Letícia Cespom Passos, Antônio Jesus Dorighetto Cogo

The gram-negative bacterium Herbaspirillum seropedicae is widely known for promoting plant growth in grasses through root colonization, biological nitrogen fixation and the production of phytohormones. Although much is known about these mechanisms, it is believed that other unexplored processes may contribute to this association. In order to define a model to help understand the plant-bacteria association, we sought to identify the morphological and physiological changes in Arabidopsis thaliana seedlings inoculated with H. seropedicae in a semi-solid medium or hydroponic culture. For this purpose, seedlings 4 days after germination were transferred to semi-solid Murashige and Skoog (MS) medium and inoculated or not with a population of 104 or 106 cells of H. seropedicae strain HRC54. The assays were conducted in the presence or absence of 100 µM of vanadate, an inhibitor of plasma membrane H+-ATPase. Seedlings were also grown in Basal Nutrient Solution (BNS) under hydroponic conditions and inoculated after 6 days of germination. Morphological and physiological parameters were assessed after 14 and 21 days. Inoculation with H. seropedicae increased root length, the number of lateral roots, the concentration of photosynthesizing pigments, including carotenoids, in seedlings grown in semi-solid medium, especially at a concentration of 106 cells. This same concentration also increased the fresh and dry mass of the aerial part and the root system. On the other hand, the presence of vanadate reduced these parameters, even in inoculated seedlings, suggesting the importance of plasma membrane H+-ATPases in the plant-bacteria association. Root growth was also detected in the hydroponic system. Thus, the beneficial effects observed by H. seropedicae inoculation in A. thaliana were dependent on cell concentration and plasma membrane H+-ATPase activity.

MORPHOMETRIC CHARACTERIZATION AND GROWTH KINETICS OF CYANOBACTERIA STRAINS UNDER DIFFERENT NITROGEN AND CARBON CONCENTRATIONS

Thamires Emidio Sateles, Jean Coutinho Oder, Allan Victor Martins Almeida, Daniela Cristina Gomes Passe, Laila Barros de Souza, Marcelo Gomes Marçal Vieira Vaz, Wagner L. Araújo

Cyanobacteria (Cyanobacteriota) are gram-negative prokaryotic microorganisms that perform oxygenic photosynthesis and exhibit high genetic and physiological diversity. Despite their biotechnological potential and adaptability to various environments, the effect of variations in the culture medium on the growth of specific strains is not yet fully understood. In this context, investigating carbon and nitrogen metabolism is crucial, as these processes regulate growth, production of organic compounds, pigments, and energy reserves, directly influencing the photosynthetic efficiency of these microorganisms. This study aimed to morphometrically characterize and evaluate the growth of two morphologically distinct strains: Synechococcus elongatus (PCC-7942) and Ancylothrix sp. (CCM-UFV034), cultured in BG-11 medium supplemented with different concentrations of N and C. For morphometric characterization, the strains were cultured in standard medium (BG-11 containing 1.5 g·L-1 of NaNO3 and 0.02 g·L-1 of Na2CO3), and cell width and length were measured using ImageJ software. Growth was assessed through optical density, dry weight, and ash-free dry weight, varying the concentrations of NaNO3 (0 [BG-110], 0.75 [BG-1150], and 1.5 [BG-11100] g·L-1) and NaHCO3 as an alternative C source (0.016 g·L-1 and 1.6 g·L-1). Additionally, the maximum growth rate and generation time were analyzed in response to each treatment. Morphometric analyses revealed that strain 034 has a cell size approximately 1.3 times larger than strain 7942. The data indicate that strain 7942 shows better growth performance at lower NaNO3 concentrations compared to strain 034, while both benefit from cultivation in NaHCO3 rather than Na2CO3. These results suggest exploring optimized use of NaHCO3 and adjustments in nitrogen supply to maximize the growth and metabolic efficiency of the two strains in future studies. This study preliminarily characterizes the strains' responses to carbon and nitrogen metabolism, contributing to the understanding of their impact on photosynthesis.

Morphophysiological Effects of Brassinosteroid Application on Young Catharanthus roseus Plants

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Brassinosteroids (BRs) are plant hormones that regulate various developmental processes in plants, such as cell division and elongation, photomorphogenesis, and senescence. Additionally, BRs confer tolerance to various types of biotic and abiotic stresses. Plant responses to BRs vary depending on the concentration and method of application. This study evaluated the effects of different application methods of the same concentration of 24-epiBl on the development of young Catharanthus roseus plants and its possible role in protecting the photosynthetic machinery. C. roseus seedlings were sprayed with BR solutions (Control: 0 M; BR1V: 10^{-6} M once; BR10V: 10^{-7} M for ten days, totaling 10^{-6} M). Growth parameters were assessed by measuring height increment, central vein length, number of leaves, dry and fresh mass of stems, roots, leaves, and flowers, leaf area, and root volume. In another group of plants, leaf greenness (SPAD-502), chlorophyll, flavonoid, anthocyanin contents, nitrogen-flavonoid index (MPM-100), and chlorophyll a fluorescence (FluorCam 800MF) were evaluated in three leaves of different ages (F1, F2, F3). A single application of BRs (BR1V) in C. roseus promoted biomass increase, possibly due to the induction of cell division and expansion, and protection of the photosynthetic machinery, as indicated by the observed non-photochemical quenching values for the F2 and F3 leaves, in addition to inducing senescence in mature leaves. Since the ten-day application (BR10V) did not promote the same effects, it is concluded that a minimum concentration of 24-epiBl is necessary to activate certain responses, and this activation is not associated with the accumulation of BRs in the tissues.

MORPHOPHYSIOLOGICAL RESPONSES OF COFFEA ARABICA TO INOCULATION WITH ARBUSCULAR MYCORRHIZAL FUNGI

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Climate change represents a significant threat to the sustainability of agricultural practices worldwide, affecting both the quantity and quality of crops. Arabica coffee (Coffea arabica L.) is economically vital globally and provides a livelihood for many families in developing countries. In this context, the symbiotic relationship between plants and arbuscular mycorrhizal fungi (AMF) has been extensively examined as a method to enhance crop resilience against various stresses. The aim of this study was to evaluate the growth and photosynthetic performance of coffee seedlings inoculated with AMF. The seedlings were grown over a four-month period, both with and without the inoculation of arbuscular mycorrhizal fungi (AMF). The results indicated that AMF inoculation increased the net photosynthetic rate in parallel with reductions in stomatal conductance. The inoculated seedlings exhibited a higher carboxylation rate of RuBisCO, which was accompanied by greater photochemical efficiency in light utilization, increased energy capture efficiency by the open reaction centers of photosystem II, and a higher photochemical quenching coefficient. These adjustments resulted in greater carbon uptake and reduced transpiration, thus improving water use efficiency. Moreover, the seedlings with AMF inoculation showed enhanced growth of both the shoot and root systems, with a higher amount of very fine and fine roots, which are essential for nutrient and water absorption. The results highlight the benefits of AMF inoculation for coffee plant growth and drought resilience, suggesting that Arbuscular mycorrhizal fungi (AMF) have the potential to serve as a highly valuable biotechnological tool for effectively mitigating and reducing the impacts of climate change.

MULTIVARIATE ANALYSIS OF DATA CONCERNING THE EFFECT OF COFFEE GROUNDS ON THE DEVELOPMENT OF Lactuca sativa L.

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Coffee grounds are an important by-product generated in the soluble coffee agroindustry and one of the alternatives for use as a bioinput in agriculture. There is a enormous potential for coffee grounds production in Brazil due to the quantity of coffee produced and high consumption by the population. The present study aimed to identify the effect of coffee grounds on the development and production of lettuce plants. The cultivation environment was a greenhouse covered with transparent plastic film and Sombrite® screen on the sides, with 50% shading. Initially, a mixture of soil and sand in a proportion of 3:1 respectively was separated into two containers, one of which was added with 10% coffee grounds and tubed for six months in a greenhouse with weekly irrigation. The test was set up in five-liter containers with four kilograms of substrate following a completely randomized design in a 2 x 2 factorial arrangement representing two types of substrates in the containers with the presence and absence of 10% coffee grounds and daily irrigation with tap water or a solution containing 10% coffee grounds. There were five replicates and the experimental plot corresponded to a pot with an American lettuce plant grown for 60 days in these containers. The results demonstrated that the use of irrigation with a solution containing 10% coffee grounds provided greater growth and production of lettuce plants through the increase in fresh mass, number of leaves and leaf area. However, the use of coffee grounds in the soil did not provide significant increases in development and production in relation to the control treatment. The results indicate that coffee grounds constitute an important bioinput for the production of vegetables and can contribute to reducing the use of mineral fertilizers and consequently saving money in the production system.

NANOPRIMING WITH SPIRULINA-DERIVED CARBON DOTS ENHANCES GERMINATION AND ACTIVATES STARCH METABOLISM IN RICE SEEDS

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Efficient germination is crucial to ensuring the uniform emergence of seedlings, maximizing the use of soil resources such as water and nutrients. This process is fundamental for agricultural success, as it lays the foundation for developing resilient plants. The climate crisis directly affects germination, plant establishment, and productivity, threatening global food security. In this context, several techniques have been studied to mitigate the stressful conditions, including seed nanopriming, which involves the prior exposure of seeds to a protective or stress-inducing agent, making the crop more resistant to future exposures. Therefore, the aim of this study was to evaluate the effects of carbon dots (C-dots) produced from Arthrospira platensis (Spirulina) biomass on the germination and establishment of rice seedlings. A concentration of 0.2 mg mL-1 of C-dots was used for nanopriming, with Arbolina (KrillTech) as the positive control (commercial product), and distilled water as the negative control. Nanopriming with Spirulina C-dots increased root length, vigor index I (% germination vs. length), and germination rate of rice seedlings by 36%, 22%, and 25%, respectively, compared to the control group. When seeds were nanoprimed with Arbolina C-dots, there was a 54%, 23%, and 2% reduction in root length, vigor index I, and germination rate, respectively. Additionally, there was an increase of 23% and 8% in starch and carbohydrate availability in plants treated with Spirulina, respectively. No significant differences between treatments were found in shoot length, dry mass, carotenoid content, total phenolics, soluble sugars, and amino acids. Our preliminary results indicate that Spirulina C-dots can bio-stimulate rice seed germination, increasing root length, germination rate, and plant vigor by improving starch metabolism, making them promising nanoparticles that could contribute to plant germination and establishment.

NUTRITIONAL DYNAMICS IN THE PHYSIOLOGY OF ISOETACEAE ISOËTES CANGAE

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Isoëtes cangae is an aquatic lycophyte endemic to the Amazon region. A thorough understanding of the physiological characteristics of I. cangae is essential for developing effective conservation strategies. This study aimed to investigate the patterns of absorption and distribution of macronutrients and micronutrients in the organs of I. cangae. Nutrient release from the substrate into the water and their uptake by the plants were assessed using closed glass containers containing specimens grown in commercial substrate and sand, along with 3.5 L of ultrapure water (n=20 plants). The uptake and distribution of nutrients in the plant tissues (leaves, corm, and root) and in the substrate were analyzed after 60 days of cultivation. Over 18 days, the release of nutrients from the substrate into the water (N, P, K, Ca, and Mg) showed an increase in nutrient concentration, with stabilization occurring from day 14 onwards. Calcium had the highest concentration released, reaching a maximum of 40 mg/L on the final day. In contrast, nitrogen had the lowest release, with values approaching 5 mg/L. Phosphorus, potassium, and magnesium concentrations were intermediate, ranging from 20 to 30 mg/L. Nutrient accumulation in I. cangae was most pronounced in the root and corm. The relative nutrient levels in the leaves were lower, though the inner leaves exhibited greater nutrient accumulation than the outer leaves. Among the macronutrients, the highest concentrations were of nitrogen in the root, potassium in the corm, and magnesium in the leaves. The micronutrients iron and manganese were most concentrated in the corm and root, while other micronutrients showed a more uniform distribution. This unprecedented data on the differential absorption of nutrients by the organs of I. cangae provides a valuable foundation for the development of new cultivation and conservation strategies for the species.

ONTOGENETIC CHARACTERIZATION OF EMBRYOGENIC CALLUS OF PALM OIL (Elaeis guineensis Jacq.)

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Palm oil is the most consumed vegetable oil in the world, and somatic embryogenesis has been the primary method used for the propagation of this species. The objective of this study is to elucidate the histological origin of embryogenic calli and somatic embryos in oil palm. For the induction of somatic embryogenesis, immature leaflets were inoculated in Petri dishes containing Y3 basal medium and kept in a growth chamber at 27 ± 1°C in the absence of light for 90 days. Subsequently, the material was transferred to multiplication, regeneration, and finally, germination media. Samples were collected at 0, 10, 30, 60, 120, 150, and 180 days of culture. The material was fixed in a solution of formaldehyde, acetic acid, and 50% ethanol. The samples were then dehydrated and embedded in acrylic resin. Histochemical analyses were conducted using Xylidine Ponceau, Lugol's Reagent, Schiff's Reagent/Periodic Acid (PAS), and Ruthenium Red. The calli originated from the vascular parenchyma of the explants. In this region, cells with meristematic characteristics were observed dividing periclinally, recognized as the first signs of competence acquisition. These cells exhibited large nuclei, thin cell walls, and an absence of reserve materials. In the calli, a significant accumulation of starch grains was observed in the peripheral regions. The central cells did not present an accumulation of reserve substances. The outer cell layers exhibited thicker cell walls than the central ones and a smaller nucleus-to-cytoplasm ratio, indicating lower metabolic activity. In the regeneration phase, it was possible to observe that the peripheral region contained cells with large nuclei and somatic embryos forming on the surface of these calli. It is concluded that the origin of the calli is the parenchyma associated with the vascular tissues, and the development of these calli is marked by various modifications in cellular structure and composition.

PARAMETERS THAT INFLUENCE FOLIATION IN Malpighia emarginata DC. CUTTINGS TREATED WITH PLANT HORMONE AND ALTERNATIVE ROOTING INDUCER

Ana Cláudia Alves Teixeira, Gabriel Batista Dantas, Nathalle Cristine Alencar Fagundes

The goal of this study was to evaluate the parameters that influence foliation in Malpighia emarginata DC. (acerola) cuttings treated with different concentrations of Solanum palinacanthum Lam extract and the commercial rooter hormone, Indole-3-butyric acid (IBA). The experiment took place in a greenhouse at the Universidade do Estado de Minas Gerais, Ituiutaba-MG campus, from March to June 2020. Cuttings of 8 cm in length were used, sanitized with Sodium Hypochlorite. To obtain the Solanum palinacanthum extract, 100 g of leaves were crushed in 1 liter of distilled water (raw extract, at 100% concentration), which was then diluted in distilled water for treatments at concentrations of 25%, 50%, 75%, and 100%. For IBA, a solution of 100 g of the acid in 1,000 ml of distilled water (100% raw solution) was used, following a similar dilution pattern. The parameters assessed were the number of leaves, internodes, and shoots, analyzed using One Way ANOVA in Statistic 10.0 software. The number of leaves ($df=8$; $F=3.88$; $p<0.00$), internodes ($df=8$; $F=4.85$; $p<0.00$), and sprouts ($df=8$; $F=5.79$; $p<0.00$) significantly differed among the treatments. The 50% S. palinacanthum treatment showed the highest values for the number of leaves ($\mu=9.32 \pm 1.15$), sprouts ($\mu=2.22 \pm 0.31$), and internodes ($\mu=0.71 \pm 0.13$), that differs statistically only from the 75% S. palinacanthum treatment in the number of leaves ($\mu=8.97 \pm 1.16$), but differing from all other treatments in the other variables analyzed. Therefore, we concluded that the 50% concentration of S. palinacanthum extract was more efficient in promoting leafing in acerola cuttings.

Performance of snap bean genotypes for seed production

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The production of snap bean seeds plays an important socioeconomic and nutritional role, especially in rural communities in Rio de Janeiro. However, its high potential is often limited by the low availability of cultivars adapted to the growing conditions of the Northern Fluminense region. In this context, it is valid to explore the genetic variability of the UENF snap bean germplasm to optimize the seed production of this legume. Therefore, 29 genotypes from the UENF snap bean seed bank, including introduced lines and cultivars, were sown in May 2023 in the experimental area of Pesagro-Rio – Campos dos Goytacazes, following the experimental design of randomized blocks, composed of 3 blocks and 5 replications, each experimental plot consisting of a row of 2.5 linear meters, with spacing of 1 meter between rows and 0.5 meter between plants. The morphological characteristics were evaluated by evaluating the number of seeds per pod (NSP), weight of one hundred seeds (W100S), total seed weight (TSW), number of pods per plant (NPP), pod length (PL) and pod diameter (PD). For the analysis of variance, grouping of means, as well as genetic parameters, the R software was used, with the aid of the "easyanova" package. Therefore, in the analysis of variance, it can be observed that there was a significant effect at the 1% probability level by the F test for all the characteristics analyzed, and the genetic parameters analyzed presented satisfactory estimates for all the characteristics. In summary, the genetic gains were positive and high for some characteristics, and the genotypic and phenotypic variances were higher than the environmental variance, which demonstrates a smaller residual effect and greater reliability in the estimates.

PHOTOCHEMICAL RESPONSES OF CAPSICUM BACCATUM AND CAPSICUM FRUTESCENS DURING IN VITRO CULTIVATION OF ZYGOTIC EMBRYOS

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Studies on optimizing the in vitro growth of the genus Capsicum are essential for producing hybrids in cases of incompatible crossing. Thus, the aim of this work was to evaluate the in vitro physiological performance of Capsicum baccatum and Capsicum frutescens under different sucrose concentrations. The embryos were isolated and placed to germinate in MS culture medium with half the salts and different concentrations of sucrose (0, 10, 20, 30, and 40 g L-1). The experiment was conducted in a completely randomized design. The photochemical efficiency variables [SPAD index, photosynthetic index (PI), maximum quantum yield of PSII (Fv/Fm), and net O2 evolution rate (NetO2), obtained by light response curve of ten decreasing photosynthetic photon flux density (PPFDs): 500, 429, 357, 286, 214, 143, 71 and 0 µmol m-2 s-1] were assessed at the end of 45 days. The variables were subjected to analysis of variance, and the means were compared using the Tukey test at a 5% error level. No significant differences were observed for the SPAD index and the Fv/Fm. Higher values of the PI (2.58) were obtained in plants grown at a concentration of 20 g L-1 for C. frutescens, while for C. baccatum, concentrations of 20 to 40 g L-1 presented higher values (1.50-1.61). No significant interaction was observed to NetO2 and sucrose for C. frutescens. In C. baccatum, plants grown in medium with sucrose showed greater O2 evolution, especially under high PPFD intensity. For C. frutescens, the evolution of NetO2 was greater with increasing PPFD and sucrose concentration up to 30 g L-1 (4.39). The increase in sucrose or PPFD concentration does not influence net O2 evolution rate to C. baccatum, and to C. frutescens, the maximum sucrose concentration (40 g L-1) resulted in a reduction in net O2 evolution rate, reducing the photochemical capacity.

Photosynthetic Characterization of Eucalyptus Clones at Different Developmental Stages

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The expansion of eucalyptus planting in Brazil has occurred in areas with different edaphoclimatic conditions, requiring genetic materials with different photosynthetic performances to maximize the carbon absorption and allocation. In this context, the physiological characterization of different clones at different developmental stages allows for the evaluation of the maximum carbon absorption potential and the selection of clones more efficient in the use of light and CO2. Additionally, by evaluating photosynthetic responses at different developmental stages, we can determine if it is possible to early select clones with higher photosynthetic efficiency.

This study evaluated five eucalyptus clones with different degrees of drought tolerance, both at the seedling stage in the nursery and after two years of age in the field, analyzing the point-in-time responses of gas exchange and under increasing light and CO2 intensities. Instantaneous measurements provide data on the physiological state of the plant momentarily, but do not capture variations over time. Overall, the analyses of photosynthesis, estomatal conductance, transpiration and Ci were similar between the two developmental stages of each genotype. Only the Clone 01 seedlings showed higher gs and Ci, which, combined with higher E, resulted in lower intrinsic water use efficiency compared to the two-year-old plants.

The analyses of light and CO2 curves evaluated photosynthetic parameters related to biochemical limitations. Clones 01, 02, 03, and 05 differed between stages for Rubisco carboxylation velocity (Vcmax) and apparent quantum yield (ϕ), and Clones 01, 02, and 05 differed between stages for electron transport rate (J). This highlights the difficulty of predicting the behavior of trees in response to climate changes and soil-plant-atmosphere relationships based on nursery seedlings.

In short, nursery seedlings provides insights into the genetic material's potential in the field. However, caution and prior knowledge of the plant's strategies to cope with climatic adversities during development are essential.

Physiological Components and Secondary Metabolites in Passion Fruit Seedling Leaves Under Rock Dust Fertilization

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The passion fruit plant holds significant economic and social importance, yet producing high-quality seedlings remains a considerable challenge. Due to the lack of information on substrates for passion fruit, the aim of this study was to evaluate the physiological development of Passiflora edulis f. flavicarpa seedlings in bags, using different concentrations of rock dust, along with bovine manure humus and soil. The experiment was conducted in the seedling propagation nursery at the Ifes Campus Itapina, using seeds of the cultivar BRS Gigante Amarelo (BRS GA1) and the fertilizer Ekosil® (28% Si and 8% K2O), set up in a randomized block design (RBD), with seven treatments, six blocks, and five repetitions. The treatments used were: a conventional substrate with 7.5L of manure + 22.5L of soil, and six mixtures with 1.5L of rock dust + 7.5L of manure + 21L of soil; 3L of rock dust + 7.5L of manure + 19.5L of soil; 4.5L of rock dust + 7.5L of manure + 18L of soil; 6L of rock dust + 7.5L of manure + 16.5L of soil; 7.5L of rock dust + 7.5L of manure + 15L of soil; and 9L of rock dust + 7.5L of manure + 13.5L of soil. Upon reaching commercial size, physiological parameters were evaluated, including chlorophyll content absorbed under green light and red light, flavonoids, anthocyanins in the red-green and red-blue wavelength ranges, nitrogen balance in green and red light, using the Multiplex. The results showed that the addition of rock dust to the substrate increased nutrient availability over time. Therefore, based on the analysis of the parameters, it is recommended to use concentrations between 3L and 9L of rock dust for the production of passion fruit seedlings.

Physiological index for predicting sugarcane flowering

Edson Yamamoto, Alexandrius de Moraes Barbosa

Flowering interrupts vegetative growth and reduces the technological quality of sugarcane. Flowering is influenced by several meteorological elements, such as photoperiod, soil water availability, air temperature and luminosity. In Brazil, due to the photoperiod, the inductive period for sugarcane flowering occurs between the end of February and the beginning of March. Thus, predicting flowering can aid in the management of flowering inhibitors. The study aimed to develop a physiological index for predicting sugarcane flowering (PIPSF). The index was based on three meteorological elements: atmospheric transmissivity (the ratio of radiation incident the top of the atmosphere to the global radiation measured on the surface), maximum air temperature and soil water availability. The index ranges from 0 to 1, with 0 being extremely unfavorable for flowering and 1 being extremely favorable. The index was validated in the region of Presidente Prudente, São Paulo, Brazil. In 2023, the PIPSF was 0.95 during the pre-inductive period and 0.91 during the inductive period. The index indicated extremely favorable conditions for flowering, which was confirmed in the field, making 2023 a year with a high flowering rate for sugarcane. The high PIPSF was due to increased cloudiness, mild temperatures and good soil water availability. In 2024, however, the PIPSF was 0.62 in the pre-inductive period and 0.48 in the floral induction period. For 2024, the PIPSF indicated unfavorable conditions for flowering due to low soil water availability, high air temperature and low cloudiness. These findings were consistent with field observations, where almost no sugarcane flowering was observed. The PIPSF proved to be an efficient tool for predicting and management sugarcane flowering, with the advantage of monitoring conditions during the pre-inductive and inductive periods for flowering.

PLANT-PLANT COMMUNICATION: THE CONSEQUENCE OF NEIGHBOR SIGNALLING IN BIOMASS ACCUMULATION

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The plant-plant communication occurs when the receiver organism perceives and processes a signal from the emitter organism. The plant response to air- and soil-borne volatile organic compounds (VOCs) signals are bioinspired strategies to ensure their survival and performance. Emerging evidence suggests that VOCs signals are modulators of receiver plant defense and growth. This study aims to verify how the growth of receiver plants could be modulated by a pool of constitutive or induced VOCs received through different pathways (soil, air-bone or both) from emitter plants. For that, soybean plants (V2 stage) were cultivated in acrylic boxes filled with substrate. Emitter plants were separated in two groups: 1- treated with a Methyl jasmonate 100 µM solution and 2- Mock (distilled water), stimulating emissions of induced and constitutive VOCs signals, respectively. A fundamental and primary setup was devised to estimate the movement of air- and soil-borne volatiles from emitters to receiver plants. Two weeks later of treatments application, the plants were removed from the acrylic boxes, and shoot and root dry weights (DW) were obtained by drying in an oven (70ºC, 3 days), and their ratio were calculated. According to the results, an increase in biomass accumulation was observed in plants that received the VOCs signals sent by emitters plants via roots. On the other hand, when the VOCs signals were sent via shoot through air-bone there were less increments, suggesting an inhibitory effect via shoot. Regarding DW ratios, a biomass investment inversion was observed according to chemical communication channels. The results from this study indicated that VOCs signals cuing from neighbors' plants cause growth changes in receiver plants depending on which pool of VOCs is released.

PLASTIC COVERING ALTERS MORPHO-PHYSIOLOGICAL TRAITS AND ALLOWS 'SAUVIGNON BLANC' GRAPE PRODUCTION IN TROPICAL REGION

Marcella Carvalho Chaves Daubermann, Marcel Bellato Spósito

In Brazil, grapevine (Vitis vinifera) cultivation faces significant limitations due to challenging weather and geographic conditions, which impact management strategies and production cycles. To overcome these challenges and enhance production, innovative techniques and technologies have been adopted. This study evaluates the combined effects of double pruning and plastic coverings on the physiology and anatomy of cv. Sauvignon Blanc grapevines. Double pruning involves a conventional pruning after winter harvesting and another at the end of summer. Plastic coverings, made of polypropylene and transmitting 70% to 80% of solar radiation, are used to mitigate disease issues such as downy mildew (Plasmopara viticola) and bunch rot (Botrytis cinerea). Our findings indicate that grapevines covered with plastic showed superior performance compared to uncovered plants. Covered plants exhibited increased growth, with greater height and stem diameter, as well as higher photosynthetic rates, transpiration, stomatal conductance, and chlorophyll content. In contrast, uncovered plants had thicker leaf epidermis and palisade parenchyma, and displayed epicuticular wax over the stomata, suggesting an adaptive response to high light intensity. The results suggest that while double pruning alone did not significantly enhance the performance of cv. Sauvignon Blanc vines, its combination with plastic covering created a favorable microenvironment. This environment promoted improved growth and physiological activity, primarily driven by enhanced photosynthetic rates and overall plant health.

POTENTIAL OF PLANT-GROWTH-PROMOTING BACTERIA FROM SEMIARID REGIONS FOR INOCULATION OF FORAGE CACTUS PEAR PLANTS

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The forage cactus pear plants are widely adapted to environments with high temperatures and water scarcity. Searching sustainable management techniques may can optimize cactus pear nutrition and yield. This study aimed to investigate the impact of plant-growth-promoting bacteria (PGPB) strains and nitrogen (N) supply on growth and N accumulation of two forage cactus pear cultivars (Baiana and Doce miúda) in semi-arid soil. For each cultivar, the experiment was conducted in a greenhouse using a randomized block experimental design in a 6 × 3 factorial scheme, consisting of six inoculation treatments [two strains of Bacillus subtilis (IPACC29 and IPACC26), two strains of Paenibacillus sp. (IPACC55 and IPACC38), one commercial inoculant (Azospirillum brasilense - AB), and a uninoculated control] and three nitrogen doses (0, 50 and 100% N recommendation). Overall, considering the visual aspects, the growth of the forage cactus pear was more affected by the addition of N. The cultivars differently responded to inoculation with PGPB and N regimes. The IPACC29-inoculated Baiana plants showed significant increase in dry mass of cladodes (DMC) at the 50% N dose, as compared to other treatments. The strains IPACC55, IPACC26 and AB promoted higher root dry mass (RDM) in the N absence, while all inoculated treatments increased RDM at 50% N regime. For the Doce miúda cultivar, the strains IPACC55 and IPACC38 increased the DMC under 50% N regime. Under N absence, all strains increased nitrogen accumulation, except for AB; while at 50% N regime, IPACC26 strain provided the highest nitrogen accumulation in cladodes, and IPACC38 and AB promoted in the roots. As a conclusion, the IPACC29 strain is the most effective in promoting nitrogen accumulation and growth in Doce miúda cultivar, demonstrating potential for use as inoculants in forage cactus pear plants.

Productive behavior of three blueberry cultivars under high-tropic conditions during a harvest season

Kevin Alejandro Miguez López, José Estiben Pacheco Díaz, Aquiles Enrique Darghan Contreras

The blueberries crop (Vaccinium corymbosum L.) has gained worldwide popularity due to their nutritional value and positive effects against diseases, which increases their demand. Colombia's productive aptitude is due to its relatively stable climatic conditions, which allow it to offer blueberries to other countries when they are out of season. Despite the economic importance of the crop, the regional productive aptitude and export expectations, there is low certainty due to the lack of local evaluations that allow the selection of the best cultivars. In this research, five plants of the cultivars 'Legacy', 'Biloxi' and 'Victoria' were evaluated during one harvest season (June to December, 2023) under tropical conditions. Yield per plant, individual weight, number and size of fruits, as well as quality indicators such as firmness, total soluble solids and titratable acidity were measured, in addition to nutritional analysis. Analysis of variance was used for the repeated measures design for the comparison of yield indicators. In addition, the productive tendency and its association with climatic variables were evaluated. Quality data were analyzed by multivariate analysis of covariance. Differences between cultivars were found for the responses involved, with a productive accumulation every five weeks. The cultivar 'Victoria' showed the best yield per plant throughout the season, with an average weekly value of 67.21 g per plant and mainly large fruits (>16mm), which may be related to a better adaptation to environmental conditions. In terms of nutritional characteristics, the values are mostly like those of other producing countries except for acidity, whose lowest value was that of the 'Legacy' cultivar and the highest that of 'Victoria'. These results provide the basis for minimizing the uncertainty related to the production of this important crop.

PROMOTION OF SOYBEAN GROWTH AND PRODUCTIVITY TRAITS BY USING NICOTINAMIDE

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The use of biostimulants, such as vitamins, applied exogenously can promote plant growth and thus contribute to higher grain productivity and greater sustainability in agriculture. Therefore, the aim of this study was to evaluate the effect of foliar application of nicotinamide on soybean crops in two growing regions, Chapadão do Sul (CHS) and Cassilândia (CAS). A randomized block design with seven treatments and four replicates was used. The treatments consisted of nicotinamide concentrations of 0, 100, 200, 300, 400, 500 and 600 mg L^{-1} water applied exogenously by foliar spraying at the R3 stage of the plants (beginning of pod formation). The application of nicotinamide resulted in an increase in vegetative traits of plant height and number of branches per plant by 9.7 and 7.8%, respectively. For productive traits, application of the vitamin resulted in increases of about 15.62, 18.57, 20.53, 4.32 and 19.19% in the number of pods, number of grains, grain mass per plant, mass of 1,000 grains and grain yield, respectively, on average across the two growing locations. The highest grain yield in CHS was 4538.9 kg ha^{-1}, obtained with 315.7 mg L^{-1} nicotinamide, while in CAS the yield was 4393.1 kg ha^{-1}, obtained with 323.8 mg L^{-1} nicotinamide. Note that the use of the vitamin reduced the difference in productivity, because without the use of the vitamin, CHS produced 14.5% more grains than CAS. It was concluded that nicotinamide at concentrations of 237.8 to 373.8 mg L^{-1} promotes soybean growth and yield in different environments and acts as a plant biostimulant.

Radiation supplementation (PAR, UV, IR) for Carica papaya L. seedlings in protected cultivation

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In protected cultivation, producing high-quality Carica papaya L. seedlings in the shortest possible time is crucial for optimizing both space and resources. The use of artificial lighting systems with LEDs (light-emitting diodes) to extend the photoperiod of photosynthetically active radiation (PAR) on the leaves presents a promising strategy to enhance CO2 assimilation rates, thereby promoting faster seedling growth. This study evaluates the effects of PAR supplementation on the growth of Carica papaya L. ('Candy') seedlings under protected cultivation. LED lamps were employed, delivering 90% PAR, 5% UV, and 5% IR at an intensity of 150 $\mu mol\ m^2\ s^{-1}$. The 'Candy' genotype was cultivated in 55 ml tubes and subjected to three treatments: total supplementation (TS) (12 hours of natural light + 8 hours of artificial light, DLI = 20 $mol\ m^{-2}\ s^{-1}$), partial supplementation (PS) (12 hours of natural light + 4 hours of artificial light, DLI = 18 $mol\ m^{-2}\ s^{-1}$), and no supplementation (NS) (12 hours of natural light, DLI = 15 $mol\ m^{-2}\ s^{-1}$). Both TS and PS resulted in greater seedling height and stem diameter. The Dickson quality index (DQI) was 75% higher in TS and 35% higher in PS compared to NS. The total net photosynthetic rate (A_{total}) was also higher in TS and PS treatments. During the supplementation period, TS and PS treatments sustained CO2 assimilation, whereas NS showed continued dark respiration. At midday, carbon assimilation and transpiration (E) rates were significantly elevated. There was no significant difference in the maximum quantum yield of PSII (Fv/Fm) between treatments; however, PI values were higher in TS and PS compared to NS. These results suggest that in protected cultivation, radiation supplementation can optimize the growth of 'Candy' papaya seedlings by extending the CO2 assimilation period.

RALF-INDUCED ROOT GROWTH INHIBITION DEPENDS ON ETHYLENE

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Plant hormone interactions are crucial regulators of root growth. Rapid Alkalinization Factors (RALFs) have been shown to affect multiple hormone biosynthesis and signalling pathways, including those for abscisic acid, brassinosteroids, and auxin. These small 5 kDa peptides are widespread throughout the plant kingdom and have also been identified in pathogenic fungi, bacteria, and nematodes. Initially described as plant peptide hormones that trigger rapid alkalinization in cell cultures and inhibit root growth, RALFs have since been linked to a variety of other functions, including pollen tube rupture, salt stress responses, and stomatal movement regulation.

Ethylene, a gaseous hormone, is another key player in plant growth and stress responses. Like RALFs, ethylene inhibits primary root elongation. In compact soils, ethylene levels increase, leading to even stronger root growth inhibition. Due to the overlapping roles of these two factors, we set out to explore how AtRALF1 may interact with ethylene in regulating root growth.

Our data suggest that AtRALF1 activity depends on both ethylene biosynthesis and signalling, particularly through the key ethylene signalling molecule EIN2. AtRALF1 treatment resulted in increased accumulation of ACO5 and higher transcription of ACS6/11, which are associated with promoting ethylene biosynthesis. Mutants lacking ACO and ACS enzyme functions were found to be insensitive to AtRALF1, indicating that these enzymes play an important role in the RALF-ethylene interaction. We are continuing to explore this relationship using various genetic tools, such as mutants and overexpression lines, to uncover the detailed mechanism of how AtRALF1 and ethylene coordinate to control root growth.

RNA-SEQ ANALYSIS OF GENES AFFECTED BY CARBON-BASED NANOMATERIAL IN TOMATO

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Recent research in agricultural nanotechnology has produced promising results, demonstrating its potential to improve plant growth, productivity and stress tolerance. Nevertheless, the assessment on the effectiveness and mode of action of carbon-based nanomaterial families is still lacking. It was aimed to evaluate a RNA-Seq dataset comparing the gene expression profiles of a foliar-sprayed and non-sprayed tomato (Solanum lycopersicum L. Cv. Micro-Tom) with a carbon-based nanomaterial. Composite samples of the leaves were harvested 48h before, 24h, 48h, and 168h after the treatment, for RNA extraction. Differentially expressed genes (Log2FoldChange ≥ 1, FDR ≤ 0.05) were identified, revealing 659 affected genes — 482 up-regulated and 177 down-regulated. Notable up-regulated genes included Solyc00g500050.1 (ATP synthase subunit alpha, 8M+ times), Solyc00g500319.1 (DNA-directed RNA polymerase subunit beta, 1M+ times), and Solyc11g018772.1 (Peroxidase, 4K+ times) after 168h. Other genes showed expression changes between 2-52 times across different time points. Down-regulated genes exhibited reductions from 50% to 0.05%, with the lowest expressions observed in Solyc08g077900.3 (Expansin-like B1, 0.097%), Solyc11g018772.1 (Peroxidase, 0.048%), and Solyc01g060020.4 (beta-1,3-glucanase, 0.048%). Interestingly, Solyc11g018772.1 (Peroxidase) switched from down-regulated at 48h to up-regulated at 168h. Moreover, the resulting differential expression can be related to regulating plant defense against biotic and abiotic stresses, elucidating part of the nanomaterial's mechanism of action. Major transcriptional changes may occur at time points not measured in this experiment and with other doses of the nanomaterial. Furthermore, these results are an important basis for understanding the nanomaterial's molecular effect in balancing plant growth and development, consequently increasing productivity in tomato crops.

SALICYLIC ACID APPLICATION EFFECTS ON YIELD AND FRUIT QUALITY IN ARISTOTELIA CHILENSIS PLANTS SUBJECTED TO DEFICIT IRRIGATION

Jorge González Villagra, León A. Bravo

Salicylic acid (SA) application could be an important tool to improve fruit quality and plant performance under deficit irrigation. Aristotelia chilensis (Mol.) is an endemic fruit species of Chile. However, few information is available on SA application effects on yield and fruit quality on A. chilensis. However, there is few information about the effect of SA application on A. chilensis. Therefore, we evaluated the SA application on antioxidant related-parameters and fruit quality in A. chilensis subjected to irrigation deficit. Three-year-old plants growing under field conditions were subjected to: 1) well-watered plants (WWP: 100% crop evapotranspiration (ETc), and irrigation deficit plants (IDP: 60% ETc) based on ETc. A single application of 0.5 mM SA was performed at fruit colour change by spraying fruits and leaves of both irrigation treatments. IDP showed the highest lipid peroxidation (LP) levels in leaves. Meanwhile, SA application reduced LP about 45% in IDP plants. SA also increased total phenols (20%) levels in fruits of IDP plants. Similar tendency was observed on antioxidant activity (AA), where SA improved its level around 20% in fruits of IDP plants. Interestingly, SA application increased equatorial diameter and fruit fresh weight (15 and 40%) in IPD plants compared to plants without SA. The WWP showed higher AA and total phenols (about 20%) in plants subjected to SA application. Meanwhile, no changes were observed on equatorial diameter and fresh weight in WWP. Thus, SA improve antioxidant-related parameters and fruit quality in A. chilensis plants subjected to irrigation deficit.

SAMBA, a member of the APC/C alters growth and fruit metabolites.

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The regulation of organ and organism growth is a complex and intriguing challenge in biology, particularly in plants where cell division and expansion are critical for development. These processes involve distinct cell types and occur at varying rates, requiring precise coordination. A key pathway in this regulation is the ubiquitin-proteasome system (UPS), which ensures that protein degradation occurs in a controlled, irreversible manner during the cell cycle. Among the components of the UPS, the Anaphase-Promoting Complex/Cyclosome (APC/C) stands out as a crucial E3 ubiquitin ligase that mediates the degradation of essential cell cycle regulators. Despite its significance, the role of APC/C in plant cell cycles and its regulatory mechanisms during division are not fully understood. Our previous research identified a plant-specific regulator of APC/C named SAMBA in Arabidopsis thaliana, which shows promise for enhancing yield through larger leaves, roots, and seeds.

To further investigate SAMBA's role in plant development, we employed CRISPR/Cas9 technology to create targeted mutations in the SAMBA gene in Solanum lycopersicum (cv. Micro-tom). Unexpectedly, the resulting edited lines exhibited significant growth delays compared to wild-type plants. Additionally, we observed alterations in fruit shape and size, along with notable differences in the metabolic profiles of fruit metabolites as analyzed by gas chromatography-mass spectrometry (GC-MS). These findings highlight the complex effects of SAMBA on plant growth and development, suggesting its critical role in regulating fruit characteristics and overall plant metabolism.

Selection of plant growth-promoting bacteria able to induce heat stress tolerance in rice plants

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One of the main abiotic disturbances resulting from climate change is thermal stress. When the temperature exceeds the critical limit, it causes irreversible damage to plants. Rice is one of the most important crops worldwide and requires an ideal temperature at each developmental stage. However, above 32ºC, all stages are affected. Biotechnology has increasingly sought strategies to enhance plant tolerance to environmental stresses, including heat. One such strategy is the use of plant growth-promoting bacteria (PGPB), which can benefit plants by providing phytohormones, fixing nitrogen, mobilizing potassium, solubilizing phosphate, chelating iron/zinc through siderophore production, thereby ensuring better development. This study evaluated the potential of PGPB in mitigating stress symptoms in rice plants subjected to high temperatures. For this purpose, four soil samples were collected from the rhizosphere of different locations to isolate PGPB resistant to high temperatures. From each soil, 100 bacterial colonies were isolated, followed by analyses of siderophore and indole-3-acetic acid production, phosphate solubilization, and growth capacity in carboxymethylcellulose. Out of the 400 isolated colonies, 28 that showed the best results were selected and grown again on petri dishes exposed to 42ºC for three days. After this period, 14 isolates were selected. These isolates were inoculated into rice seeds, and at the V5 stage, the plants were subjected to stress for five days, with a daytime temperature of 40ºC and 32ºC at night. Post-stress and post-recovery (11 days) collections were performed, and growth parameters were evaluated. Out of the 14 isolates, 9 showed the best results and will be used in future experiments, where further analyses and the selection of two isolates will be carried out. These isolates will be inoculated into rice seeds and the plants will be submitted to heat stress and grown to the end of the cycle to evaluate the reproductive stage and productivity.

SGSi - Sugarcane growth status index

Alexandrius de Moraes Barbosa

In recent years, various foliar application management practices have been implemented in sugarcane cultivation. The main objectives of these practices are to promote vegetative growth, induce maturation, and aid post-stress recovery. However, one of the challenges is determining the appropriate management strategy based on the plant's growth stage and current weather conditions to ensure an optimal response. In this context, the study aimed to develop an index indicating the current growth status of sugarcane. The Sugarcane Growth Status Index (SGSi) was developed considering five agrometeorological parameters: average, maximum, and minimum air temperature; solar radiation; and soil water availability. Sugarcane growth was classified into three states: vegetative growth (favorable climatic conditions for stalk development), transition (limitation of vegetative growth or end of the rippening period), and rippening (climatic conditions promoting sugar accumulation in the stalk). The SGSi was applied to the conditions of western São Paulo, Brazil, over three crop seasons (2021/22, 2022/23, and 2023/24). Based on climatic conditions, the SGSi indicated favorable periods for stalk development (October to March) and the rippening period (May to August). Additionally, the SGSi identified that April and September are months with transitional climatic conditions. The SGSi also helped identify the climatic parameter that most significantly impacts sugarcane development. The soil water availability factor during spring and summer was 0.87 in the 2022/23 season and 0.74 in the 2023/24 season. Regarding the temperature factor, the SGSi indicated values of 0.88 in the 2022/23 season and 0.80 in the 2023/24 season. The SGSi indicated a reduction in sugarcane yield in the 2023/24 harvest due to periods of low soil water availability and high temperatures. Thus, the SGSi proved to be an important tool for monitoring and understanding the effect of climate on plant development, enabling better planning and decision-making in sugarcane cultivation management.

SILICON SUPPLY MODIFIES ELECTROLYTE LEAKAGE AND PHOTOSYNTHETIC PIGMENT SYNTHESIS IN HYDROPONIC CORIANDER

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Despite the importance of Coriander (Coriandrum sativum L.), there is little research on the effect of silicon (Si) supply on its physiology. Therefore, the objective of this study was to evaluate the influence of foliar application of Si supply on the physiology of coriander plants. The experiment was carried out in a greenhouse located in the municipality of Capitão Poço - PA, using hydroponics. The experiment was conducted in a randomized block design, in a 2 x 4 factorial scheme, with two sources (nanosilica - NS and potassium silicate - SK) and four doses of Si (0, 1, 2 and 4 mmol L-1), with four replicates. After 24 days, the physiological variables were determined: electrolyte leakage index (EE), chlorophyll, carotenoid and pheophytin contents. To determine the EE, ten leaf discs were taken from a developed leaf and the electrical conductivity was measured. On the other hand, pigments were determined using a spectrophotometer. The data were subjected to analysis of variance using the F-test ($p<0.05$) and, when significant, regression analysis was used for the dose and interaction factors and the Tukey test for the source factor ($p<0.05$). For EE, there was a significant effect only of the Si dose factor with quadratic adjustment. Contrarily, foliar spraying with SK and NS promoted a quadratic increase in total chlorophyll concentration up to doses of 2.1 and 3.5 mmol L-1, respectively. Regarding carotenoids, foliar application of SK and NS increased their concentrations quadratically, reaching maximum concentrations of 64.53 and 60.08 ug mL-1, respectively. Lastly, the application of NS reduced the total concentration of pheophytin in the leaves, while there was no significant response to the increase in SK doses. In general, the foliar application of 2 mmol L-1 of Si is beneficial for the physiology of coriander plants cultivated in the nutrient solution.

SINGLE-MERISTEM TRANSCRIPTOMICS: UNCOVERING VEGETATIVE DYNAMICS DURING FLORAL TRANSITION

Camila Pinto da Cunha, Grace Lhaineikim, Zohar Meir, Yuval Eshed

The tomato shoot apical meristem (SAM) undergoes a consistent and iterative transition from vegetative to reproductive states, serving as a model for studying the onset of flowering. Loss-of-function mutants of key regulatory genes can elucidate their roles in this process, though causal and random molecular events influencing phenotype may introduce complexity. In this context, temporal analysis of mutants offers deeper insights. We evaluated 1,202 single-meristem transcriptomes, spanning vegetative to floral stages in wild-type (M82) and two late-flowering mutants: single-flower truss (sft) and delayed sympodial termination (dst). Meristems were classified into seven developmental stages based on size, shape, and color. We inferred pseudotime-based ordering for each genotype using two approaches: (i) a morphology-based supervised clustering with the Slanter algorithm, with minor modifications from our laboratory previous work, and (ii) an unsupervised deep learning-based tool. By integrating early vegetative and floral meristems, we generated a detailed map of the SAM floral transition. We compared trajectory inferences from both methods for WT and mutants, focusing on transcription factor families involved in flowering time and inflorescence architecture, such as AP2, SPL, and MADS. Pseudotime inference was particularly challenging in the early stages of the developmental trajectory due to a lack of morphological differences, batch effect, potential missing intermediate states, and limited prior knowledge of the data. Nonetheless, our analysis reveals significant gene dynamics within the vegetative SAM, well before the onset of transient floral programs. These findings will aid in identifying new target genes involved in early SAM dynamics for future genetic analyses and support new hypotheses regarding the molecular control of the floral transition.

Slow growth in the in vitro conservation of Byrsonima gardneriana A.Juss

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Byrsonima gardneriana A.Juss popularly known as murici it is distinguished by its multiplicity of uses, including food and medical. Due to the low germination rate added the degradation of their natural habitat and the extractive exploitation, there is a real risk to the survival of the species in the wild. Thus the tissue culture, by minimal growth allows the conservation of plant genetic resources, becoming a complementary tool to conventional conservation practices. The objective of this study was to develop efficient protocols for in vitro conservation of B. gardneriana. They were used as initial explant, seedling from germination in vitro with up to 2cm long Seedlings were transplanted to medium MS / 2 culture, with 0.7% of agar. In the first experiment the culture medium was supplemented with different concentrations of sucrose (43.82 and 87.64 mM) combined with sorbitol or mannitol concentrations (0.0 and 58,42mM). In the second experiment, the seedlings were inoculated into culture medium containing different concentrations of PBZ (0.0; 0.42; 0.85; 1.70; 3,40µM). Were evaluated at 90, 180 and 240 days: Percentage survival, number of green leaves, senescent leaves, number of roots, shoot length. At 180 and 240 days for the evaluation of anatomical characteristics were measured thickness of the adaxial and abaxial epidermis, palisade and spongy parenchyma, mesophyll and leaf blade. 240 days were evaluated chlorophyll a, b and total. The species conservation in vitro was not efficient with the supplementation of culture media with osmotic agents and hormonal retardant species survival rate is 60 to 80% by 240 days without subculture.

Spatio-temporal expression of SAMBA in Solanum lycopersicum (tomato) cv. Micro-tom

Ana Isabela Chang, Perla Novais de Oliveira, Gabriela de Fátima Cia, Nubia Barbosa Eloy

The Anaphase Promoting Complex/Cyclosome (APC/C) is a E3 ubiquitin ligase involved in the ubiquitin-dependent proteolysis of cell cycle regulatory proteins by the 26S proteasome. Due its essential role for correct cell division, in mammals and yeast their components have been extensively studied, but relatively less in plants. Furthermore, several studies have demonstrated that APC/C plays roles beyond cell cycle regulation. Some years ago, we identified a plant-specific regulator of the APC/C complex, called SAMBA. In Arabidopsis, SAMBA is expressed during embryogenesis and early development and plays a key role in organ size control, making it a promising candidate for translational research in cultivated crops. To extend our study with SAMBA gene, we identified and isolated the putative promoter region of SISAMBA (Solanum lycopersicum) from tomato plants, Micro-tom. A 1.6-kb fragment upstream of its ATG start codon was fused with β-glucuronidase gene and introduced into tomato plants through Agrobacterium transformation. Our data show that SlSAMBA is expressed in different parts of floral buds: pistil, anther and pollen grains. In the fruit, a strong signal was observed at 10 days post anthesis and gradually decreased until the ripening. Additionally, we characterized the tissue-specific expression profile of SISAMBA using Real Time quantitative PCR. The comparative ΔΔCt method was used to calculate the relative expression displaying the highest mRNA levels in floral buds (20 days before anthesis (-20DBA) and -1DBA), which decreased in anthesis flowers (0 DBA). SlSAMBA expression was also high in early fruit development and gradually decreased through fruit ripening. At early stages of leaf growth, the expression was very strong, however it was absent in the 30-day-old seedlings' roots. Our study shows that SlSAMBA is highly expressed throughout the early stages of plant development demonstrating its central function during this phase.

SPATIOTEMPORAL PHYSIOLOGICAL DYNAMICS OF SPECIALIZED BIOACTIVE METABOLITES IN *Piper rivinoides* KUNTH A NATIVE ATLANTIC FOREST SPECIES

Jessica Sales Felisberto, Samik Antonio Massau, Daniel de Brito Machado, Jefferson Adriano Assunção, Ygor Jessé Ramos, Davyson de Lima Moreira

Plant metabolism is categorized into primary or central metabolism, which produces essential macromolecules like carbohydrates, proteins, fatty acids, and nucleotides, and secondary or specialized metabolism, responsible for generating low molecular weight, complex compounds crucial for environmental signaling and adaptation. Chemical phenotypic plasticity is key for plants' adaptive responses to environmental variables. Spatiotemporal patterns, shaped by biotic, abiotic, and genetic factors, greatly influence this plasticity. Understanding the modulation of specialized metabolites' physiology throughout plant development provides critical insights for research in plant physiology, pharmacology, and phytochemistry. This study focuses on Piper rivinoides (Piperaceae), a native Brazilian plant known for its medicinal and aromatic properties. P. rivinoides produces various specialized metabolites, including terpenes and neolignans, which demonstrate significant bioactive potential. The goal of this research is to quantify the neolignans eupomatenoid-5, eupomatenoid-6, and conocarpan at different developmental stages and in various organs of P. rivinoides Kunth to better understand the species' physiological and adaptive dynamics in natural ecosystems. 70g of roots, main stems, branches, and leaves from Pedra Branca State Park, RJ was collected. The developmental stages ranged from 25 cm unbranched seedlings (Phase I) to mature 7-meter lignified plants (Phase V). At least five plants of similar size were selected within a 30-meter radius to ensure genetic uniformity. The samples were lyophilized, ground, and subjected to ultrasound-assisted hydroalcoholic extraction, followed by HPLC analysis using an isocratic method. All three neolignans were detected across the samples, with leaves showing the highest concentrations. The extract yield ranged from 1.4% to 7.1%, peaking in Phase V leaves. A decreasing trend in neolignan concentrations was observed in roots, leaves, and stems as plants matured. These variations likely reflect physiological adaptations, such as resource redistribution and ecological factors like shifts in selective pressures (Pant et al., 2021; Divekar et al., 2022).

SPECTRAL QUALITY EFFECT ON in vitro ROOTING OF Eucalyptus urophylla x E. grandis AND ACCLIMATIZATION IN BIODEGRADABLE CONTAINER

Douglas Machado Leite, Marcelo Henryque Barbosa Melo Junior, Alfredo Rodrigues de Sena Neto, Gilvano Ebling Brondani

Clonal forestry with eucalypts is one of the most established practices, allowing, among other advantages, the standardization of plantings, maximization of gains in productivity and wood quality, better adaptation of clones to the area to be planted, and the use of specific hybrid combinations. Plant biotechnology through micropropagation makes it possible to seek and improve genetic materials that can reflect in great improvements in the productive chain of the species. The objective of this study was to evaluate the effect of spectral quality on in vitro adventitious rooting of urograndis eucalypt and the influence of biodegradable container on plant acclimatization. Explants were collected from plants in vitro established, standardized to 1 cm in length and subcultured in MS medium, supplemented with 6 g/L agar, 0.04 g/L charcoal, 0.1 g/L indole-3-butyric acid, 0.1 g/L α-naphthaleneacetic acid, 0.05 g/L benzylaminopurine and, pH adjusted to 5.8. The experiment was conducted in a completely randomized design, with 20 repetitions per treatment, namely: white LED lamp/37 µmol/m2/s, red LED lamp/9 µmol/m2/s, and blue LED lamp/14 µmol/m2/s. Plant acclimatization was done in biodegradable container in a mini-greenhouse system. It was observed that spectral quality did not present significant differences for the variables studied, presenting on average three roots per explant, good vigor, average shoot height of 1.4 cm, and an average of two shoots per explant, generating complete clonal plants. The use of container in plant acclimatization was efficient with survival above 80% in the three acclimatization tests. The protocol used for in vitro rooting was efficient and can be performed under white light, and the use of containers is recommended for acclimatization.

Statistical evaluation of coinoculation of growth-promoting and N-fixing bacteria in snap beans

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The snap bean (Phaseolus vulgaris) is a Fabaceae of Latin American origin and widely cultivated and consumed. The objectives of this study were to evaluate the effect of coinoculation of the seeds of the bean lines with the bacteria Bradyrhizobium elkanii and Azospirillum brasilense on the morphoagronomic traits of the plant. Ten lines of the F6 generation from the Plant Genetic Improvement Program of UENF were evaluated, obtained from crosses between a line with yellow pod color and UENF Goytacá (L7). The experiment was conducted in pots, in a greenhouse at UENF and the management followed the recommendations for the crop. The following variables were evaluated: Number of days to emergence (NDE), plant height (ALTP), number of days to flowering (NDIF), number of nodules (NNOD), root dry mass (MSRZ), number of pods per plant (NVP), number of grains per pod (NGV), grain weight per pod (PGV), grain weight per plant (PGP), pod length (COMPV). Statistical analyses, analysis of variance and grouping of means, were performed with the aid of the R program. According to the analysis of variance, there was no significant interaction for the variables NNOD, NVP, PGP and COMPV, however, for the bacteria factor (coinoculation) there was a significant effect for these variables which differed from the control treatment (without inoculation). For the variables NNOD, MSRZ, NGV, PGP and COMPV there was a significant effect of the interaction, that is, they cannot be studied in isolation, and their responses are differential for each genotype.

STREPTOMYCES TOLERANCE TO WATER STRESS AND POTENTIAL TO ALLEVIATE DROUGHT IN MAIZE (ZEA MAYS L.)

Luísa Machado Ramos, Eliane Romanato Santarém

Modern agricultural practices encounter several challenges, particularly abiotic stresses such as drought, especially in arid and semi-arid regions. Streptomyces spp. rhizobacteria are recognized for their plant growth-promoting abilities (PGPR), primarily through nutrient mobilization and metabolite production. This study aimed to assess the water stress tolerance of four Streptomyces isolates and their impact on the growth of maize plants cultivated under drought conditions. We evaluated the tolerance of Streptomyces isolates CLV16, CLV100, CLV115, and CLV179 to water deficit by cultivating them at water potentials of -0.6, -1.0, and -1.7 MPa. We also assessed the viability (CFU mL^{-1}) and production of metabolites such as indole-acetic acid (IAA) and siderophores. Initially, we evaluated the ability of Streptomyces to mitigate the harmful effects of drought on the growth of maize plants at 30% of field capacity compared to non-stressed plants. The isolates proved viable under a water deficit of -1.7 MPa, although a deleterious effect of stress was evidenced from –1,0 MPa. CLV115 produced the highest concentrations of IAA under stress conditions of -1 and -1.7 MPa. All isolates exhibited reduced siderophore production, but CLV16 was the least impacted by the water deficit. The response of maize plants treated with Streptomyces under water deficit conditions revealed that root colonization by CLV179 led to an increase of 11% in root biomass under stress. No significant variation was observed neither in leaf growth or biomass accumulation. These results suggest that CLV179 tolerates water deficit and enhances the root system development of Z. mays under drought conditions, likely through effective IAA production. Previously identified as halotolerant, Streptomyces CLV179 could be a biostimulant for maize cultivation under abiotic stresses, potentially improving root function for better water and nutrient acquisition.

STUDY OF INTERACTING PROTEINS WITH AtPI4Kγ1 IN ARABIDOPSIS THALIANA

Maria Eduarda Pena Ferreira, Gabriel Luis Lima Soares Moreira, Jennifer Eduarda Ibiapino Neves, Mônica Lanzoni Rossi, Francisco Scaglia Linhares

Phosphoinositides (PIPs) are lipids that define the identity of cellular and vesicular membranes, connecting vesicles with the cytoskeleton. In Arabidopsis thaliana, the phosphatidylinositol kinase AtPI4Kγ1, expressed during late floral development, is essential for the formation of viable pollen grains. However, its biochemical activity has always been elusive, possibly due to the "coincidence detection" mechanism, which requires interactions with other proteins, in specific compartments, to activate the biochemical function. A yeast two-hybrid screening identified 42 interacting proteins (PPIs) of AtPI4Kγ1. Detailed studies were conducted on different PPIs, based on their biological function, interaction strength, and the presumptive activity inferred from their mutants. Firstly, microscopic analyses (light and TEM) were performed on available KO mutants of the main PPIs, looking for defects shared with AtPI4Ky1 in the development of tapetosomes and elaioplasts during anther formation and pollen grain maturation. Additionally, aborted pollen grains with ornamental defects and delayed tapetum degradation were identified in some of the mutants. Expression analyses of these PPIs and the AtPI4Kγ1 gene were also carried out in arf8-7 plants, compared to WT individuals. Lastly, the five PPIs with the most coincidental experimental evidence regarding AtPI4Ky1's role in anther development were cloned in the yeast two-hybrid system, reversing bait and prey compared to the initial screening of interactors, in order to confirm the results obtained previously. The results obtained indicate that the "coincidence detection" mechanism effectively occurs between PPIs and AtPI4Kγ1, demonstrating that both are functionally related and play integrated roles in the floral development processes in Arabidopsis thaliana.

The in vitro germination and shoot development in Chloroleucon tortum (Mart.) Pittier

Guilherme da Silva de Oliveira; Mateus Santana Rodrigues; Renan Carrari dos Santos; Claudete Santa-Catarina

Chloroleucon tortum is a critically endangered Fabaceae recommended for restoring degraded areas. Alternative approaches using biotechnological methodologies for seedling production could be a significant tool for the conservation of this species. This work aimed to establish better conditions for in vitro germination and shoot development in C. tortum. For germination, seeds were inoculated in MS and WPM culture media supplemented with different concentrations of salts (50, 75 and 100%), sucrose (20 g.L-1) or agar (7 g.L-1), pH 5.7. Seeds were subsequently incubated under a fluorescent lamp and different LED lamps containing white (W), low blue (lB), medium blue (mB) and higher Blue (hB), deep red (dR) and far red (fR) light spectra: WmB, WhB, WlBdR, WmBdR, WlBdRfR and WmBdRfR. After 30 days, the germination (%), germination speed index (GVI), fresh and dry mass, and length of the aerial parts of the seedlings were measured. For shoot development, apical and cotyledonary nodal segments from germinated seedlings were inoculated in MS and WPM culture media supplemented with different concentrations (0.0, 0.5, 1.0, 2.5 and 5.0 µM) of benzyladenine (BA), sucrose (20 g/L) or agar (7 g/L), pH 5.7. After 45 days, shoot induction, number and length (cm) of the shoots were measured. Higher germination rates and aerial lengths of the seedlings were observed at 50 and 75% treatments in MS culture medium and 50% in WPM culture medium. A greater aerial length of the seedlings occurred under the WlBdRfR LED lamp. A greater length of shoots was observed at 0.5 µM and 1.0 µM BA in MS and WPM culture media, respectively. The cotyledonary nodal segment presented significantly higher shoots than the apical segment in both culture media. This is the first study on the in vitro propagation of this endangered species.

The Influence of Light on Cocoa Production in the Cerrado of Bahia

Edivânia Muniz de Souza Santos, Ana Maria Mapeli, Paulo Cesar Lima Marrocos

Cocoa (Theobroma cacao) is a highly significant crop in agribusiness, with a constant increase in the demand for cocoa beans. In response, the Executive Commission of the Cocoa Farming Plan (CEPLAC), in partnership with both private and public sector entities, has been developing new cultivation methods in non-traditional areas, expanding cocoa farming to Western Bahia. This study aimed to evaluate the leaf development of PS1319 cocoa plants under different light regimes during the early stages of production. Monthly collections of fully expanded leaves from PS1319 cocoa plants, cultivated at Fazenda Santa Helena, São José do Rio Grande-BA, were conducted from September 2023 to February 2024. Leaves were obtained from plants exposed to full sunlight throughout cultivation and from plants grown under shade for 15 months after planting, in consortium with banana plant. The following leaf characteristics were evaluated: fresh mass (FM), dry mass (DM), leaf area (LA), relative total chlorophyll content (RTChl), and the content of total soluble sugars (TSS), reducing sugars (RS), and non-reducing sugars (NRS). The experiment was conducted using a completely randomized design, with 8 replicates of 10 plants as experimental units. The analysis revealed that, during the evaluation period, plants grown under shade at the beginning of production had higher FM (16.6%), DM (48%), LA (2.3%), and RS content (13.8%); but lower values for RTChl (3.0%), TSS (1.0%), and NRS (4.5%). Therefore, it can be concluded that light exposure during the early stages of production influences cocoa plant development by affecting carbohydrate levels, which can impact leaf growth.

THE ROLE OF TYPE II PHOSPHATIDYLINOSITOL-KINASES DURING ANTHER DEVELOPMENT IN ARABIDOPSIS THALIANA

Gabriel Luis Lima Soares Moreira, Maria Eduarda Pena Ferreira, Jennifer Eduarda Ibiapino Neves, Mônica Lanzoni Rossi, Francisco Scaglia Linhares

The composition and diversity of the lipid bilayer directly affect the functions performed by membranes, as well as define their identity and state. Among them, the phosphatidylinositols have a myoinositol ring facing the cytosol capable of mono, bi, or tri phosphorylation on its carbons 3, 4 and/or 5, producing the phosphoinositides by the action of specific phosphatidylinositol kinases. The number and the position of the phosphorylations promote the membranes flagging defining their identity. Two type II PI4Ks (PI4Kγ) exhibit increased expression in floral buds of Arabidopsis thaliana, particularly within the anthers. Thus, this work focuses on uncovering their role in anther development processes. Within the anther, the tapetum is a secretory tissue that nurtures the developing pollen grains. Transmission Electron Microscopy revealed that single and double mutants lacking PI4Kγ expression exhibit vesiculation defects in tapetal cells, leading to abnormalities in pollen grain ornamentation. The maturation of pollen grains needs to be temporally coordinated with the anther dehiscence. Auxin seems to act as spatio-temporally link between anther dehiscence and pollen maturation. In silico analysis shows that the putative promoter region of these two PI4Kγ present Auxin Responsive Elements. Nonetheless, in a qRT-PCR assay, we demonstrated that both PI4Kγs exhibited lower expression in mutants lacking ARF (AUXIN RESPONSE FACTOR) transcription compared to the wild type. This work sheds light on the role of phosphatidylinositol-kinases and their product, phosphoinositides, regarding vesiculation process in tapetum development and its effects on pollen grain ornamentation. In addition, our results contribute to understanding the role of auxin during anther development.

TIME OF APPLICATION PROMOTES ANATOMICAL CHANGES AND GENOME DAMAGE INDUCED BY GLYPHOSATE IN TOMATO LEAVES

Welson Junior Silva, Domingos Ferreira Neto, Wagner L. Araújo, Adriano Nunes Nesi, Isabela Miriam dos Santos Barros, Júlia de Paiva Gonçalves

The circadian rhythm is the biological mechanism that regulates the metabolic activity of all living beings and is crucial for various physiological functions, such as stomatal movements. Glyphosate (N-(phosphonomethyl)glycine), a widely used herbicide, inhibits the enzyme 5-enolpyruvylshikimate-3-phosphate synthase, blocking the synthesis of amino acids essential for plant growth, leading to desiccation in susceptible plants. Research indicates that the time of application of agricultural inputs can influence their performance in plants. In this study, we investigated the impacts of glyphosate on the leaf architecture and genome integrity of tomato plants, with herbicide applications at dawn, noon, and dusk. The results revealed significant variations in stomatal opening throughout the day, which may have contributed to greater cellular damage when glyphosate was applied during the light cycle. The analysis of stomatal images suggests that stomatal opening is greater in the morning, potentially facilitating increased glyphosate absorption, which may explain the herbicide's greater efficacy when applied at this time. As the day progresses, stomatal opening decreases, potentially reducing glyphosate absorption and effectiveness. Studies with *Arabidopsis thaliana* have also shown that the expression of glyphosate tolerance genes varies according to the circadian cycle, with greater tolerance observed during the day compared to night. Thus, understanding the influence of the circadian rhythm on glyphosate absorption and performance is essential for developing more effective and sustainable agricultural practices for weed control.

TIME-DEPENDENT PROTEOMIC SIGNATURES IN EMBRYOGENIC CALLUS MATURATION OF *Passiflora edulis* SIMS 'UENF RIO DOURADO'

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Sour passion fruit (Passiflora edulis Sims) demonstrates significant economic and social importance, serving as a viable alternative, particularly for family farming. The cultivar P. edulis 'UENF Rio Dourado' was developed by the UENF plant breeding program that possesses climate characteristics suitable for regions north and northwest of Rio de Janeiro state. In vitro culture studies of Passiflora have provided valuable insights into the species' complex developmental processes, particularly somatic embryogenesis. In this study, we conducted a time-dependent analysis of the shotgun proteomics of P. edulis calli to investigate the key players involved in development of somatic embryos in response to a 6% PEG treatment throughout maturation. Proteins were extracted from explants at 0, 14 and 28 days of maturation using a bottom-up proteomic approach, and a total of 238 proteins were identified. Clustering analysis revealed four distinct patterns of protein accumulation throughout callus maturation. Proteins involved in cell cycle (I1J752; TUBB3) and cell communication (A0A0R0L0W8; UGP1) were abundant in the explants initially, with their levels decreasing as maturation progressed. Proteins related to primary metabolic processes and cellular organization maintained their accumulation patterns at the beginning of maturation but showed decreased levels by 28 days. UGP2 protein (A0A0R0EVU4), associated with cell wall organization, was more abundant at 14 days, suggesting its involvement in the development of somatic embryos during maturation. Stress response proteins, such as heat-shock proteins (HSPs), accumulated in response to the presence of 6% PEG during callus maturation. Predicted protein–protein interaction networks among differentially accumulated proteins (DAPs) revealed associations of proteins involved in the generation of precursor metabolites and energy at 14 days/0 days comparison of callus maturation. The identified proteins represent potential targets for enhancing Passiflora micropropagation and regeneration efforts.

Ultra-high carbonic fertilization in hops (Humulus lupulus L.) seedlings: growth and photochemical efficiency

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The increase in CO2 concentration in the air ([CO2]e) around the leaf notably affects plants with C3 metabolism. When exposed to [CO2]e (carbonic fertilization technique: Ultra-high CO2), some plants show high growth. This technique can be important in the production of hop seedlings (it has C3 metabolism, and the culture is very important in the brewing industry). Thus, this work analyzed the morphophysiological effects of macropropagated hop cuttings subjected to ultra-high CO2. The experiment was carried out in split plots [two CO2 chambers: CO2-400ppm and CO2-5000ppm (ultra-high CO2)] in a randomized block design, containing two cultivars ('Amália' and 'Nugget') and with six replications each. During 30 days of cultivation after staking (DCAS) and 30 days of acclimatization [interception of photosynthetically active radiation (PAR) in the greenhouse = 30%], the seedlings were irrigated at the capacity of the pot. Inside the CO2 chambers, seedling growth and leaf ontogeny were evaluated at 30 DCAS, and between 20th and 30th DCAS in fully grown leaves, the SPAD8:00am index, leaf temperature (Tleaf-12:00am), as well as the temperature difference between the leaf and the air (ΔTleaf-air12:00am = Tleaf-12:00am – Tair-12:00am), and the chlorophyll fluorescence (NPQ12:00am, qL-12:00am, PhiII - 12:00am). Significantly ($p<0.05$), in 'Amália' CO2-5000ppm promoted a reduction in seedling height and in 'Nugget' it reduced the values of the SPAD8:00am index. In both cultivars subjected to CO2-5000ppm there was an increase in Tleaf-12:00am and a lower ΔTleaf-air12:00am. Furthermore, in this condition, both cultivars showed greater heat dissipation evaluated using NPQ12:00am. During acclimatization, only 'Nugget' with CO2-5000ppm showed a significant root increase. Therefore, among the cultivars studied, 'Nugget' showed the most significant morphophysiological effects. However, it is important to study ultra-high CO2 in other cultivars, as well as to study other concentrations of ultra-high CO2.

USE OF PACLOBUTRAZOL AS A STRATEGY TO REDUCE THE SIZE OF ORNAMENTAL SUNFLOWER CV. VINCENT'S CHOICE

Maria Eduarda de Souza Santos, Livia Mendes Carvalho, Giovanna Maria de Paula Carvalho, Paula Rabelo Vasconcelos, Ângela Maria Pereira Nascimento, Simone Novaes Reis, Fernanda Carlota Nery

The sunflower "Helianthus annuus" cultivar Vincent's Choice is very popular with growers due to its ornamental characteristics. However, these plants are large and can reach a height of 2.0 meters, which makes it impossible to sell them in pots. In this way, the growth reducer Paclobutrazol (PBZ) could be a strategy that provides an adequate size, both for inflorescences and stems, to better meet the demand of producers. The aim of this study was to evaluate the effects of soil application of different concentrations of paclobutrazol on plant size and inflorescences. The experimental design used was a randomized block design, with six treatments and five replications. The concentrations tested were 0.0, 100.0, 200.0, 300.0, 400.0 and 500.0 mL L^{-1} of PBZ, with five replications each. The seeds were obtained commercially and one week after sowing, the plants were transplanted into one liter pots containing commercial substrate. Phytotechnical evaluations of inflorescence height and diameter were carried out 15, 30 and 45 days after the soil application of PBZ. As a result, there was a linear reduction in plant height as the doses applied increased. At 45 days, at a concentration of 500.0 mL L^{-1} the plants had an average height of 17.47 cm, while the plants in the control treatment (0.0 mL L^{-1}) had an average height of 67.60 cm. As for the diameter of the inflorescences, there was no statistically significant difference between the treatments. These results are considered promising for the floriculture market, given that the size of the plants was reduced without altering their ornamental value, preserving desirable characteristics for the marketing of potted ornamental sunflowers. A dose of 500.0 mL L^{-1} of the growth regulator paclobutrazol is recommended for the Vincent's Choice cultivar.

UTILIZATION OF NANOPRIMING TO IMPROVE THE PERFORMANCE OF RICE SEEDLINGS

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Environmental stresses, especially water limitations, significantly affect rice cultivation, leading to slow germination, impaired stand uniformity, reduced growth, and lower yields. This study investigates the application of nanoparticles (NPs) in the physiological conditioning of seeds as a strategy to promote faster germination and minimize seed exposure to biotic and abiotic stresses. We hypothesize that nanopriming can improve plant establishment and optimize growth under challenging conditions. Japonica rice seeds were subjected to four treatments: control (non-primed seeds - US), hydropriming (water only), and nanopriming with Zn+Se and Zn+Se+B, with six replicates for each treatment. The seeds germinated in a growth chamber kept at 25 °C. Every six hours, we measured the content of glucose, fructose, sucrose, and starch, as well as the activity of α-amylase, germination percentage, germination speed index (GSI), and root length. The data was assessed for normality, followed by the analysis of variance, with the means compared using the Tukey test ($p \leq 0.05$). The results indicated that the seeds conditioned with NPs showed significantly higher α-amylase activity and higher rates of starch degradation compared to the controls. In addition, there was an increase in the concentrations of reducing sugars (glucose and fructose) and a reduction in sucrose levels. In addition, the seeds from the nanopriming treatments showed higher germination percentages, GSI, and longer root lengths. Our results suggest that nanopriming with Zn, Se, and B is a viable strategy for reducing germination time in Japonica rice seeds, thus improving seed and seedling performance. This method offers a promising solution to direct sowing in soil, especially in scenarios where water resources are limited.

Plant Metabolism and Photosynthesis

ACTION OF ALTERNATIVE SOURCE OF PHOSPHORUS IN THE ACTIVITY OF PHOSPHATASES IN RICE PLANTS

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To understand how plants will respond to alternative sources of fertilizers and how to apply these technologies in the field is essential for the food and nutritional security of the population. To elucidate the action and viability of an alternative source of phosphate fertilizer (ReFertP), obtained from material synthesized from iron mining residues, this study evaluated the initial growth and activity of acid and alkaline phosphatases in rice plants (Oryza sativa). An experiment was conducted in a greenhouse at the Federal University of Viçosa, Campus Florestal, where rice seeds, cultivar BRS Esmeralda, were sown in three-liter pots containing three types of tropical soils (distinct in relation to the concentration of organic matter), with three sources of phosphorus (No P, ReFertP and Simple Superphosphate), in a randomized block design, 3 x 3 factorial scheme, with five replications, totaling 45 experimental units. When the plants reached phenological stage V3, the accumulation of dry mass and the activity of acid and alkaline phosphatases of the rhizospheric soil were quantified. The data obtained were statistically evaluated using ANOVA and Tukey's test ($p<0.05$). The activity of phosphatases was increased in soils with higher concentrations of organic matter, and treatments with ReFertP showed elevated activity of acid phosphatases in red latosol. This activity of acid phosphatases indicates the promotion of the hydrolysis of phosphates present in the alternative source of P, however this increase did not represent a significant gain in the total dry mass of plants fertilized with simple superphosphate. The results of mass production from the use of traditional fertilizers do not make the use of ReFertP unfeasible, however indicate the need for studies to increase the availability in the soil to rice plants.

ARBOLINE NANOPARTICLE STIMULATES GROWTH AND PHOTOSYNTHESIS IN Bertholletia excelsa SEEDLINGS

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Brazil nut tree (Bertholletia excelsa Bonpl.) is an Amazon species with potential for forestry plantations and sustainable restoration. It holds high commercial value, established market chains, and phenotypical plasticity in different weather conditions. Seedling availability is the biggest challenge for tropical forestry, with great pressure on highly valued plants. Nanotechnology may offer an alternative to enhance physiological performance by stimulating plant growth and development. Arboline biostimulant is a commercial nanoparticle, with documented increase in agricultural production. In this study nanoparticle (arboline) soil application was investigated to verify the potential promotion of B. excelsa´s seedlings growth and photosynthesis. Thirty seedlings were grown for 6 months in a nursery at the National Institute of Amazonian Research (INPA-MCTI) in Manaus/Brazil. For the analysis, the plants were randomly separated into a control and an arboline treatment group. Arboline was applied weekly for a month. Biometric attributes were measured monthly, until four months. Photosynthesis rates were collected during the application period, operating infrared gas exchange analyser LI-6800 (LiCor/USA). All growth parameters were highly influenced by arboline applications. Plants' height, leave number, aerial mass, and leaf area were significantly enhanced by nanoparticle stimulation ($p = 0.011, 0.027, 0.017, 0.077$, respectively). The diameter was negatively affected, with greater thickening in the control group. The arboline treatment showed superior AGR, H/D, LGI, SLA, and NAR index ($p = 0.011, 0.001, 0.003, 0.048$, and 0.013, respectively). The biostimulant affected photosynthesis and carbon assimilation, without affecting water loss. Seedlings treated with arboline showed higher photosynthesis rates ($p = 0.007$), while estomatic conductance and transpiration were not significantly influenced by the treatment ($p = 0.990, 0.880$). The control group presented higher Ca and Ci ($p = 0.014, 0.081$). Therefore, the soil application of arboline for one month stimulated the growth and physiological activity in B. excelsa seedlings, enhancing carbon assimilation.

ARBUSCULAR MYCORRHIZAL FUNGI AND ACID METABOLISM OF CRASSULACEANS: EFFECTS ON THE MORPHOPHYSIOLOGY OF BRYOPHYLLUM LAETIVIRENS

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Arbuscular mycorrhizal fungi (AMF) form symbiotic relationships with plants, where AMF provide water and nutrients and plants provide carbohydrates and lipids. However, there are few studies in the literature associating AMF with acid metabolism plants of Crassulacea (CAM). The aim of this study was to evaluate the influence of AMF on the growth and physiological parameters of Bryophyllum laetivirens. The inoculum with AMF was obtained in the Savannah of Santarém - PA and multiplied with corn for 20 days. The propagules of B. laetivirens were grown in pots under two conditions: 500 g of soil + 50 g with AMF and 550 g of soil without AMF, both were maintained at 20% of field capacity until dismantling, after 50 days. Root volume (RV), fresh root and shoot mass (MFR and MFA), total dry mass (MST), photosynthetic pigments and leaf water content (TAF) were evaluated. The means were compared by the Tukey test at 5% confidence level. MFA did not show statistical difference ($p \geq 0.05$). Plants without AMF had RV and MFR 50% higher than plants with AMF and approximately 110% higher in MST. The treatment without AMF also showed an increase in the content of photosynthetic pigments: 40% for chlorophyll a, 30% for chlorophyll b, 50% for total chlorophylls and 35% for carotenoids. Plants with AMF had TAF 10% higher than plants without AMF. The species B. laetivirens has CAM metabolism, therefore, it presents low production of photoassimilates. AMF present in plants act as a strong sink of organic carbon, thus, the allocation of photoassimilates to AMF causes harm to plant development. However, AMF also provide greater hydration to the leaves. Therefore, further analyses are needed to assess the importance of AMF associated with CAM.

Association between high photosynthetic activity and leaf metabolism in introgression sub-lines of Solanum pennellii under high CO2 levels

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Higher photosynthetic efficiency can be achieved by genetic approaches through the identification of natural genetic variation. By using two Solanum pennellii introgression lines (ILs), we previously demonstrated that IL2-5 and 2-6 exhibit high photosynthetic efficiency associated with altered biochemical components of photosynthesis, such as higher RuBisCO levels under non-photorespiratory conditions. In order to understand the association between physiological bases and metabolic to high photosynthesis, we characterized plants from introgression sub-lines (SILs) of S. pennellii (SILs 2-5-2, 2-5-6, 2-5-12, 2-6-1, 2-6-3, 2-6-6) and the parental M82 (S. lycopersicum) under ambient and high [CO2], 400 and 800 ppm CO2, respectively. We performed gas exchange analyses and light-response curves, as well as leaf harvest for biochemical and metabolic profile analyses. The SILs 2-5-2 and 2-5-6 exhibited higher photosynthetic efficiency compared to M82 in both ambient and high [CO2]. Surprisingly, these SILs share overlap points with the BIN 2K, within chromosome 2 of S. pennellii, a fragment previously related to high photosynthesis in ILs 2-5 and 2-6 under ambient [CO2] conditions. Under high [CO2], the SIL 2-5-2 accumulated cysteine, glutamate, glycine, isoleucine, lysine, malate, pyroglutamate and reduced fumarate, while SIL 2-5-6 accumulated proline, glucose, fructose, and reduced myo-inositol-1-phosphate. Notably, the biggest changes in metabolic profile occur in SILs 2-5-2 and 2-5-6, but variations in SILs 2-5-12, and 2-6-1 were also observed. In summary, the high photosynthesis is associated with deep changes, especially in the amino acid profile of SIL 2-5-2, and by some changes in sugars in SIL 2-5-6 under high [CO2]. Together, these results suggest that the metabolic components may explain, at least partially, the high photosynthetic rates observed in plants from the studied SILs.

Bioherbicidal effect of secondary metabolites from sorghum plants

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The use of allelochemicals is an important alternative to reduce the use of synthetic herbicides to control weeds. The allelochemical sorgoleone present in sorghum extract has a herbicidal action similar to atrazine, which inhibits the FSII of photosynthesis. The present study aimed to identify the bioherbicidal effect of sorghum extract in controlling Amaranthus viridis (L.), as well as determining the appropriate phenological stage of sorghum to obtain the extract. The work was carried out in a greenhouse at the State University of Goiás, in Ipameri. The experiment was conducted in a completely randomized design in a 3 x 4 factorial scheme, using the extract extracted from leaves at three phenological stages of the sorghum plant (E1, E3 and E6) and four doses (0%, 25%, 50% and 100 % of extract obtained) with three replications. The extraction took place in 3 g of dry leaf with 100 ml of 70% ethyl alcohol in a water bath for 72 h. Three applications of 20 ml of the extract were carried out on the weeds at 33, 39 and 43 days after emergence. At 50 days, physiological assessments of weed growth were carried out. The results indicate that the sorghum leaf extract can be obtained at any of the phenological stages: E1, E3 and E6 of the sorghum plant, without loss of bioherbicidal action for Amaranthus viridis (L.). With an increase in the dose of sorghum extract, there was a reduction in the growth of Amaranthus viridis (L.) through lower biomass accumulation, reduced leaf area and low number of leaves. The present study concludes that sorghum extract has a more efficient herbicidal action when used at a dose of 100% of the extract obtained without dilution.

Biometric Analysis and Bixin Quantification in Annatto: Insights into Mildew Resistance

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Bixa orellana L. (annatto) is an Amazonian plant and is the main source of bixin, a natural dye widely used in various industries. However, the majority of cultivated types are susceptible to powdery mildew (Erysiphales), a biotrophic fungus influenced by the MLO gene in plants. Mildew attacks the young and mature plants compromising photosynthesis and bixin productivity. Seeds of four Annatto varieties were used, namely: Piaçava Amarela (PA), Capote Pequeno (CP), Capote Grande (CG) and Disease Resistant (DR) to disease, according to the producer. Annatto seedlings were germinated and grown for 30 days in a greenhouse. From these, the third leaf was used for bixin quantification by LC-MS. It was observed that the DR and CG varieties had the highest bixin levels (approximately 3 ng/mg), forming a homogeneous group. Conversely, the PA and CP varieties had the lowest concentrations. Regarding the growth parameters over time, at 15 and 30 days, the PA and CP varieties had stems around 10% longer than the resistant variety. The CG variety showed intermediate growth. At 30 days, CP stood out with the tallest stems, followed by the PA and CG varieties, while the DR variety had the lowest stem height. The results indicate that the bixin amount in the annatto leaves varies significantly among the different varieties growth patterns, since DR and CG showed higher compound levels. These data suggest that bixin is an important drain at this development stage in the DR and CG varieties, as they have higher compound levels at the expense of lower growth. Future studies aim to characterize the varieties in terms of their tolerance to powdery mildew and test growers' empirical knowledge, correlating with bixin production and genetic factors related to disease tolerance.

BIOPHYSICAL PARAMETERS DESCRIBE LEAF PHOTOSYNTHETIC FITNESS IN *Guapira pernambucensis*

Gabriel Rosa, Mariela Mattos Silva, Lucas Pimentel Pereira, Rebeca Matos Groner, Diolina Moura Silva

The purpose of this work was to evaluate the photochemical activity during leaf development in Guapira pernambucensis, native to the Atlantic Forest, for use as reference for environmental impact assessments in coastal ecosystems. Thus, newly-emitted leaves from plants obtained by cuttings collected in October 2022 were evaluated at three ages: 20, 30 and 40 days after emission. To evaluate photosynthetic development, chlorophyll a fluorescence kinetics were used to estimate parameters related to vitality and structural conditions of the electron transport chain (ETC), with a portable fluorometer (Handy-PEA, Hansatech Instruments). The parameters analyzed were related to energy fluxes through reaction centers and cross-sections in the ETC, such as: absorption, capture, transport, and dissipation, as well as performance indices in energy conservation. For further assessments, chlorophyll index was analyzed with a portable chlorophyll meter (SPAD-502 Plus, Konica Minolta), and leaf area estimated from digital images with the ImageJ software. As expected, with age progression there was an increase in leaf expansion as well as in chlorophyll index, consequently, parameters related to cross section and reaction centers also increased. On the other hand, despite the efficiency related to absorption, transport and dissipation of electrons, the performance indices for energy conservation by photosystem II antenna (PSII) to reduction beyond quinone A and energy conservation by PSII until the reduction of photosystem I acceptors presented highest values on the twentieth day, indicating a drop in photosynthetic efficiency with age. However, this scenario does not prove to be harmful to the species, as it occurs abundantly in the Restingas of the Brazilian coast, in formations exposed to high irradiance. Therefore, these results suggest the presence of photosynthetic adaptations in newly-emitted leaves of the species in order to allow greater efficiency in the use of energy, which may represent a strategy for its establishment in limiting environments.

Biostimulant action on the phenological dynamics of carbohydrate, protein and lipids in source organs and reproductive sinks in soybean crops

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Soybean is among the world's main commodities, however its production is highly dependent on chemical fertilizers that cause major environmental impacts. The use of biostimulants in soybean crop is a sustainable alternative to improve the efficiency of nutrient absorption and production. The objective of this work was to evaluate the effect of the biostimulant Vital® on the carbohydrate, protein and lipids dynamics of soybeans in different phenological stages and the impacts on the crop yield. The experiment was conducted in the field in randomized blocks divided into three treatments with four replications, namely: 1) control; 2) application of 100 ml ha-1 of Vital®; 3) application of 200 ml ha-1 of Vital®. Yield parameters and carbohydrate concentration, proteins in leaves, pods and grains and lipid concentration in soybean pods and grains were analyzed. The application of 200 ml ha-1 of the biostimulant in R5 increased the concentration of reducing sugars in the leaves which, converted into sucrose and primary starch, were quickly consumed due to the greater demand from draining tissues, as observed by the greater production of lipids in the pods and starch in the grains. The application of 200 ml ha-1 of Vital® also resulted in an increase in the concentration of proteins in the leaves at the R6 stage and a decrease in the levels of amino acids and proteins in the grains (R8) and pods (R6), respectively. Considering that the biostimulant Vital® did not change the crop yield parameters, it is concluded that the biostimulant applied at the correct dose and time can improve the quality of soybeans but does not significantly alter crop productivity under the experimental conditions evaluated.

BORON (B) AS A MODULATOR OF PHYSIOLOGICAL AND ANATOMICAL RESPONSES IN Alternanthera tenella Colla. (AMARANTACEAE)

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Boron (B) participates of plant metabolism and its deficiency rapidly inhibits the plant growth and development. Alternanthera tenella Colla. is widely abundant in mining areas, indicating its potential to tolerate and accumulate heavy metals from the soil. The objective of this study was to evaluate the physiological and anatomical responses of A. tenella biofortified with B. The experiment was conducted with nodal explants grown in vitro at 0, 250, 750 and 2000 μM B. Chlorophyll a fluorescence was measured in 15 plants per treatment using a portable fluorometer Handy-PEA (Hansatech, UK) after 30 days of cultivation in samples predark-adapted. The cross sections images of leaves were captured with a digital camera Leica (Wetzlar, Alemanha). Higher Sm values, which reflects multiple-turnover quinone-A (QA) reduction events, and QA-reducing reaction centers number (RCs) per cross section (CS) (RC/CS0) occurred when the plants were grown at 750 μM B. In contrast, higher values of quantum yield for energy dissipation (F0/FM) occurred in 0, 250, and 2000 μM B. Plants grown with 750 μM B showed thicker spongy and palisade parenchyma. Higher spongy parenchymal thickness is correlated with an increase in intercellular spaces increasing the CO2 accumulation. Furthermore, increased thickness of the palisade parenchyma may be related to the higher photosynthetic capacity, which may also be associated with biomass production and, thus, could be used as indicators of growth potential in plants. Therefore, the betther anatomical and physiological responses of plants were observed at 750 μM B, showing potential to be used for biofortification in A. tenella.

C3 AND C4 PLANTS DIFFER IN CARBON FLUX THROUGHOUT TRICARBOXYLIC ACID CYCLE AND ASSOCIATED PATHWAYS

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C3 and C4 plants differ at anatomical, biochemical and physiological levels. However, the distribution of the metabolic fluxes downstream of CO2 assimilation throughout the TCA cycle and associated pathways remain unclear. In view of the paramount role of nitrogen assimilation for plant growth, we hypothesise that the higher photosynthetic efficiency of C4 plants could also be achieved by differential regulation of the metabolic fluxes throughout the TCA and GS/GOGAT cycles. We carried out 13C-HCO3 kinetic labelling experiments in dark-exposed and illuminated leaves of maize and sorghum (C4 plants) and used cowpea as a representative C3 plant. In all species, illuminated leaves displayed substantial increases in 13C-labelled metabolites, which likely reflects the activity of RuBisCO. Positionally malate 13C-labelling information confirmed that C4 plants have higher PEPc-mediated CO2 assimilation under both dark and light conditions. Cowpea plants had lower 13C-enrichment in TCA cycle metabolites in both dark-exposed and illuminated leaves. The 13C-enrichment in glutamate was higher in C4 leaves, suggesting a higher flux derived from PEPc activity toward the GS/GOGAT cycle in C4 plants, as compared to cowpea. Moreover, the 13C-enrichment in TCA cycle and associated metabolites is higher in C4 plants, especially in citrate which showed 13C-enrichment in both dark exposed and illuminated leaves. Sorghum showed higher 13C-enrichment in sugars, while the 13C-enrichment in malate and aspartate was higher in maize, indicating a differential carbon flux mode within C4 species. Our results suggest that C4 plants have higher metabolic flux throughout the TCA cycle under both dark and light conditions as well as that the photosynthetic carbon distribution throughout primary metabolism is species-specific and time-dependent, especially under light condition.

CARBON BALANCE UNDER WATER DEFICIT CYCLES IN A PHOTOSYNTHETIC STEM PLANT FROM SEMIARID

Joana Sherylyn Nicodemos Cordeiro, Juliana de Carvalho Paes Barreto, Mauro Guida dos Santos

Dry environments affect the survival and distribution of species. In response, plants have developed strategies such as efficient carbon dynamics, photosynthesis in non-foliar tissues, and deciduity to tolerate limiting conditions. This study investigated the ecophysiological responses of Commiphora leptophloeos (Mart.) J. B. Gillet (Burseraceae), a green-stemmed species, to recurrent drought cycles. Young plants were subjected to four treatments: control (CO), control + stem light exclusion (CE), water deficit (D), and deficit + stem light exclusion (DE), undergoing two drought cycles interspersed with rehydration. Growth parameters, water status, stomatal conductance (gs), photochemical activity, photosynthetic pigments, and non-structural carbohydrates (NSC) were evaluated. The CE treatment showed a greater number of leaves and height compared to D and DE (cycle 1). Stem and leaf water content remained high in all treatments, even with a 90% reduction in soil moisture (cycle 2). Plants under water deficit reduced gs after three days without water in the first cycle and after nine days in the second. Chlorophyll a was present in the stem, although in lower amounts than in the leaves, resulting in minimal impact on the plant's photochemical activity under drought conditions. NSC concentration decreased by 63% in the water deficit treatments compared to controls (cycle 2), but the partitioning of these carbohydrates among organs did not change throughout the experiment, with a preference for allocation to the stem and roots. During cycle 1, the soluble sugars/starch ratio was altered in the leaves and stem, mainly in the plants under DE, but remained stable in the evaluated roots. The results indicate that maintaining water status, controlling gs, and reducing the number of leaves are crucial strategies for survival under water deficit for this species. Furthermore, we suggest that the stability of NSC concentration in the stem may play a protective role.

CHLOROPHYLL A FLUORESCENCE IN WHEAT INOCULATED WITH GROWTH-PROMOTING BACTERIA: MORPHOMETRIC AND BIOCHEMICAL CHANGES

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Research aimed at elucidating the bacteria/plant interaction regarding growth promotion has been highlighted in recent decades. These studies seek proposals for more sustainable production systems that generate fewer environmental impacts and liabilities. The study aimed to identify increments in morphometry and photosynthetic pigments and their influence on the use of incident light of wheat plants inoculated with the plant growth promoting bacteria (PGPB) Azospirillum brasilense, Bacillus (B. megaterium + B. subtilis) and Pseudomonas fluorescens. In a protected environment, following a randomized block design, wheat plants, cultivar CD150, grown in pots until the heading phenological stage, were inoculated with Azospirillum brasilense, Bacillus (B. megaterium + B. subtilis), Pseudomonas fluorescens and non-inoculated (control). At the heading stage, point gas exchange, chlorophyll a fluorescence, photosynthetic pigments and morphometry were evaluated. The use of PGPB influences leaf area in wheat plants and alters the chlorophyll a fluorescence responses. Inoculation with A. brasilense increased the leaf area of wheat plants, making the photosynthetic apparatus more stable. Inoculation with Bacillus (B. subtillis + B. megaterium) and P. fluorescens did not increase the morphometry and biochemistry of wheat plants. The use of B. subtillis + B. megaterium and P. fluorescens optimized the stability of the photosynthetic apparatus, increasing light absorption and its use in the photochemistry of photosynthesis. The increased stability of the wheat membrane system, resulting from inoculation with these bacteria, optimized the absorption and utilization of incident light. Based on the answers obtained in this study, it is possible to affirm that bacteria/plant interaction is an advantageous strategy for agricultural systems, which can result in optimization of the use of production factors by crops, resulting in greater efficiency in the use of these factors, with positive impacts on productivity.

CHLOROPHYLL FLUORESCENCE PARAMETERS IN Enterolobium contortisiliquum UNDER DIFFERENT NPK FERTILIZATION LEVELS

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Mining in Brazil has recently been associated with significant environmental impacts, requiring recovery practices in impacted areas. The lack of data on the nutrition and photosynthetic metabolism of Brazilian native species makes it difficult to manage them under the stressful conditions imposed by degraded environments. The legume Tamboril (Enterolobium contortisiliquum) has been commonly used in land reclamation projects and, like other native trees, lacks detailed physiological information. In this context, this study aimed to evaluate the in vivo physiological responses of Tamboril in degraded soil under increasing doses of NPK fertilization. After 100 days of cultivation, the plants were assessed using the chlorophyll fluorescence in representative senescent (SE), fully expanded (FE), and sink (SI) leaves using a portable chlorophyll meter, MulstispeQ v2.0 (PHOTOSYNQ INC.). The principal component analysis revealed a similarity between the data obtained for FE and SI, which differed from the data for SE. The first two principal components were able to explain 83% of the data variability, revealing greater explanatory power of the variables associated with the species' capacity to regulate excess energy. The main explanatory variable was ΦNPQ. The regulation of excess energy to reduce damage in this species occurs at the highest dose in SE leaves and at the lowest doses in FE and SI leaves. Based on the leaves with the highest photosynthetic activity (FE), the results allow us to conclude that lower fertilizer doses provide better plant capacity to resist high irradiance and other abiotic stress, which is reduced when luxury consumption occurs.

CIRCADIAN REGULATION OF TRANSPIRATION: THE SYNERGY BETWEEN SUGAR METABOLISM AND TRANSPIRATION TIMING

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Aspects of plant growth and development are generally governed by the action of the circadian rhythm, which makes plants adapt to their environment. The circadian clock not only regulates basic metabolic processes such as starch synthesis and degradation, enzyme activation, senescence, and stomatal opening but also coordinates responses to plant-environment interactions. Environmental signals exert a significant influence on circadian clock oscillators, serving as `input' information that sets the appropriate rhythm for the time of day, leading to `output' responses that can be interpreted as adaptative responses to the environment. The exploration of circadian and environmental interactions is an attractive avenue as insights gained could be of significant importance and benefit to a wide range of plant species. We therefore tested plant responses to timed irrigation, with water applied at certain times of the day. The treatments consisted of plants receiving water at the beginning of the day (DAWN) and plants receiving water only in the evening (DUSK). Results were obtained for gas exchange and primary metabolism. Plants watered at the beginning of the day exhibited more cautious gas exchange behaviour, maintaining lower stomatal conductance compared to those watered at the end of the day. In contrast, the DUSK treatment resulted in greater stomatal conductance, which led to increased transpiration and growth. This finding is in good agreement with the results of sugar metabolism, where plants in the DUSK group showed greater consumption of starch and sucrose, potentially supporting the maintenance of stomatal opening. Additionally, malate levels in DUSK are higher than in DAWN, suggesting a greater maintenance of stomatal aperture. Altogether, our results indicate that plant irrigation at the end of the day leads to significant gains in stomatal conductance and ultimately leads to gains in biomass accumulation.

Cyanobacteria as a tool for Environmental Cleanup: Bioaccumulation of Phosphorus and Nitrogen by Nostocaceae Strains

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The phylum Cyanobacteriota (from the domain Bacteria) encompasses a group with remarkable morphological and metabolic diversity, offering immense potential for the food, pharmaceutical, and environmental industries. Among their various applications, cyanobacteria are particularly noteworthy for their capacity as nutrient bioaccumulators and their role in wastewater treatment, thanks to their versatile metabolic machinery and ability to absorb both organic and inorganic substances from polluted waters. This potential is especially relevant in the context of environmental disasters, such as the 2015 collapse of the Fundão Dam in Mariana, which released a large amount of contaminants into the Rio Doce basin. Monitoring reports indicated concentrations of approximately 1.0 mg/L of phosphorus (P) and 4.0 mg/L of nitrogen (N) at certain points in the basin. This study investigated the hypothesis that cyanobacterial strains from the Nostocaceae family (Nostoc sp. PCC-7120 and Calothrix sp. CCM-UFV006) could significantly reduce P and N concentrations in their cultivation environment. The treatments applied were: [C], BG-110 (5.4 mg/L of P and 0.3 mg/L of N); [T1]: BG-110 (5.4 mg/L of P and 4.0 mg/L of N); and [T2]: (1.0 mg/L of P and 4.0 mg/L of N). Key parameters were evaluated, including growth rates at different P and N concentrations, metabolite content in relation to the treatments, and P and N concentrations before and after strain cultivation. The Calothrix sp. CCM-UFV006 strain demonstrated superior efficiency in P bioaccumulation, particularly at a concentration of 1.0 mg/L, while also exhibiting substantial biosynthesis of exopolysaccharides. Meanwhile, the biomass of the Nostoc sp. PCC-7120 strain achieved protein levels close to 50%. Both strains successfully depleted all the N available in the treatments. Our results highlight the promising potential of these cyanobacterial strains for further research into their applicability in environmental remediation.

DETECTION AND QUANTIFICATION OF PHENOLIC COMPOUNDS IN ERYTHRINA MULUNGU MART. EX BENTH (FABACEAE)

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The secondary metabolism of plants produces compounds that, although not essential for growth and development, are fundamental for adaptation, defense, and environmental interactions. In agriculture, these metabolites can act as bioherbicides and biopesticides. Phenolic compounds, mainly found in tree bark, have beneficial properties for human health and are used in the beauty, health, and medical industries. The secondary metabolites present in Erythrina mulungu confer medicinal properties to this plant, including neuroprotective, anxiolytic, antidepressant, and relaxing effects. This study aimed to quantify the extraction yield, total phenol content, flavonoids, and condensed tannins present in the extracts of E. mulungu bark. The bark of this tree was collected in a Cerrado area in northern Minas Gerais, Brazil. The quantification of polyphenols was performed using ethanol and methanol extractions in water (50% v/v). Additionally, transverse sections of the bark, 16 µm thick, were obtained with a Leica sliding microtome and subjected to a 10% ferric chloride solution to detect phenolic compounds. The results were subjected to analysis of variance (ANOVA) using SPSS software version 21, and the means were compared using Tukey's test, considering a significance level of 5%. The ethanol-water and methanol-water extracts showed total phenol, flavonoid, and condensed tannin contents as follows: 69.39 and 97.40 mg GAE.g^{-1} of bark, 6.19 and 6.99 mg CE.g^{-1} of bark, and 2.26 and 2.42 mg CE.g^{-1} of bark, respectively. Only the total phenol contents differed statistically between the ethanol-water and methanol-water extracts. Histochemical analysis revealed phenolic compounds in the phloem and periderm of the bark, with a higher concentration in the periderm. This facilitates the sustainable management of the species. The bioprospecting of these barks suggests the valorization of these compounds with potential chemical and bioactive functionalities.

Disentangling the role of sucrose for stomatal movement regulation

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The role of sucrose for stomatal movement regulation has been debated for more than a century, with several controversial studies and theories. Here we demonstrated that sucrose concentration at the leaf apoplast underpin the diel course of tobacco stomatal conductance (gs). The early morning stomatal opening was associated with reductions in both sucrose concentration and organic acids content at the apoplast. By contrast, the reductions in gs over the diel course was associated to increases in apoplastic sucrose concentration. In agreement with this, exogenously applied sucrose increased stomatal speediness to open and to close in dark or light-adapted leaves in a concentration-dependent manner. Interestingly, these sucrose-mediated stomatal responses were drastically reduced in transgenic plants with lower expression of the SUCROSE TRANSPORTER 1 in guard cells. We further showed that the light-induced stomatal opening is closely associated to the dynamic of sucrose and organic acids within guard cells. Our results provide compelling evidence indicating that sucrose is a master regulator of the daily gs, being capable of inducing and accelerating both stomatal opening and closure in a concentration and location of accumulation dependent manner. Our study suggests that the sucrose importation and its degradation within guard cells is a feedforward mechanism to enhance gs, which consequently increase the photosynthetic rate (A) and the transport of sugars from mesophyll to guard cells through the transpiration stream, whilst the excess of sucrose accumulated at the apoplast and imported to the guard cells induce stomatal closure likely as a mechanism to improve water use efficiency in periods of high A.

Diurnal and seasonal changes of photosynthesis in the invasive Arundo donax under Cerrado edaphoclimatic conditions

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Arundo donax, an invasive rhizomatous C3 grass, has aggressively spread across the Brazilian Cerrado urban and natural areas. It exhibits fast and aggressive growth and adapts to both wet and dry seasons, which highlights its resilience. To better understand the mechanism behind the acclimation capacity of A. donax to contrasting and extreme situations, we have performed an integrative analysis of diurnal changes in maximum CO2 assimilation and chlorophyll fluorescence parameters in both wet and dry seasons under edaphoclimatic conditions of the Brazilian Cerrado. The photosystem II maximum efficiency, Fv'/Fm'; photosystem II operating efficiency, ΦPSII; nonphotochemical quenching, NPQ) coupled to measurements of net CO2 assimilation rate (Anet) under saturated light irradiances were assessed through daytime in the wet and dry seasons. In the dry season, air temperature (T), relative humidity (RH), predawn water potentials and PPFD averaged 24±2 Cº, RH 49±3%, Ψpd -0.9 MPa, and PPFD 1200±30 µmol m-2 s-1, respectively. In the wet season, T averaged 28±3 Cº, RH 70±8%, Ψpd -0.35 MPa, PPFD 1300±50 µmol m-2 s-1. Despite similar averages in Anet and ΦPSII across dry and wet seasons, diurnal dynamics of these parameters markedly varied, with distinct patterns observed between the early morning and midday. During the dry season, A. donax plants exhibited higher Anet and slight increases in Fv'/Fm' and ΦPSII in the early morning as compared to the wet season. In contrast, at midday, average values of Anet, Fv'/Fm' and ΦPSII were higher in the wet than in the dry season - which otherwise showed augmented NPQ. These preliminary results indicate that A. donax holds a strategy to enhance photosystem activity in the early morning during dry conditions to compensate for photosynthetic limitations at midday; while improving ΦPSII to support periods of high light energy in wet seasons. Further associated biochemical responses should be deeply investigated.

DROUGHT RESILIENCE IN WILD SOLANACEAE: COMPARATIVE PHYSIOLOGICAL RESPONSES AND ADAPTIVE MECHANISMS

Alana Cavalcante da Silva, David de Oliveira Medeiros, Lucas E. Realto-Silva, Maria Clara Oliveira Monteze, Agustin Zsögön, Wagner L. Araújo

Abiotic stresses such as drought, reduces water availability in the soil, significantly limiting plant growth and development. In this context, some species, such as wild Solanaceae, exhibit anatomical and physiological adaptations that enhance drought resistance. This study aimed to analyse the physiological responses in wild Solanaceae species under water deficit conditions. Three species were evaluated - Solanum lycopersicum, Solanum lycocarpum, and Solanum pennellii - subjected to two water conditions: Control (80% field capacity – FC) and drought. For the drought treatments, irrigation was suspended four weeks after transplanting, and the effects of water limitation were assessed by measuring reductions in photosynthesis levels, which eventually approached or reached zero. Gas exchange parameters were monitored over time, and at the end of the experiment, plant material was collected and dry biomass of leaves, stems, and roots was measured. The data revealed a significant reduction in photosynthetic rate across all species subjected to drought. However, S. lycopersicum was found to be more sensitive to these conditions, reaching photosynthesis values of zero at 16 days compared to 28 and 20 days for S. lycocarpum and S. pennellii, respectivelly, indicating a higher resistance to water limitation in the latter species. A similar trend was observed in stomatal conductance and transpiration data, as well as in the reductions of dry biomass under the same conditions. Notably, S. pennellii demonstrated greater root investment under drought compared to the control. In conclusion, this study highlights differentiated mechanisms and responses among Solanaceae species when subjected to drought, with wild species displaying superior performance under stressful conditions.

ECOPHYSIOLOGICAL RESPONSES OF SOLANUM SESSILIFLORUM TO WATER LIMITATION: PHOTOSYNTHETIC RECOVERY AND ANTIOXIDANT DEFENSE

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Genetic variability is often emphasized as a universal evolutionary advantage. However, during domestication, the focus is typically on maintaining and selecting genotypes that optimize productivity in environments with minimized stress factors and abundant vital resources. As a result, traits essential for species survival in environments with increasingly variable biotic and abiotic factors are often neglected. Considering the risks that climate change poses to the performance of agronomic species, exploring genetic resources in wild relatives and reintroducing these traits into cultivated species may be a key strategy to mitigate genetic erosion in these cultivars. Thus, this study aimed to evaluate the biochemical and ecophysiological responses of Cubiu (Solanum sessiliflorum), a wild plant native to the Amazon basin that produces an edible fruit, under water stress conditions. The experiment involved growing plants under two conditions: constant water availability and water restriction followed by rehydration. Seventy days after germination, water restriction was initiated, and plants were monitored through measurements of gas exchange parameters. When these parameters approached near-zero values, rehydration was initiated until full recovery of the assessed parameters, including relative water content, chlorophyll a fluorescence, gas exchange, and metabolite levels. The photosynthetic apparatus exhibited satisfactory recovery, with energy dissipation strategies and the action of defense metabolites (proline, ascorbate, and dehydroascorbate) contributing to protection against oxidative stress. Photosynthesis and stomatal conductance showed an expected behavior, gradually decreasing with the progression of water deficit. Our results indicate a robust performance of the photosynthetic and antioxidant systems, demonstrating potential for identifying traits that confer protection against oxidative stress in Solanum sessiliflorum.

Effect of Azospirillum brasilense Association on Ascorbate Production and Post-Harvest Quality of Solanum lycopersicum.

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The enzyme L-galactono-1,4-lactone dehydrogenase (L-GalLDH) is responsible for catalyzing the oxidation of L-galactono-1,4-lactone (L-GalL) to ascorbic acid (AA). Associated with the mitochondrial electron transport chain (ETC), this enzyme links AA synthesis to cellular respiration. Plant growth-promoting bacteria (PGPB) are known for enhancing the productivity of economically important crops, as well as increasing the nutraceutical value of fruits. This study investigated how the association between PGPB, Azospirillum brasilense, and the fungus Trichoderma with tomatoes influences AA accumulation in fruits and the activity of the enzyme L-GalLDH during ripening and post-harvest. The experiment was conducted in a greenhouse using wild-type (WT) cherry tomato plants and a transgenic line with the L-GalLDH enzyme gene silenced (P35S:SlgalldhRNAi). Three treatments were applied: inoculation with A. brasilense, inoculation with A. brasilense and Trichoderma, and control (no inoculation). Fruits were analyzed post-harvest to assess firmness, skin color, and soluble solids content. Mitochondria were isolated from the pulp of ripe fruits to evaluate L-GalLDH activity via spectrophotometry. The results showed that plants inoculated with A. brasilense positively influenced acidity levels and soluble solids, improving the fruit's palatability and ratio. On the other hand, L-GalLDH activity in fruits was reduced in P35S:SlgalldhRNAi plants inoculated with PGPB. Ultra-performance liquid chromatography (UPLC) analysis revealed that only the bacterial treatment increased the total AA content in ripe fruits of WT plants, while in the P35S:SlgalldhRNAi genotype, there was no significant increase in total AA. These results support previous studies, indicating that the use of PGPB not only promotes plant growth but also improves fruit quality.

Effect of Seasonality on the Biochemical Composition of Paricá and Guapuruvu Tree Leaves Grown in Southern Minas Gerais

Ana Julia Martins Delbin

Seasonal variations directly affect biological activity and metabolic pathways essential for plant survival. Being highly adaptable organisms, plants can adjust their metabolite production in response to seasonal environmental changes. This ability to alter biochemical compound production represents an important adaptive strategy that allows plants to survive and grow under variable environmental conditions. The Paricá and Guapuruvu varieties of the species Schizolobium parahyba, native trees, are notably used in reforestation projects due to their adaptive characteristics. Given the importance of these varieties for the recovery of degraded areas and the scarcity of studies on their biology, it becomes essential to conduct biochemical research to better understand the survival strategies of these plants under different environmental conditions, particularly in climates with high variability. Based on these observations, it is hypothesized that S. parahyba varieties exhibit distinct biochemical responses to seasonal variations, which may influence their growth and survival capacity. The aim of this study is to analyze and characterize the biochemical composition of the leaves of the two varieties of Schizolobium parahyba throughout different seasons (dry and rainy), focusing on carbon compounds. Leaf samples of the Paricá and Guapuruvu varieties were collected in the city of Ijaci, MG, during the dry and rainy seasons. Carbon compounds in the leaves were quantified, comparing the seasonal variations. The results show that both Paricá and Guapuruvu exhibited a quantitative decrease in starch and an increase in reducing sugars from the rainy season to the dry season, with no statistically significant difference in total soluble sugars between seasons in either variety. From this, it is concluded that Schizolobium parahyba varieties exhibit similar responses to rainy and dry regimes.

EFFECT OF STROBILURIN FUNGICIDE ON THE SENSITIVITY OF PHOTOSYSTEM II IN BEAN (Phaseolus vulgaris L.)

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The study evaluated the effect of pyraclostrobin (PCL), a strobilurin fungicide, on the physiological traits of Phaseolus vulgaris. Bean seeds were soaked in PCL (0, 450, and 1800 mg/L) for 10 and 30 minutes. After germination, the seedlings were transferred to tubes containing soil and maintained in a greenhouse. After 15 days, chlorophyll a fluorescence evaluations were performed (Handy-PEA, Hanstech, UK). The results demonstrated increased values of energy flux values per reaction center (RC) in the 1800mg/L PCL compared to the 0mg/, for 10 and 30 minutes, respectively. In this PCL dose, increases of 24.5% and 21.3% in the energy flux for absorption (ABS/RC), 21.5% and 16.5% in the captured energy flux (TR_0/RC), 45.3% and 37.1% in the dissipated energy flux as heat (DI_0/RC), and reductions of 19% and 18% in active reaction centers per cross-section (RC/CS_0) occurred after 10 and 30 minutes exposure, respectively. Higher DI0/RC indicates lower electron transport efficiency, suggesting an overload in active RCs, increasing ABS/RC. The fraction of quinone B (QB)-reducing centers decreased proportionally with PCL concentration, while the fraction of non-QB-reducing centers (N-QB) increased at both times. Approximately 9.2% and 7.4% of N-QB were inactive in plants originated from seeds soaked in 0mg/L PCL, at 10 and 30 minutes, respectively. However, increases in N-QB occurred at 450 (+6.5% and +11%, respectively) and 1800mg/L PCL (+8.5% and +13.2%, respectively). After 10 and 30 minutes exposure, QB-reducing centers decreased at 450 (-6.5% and -8.6%) and 1800mg/L PCL (-11.2% and -13.3%), resulting in reduced electron transport from photosystem II beyond QA, due to PCL binding at the QB site. The study reveals that physiological responses to PCL vary according to concentration and soaking time, impacting electron transport and causing physiological disorders in plants of agronomic interest.

Effects of Nitrogen and Ethylene Interaction on Tomato Plant Photosynthesis

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Nitrogen (N) is an essential macronutrient that can be absorbed in the form of ammonium ($NH4+$) or nitrate ($NO3-$) and interacts in a complex way with phytohormones, such as ethylene, regulating and generating physiological responses. Photosynthesis is a biochemical process of converting light energy into chemical energy that can be influenced by N and ethylene, but there is still no clear understanding of how these processes occur. Thus, the aim of this study was to characterize the photosynthetic mechanisms related to the interaction between different N sources and ethylene in tomato plants. The study was conducted in a controlled environment using wild-type (WT) and ethylene signaling mutant (Never ripe - Nr) tomato plants (Solanum lycopersicum L. cv. Micro-Tom). The plants were then treated with a modified Hoagland's solution for the N source, with solution I: ammonium as the priority source and solution II: nitrate as the priority source. The experiment was conducted in a completely randomized design with a double factorial arrangement (2 genotypes and 3 N nutritional treatments). Gas exchange and chlorophyll a fluorescence analyses were performed during the vegetative period using an infrared gas analyzer and a MINI-PAM portable fluorometer, respectively. It was found that the $NH4+$ only treatment acted as a nutritional stress for the plants, affecting their photosynthetic apparatus. Despite this, the mutant plants showed better photochemical performance than the WT plants, even under stressful conditions, as ethylene acts directly on these processes and their low sensitivity makes the effects of nutritional stress less severe, thus demonstrating the effects of the interaction between ethylene and N on photosynthesis.

EFFECTS OF THE APPLICATION OF CARBON NANOPARTICLES (C-dots) PRODUCED FROM SPIRULINA ON RICE METABOLISM

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The use of carbon nanoparticles (C-dots) has emerged as a promising technology to enhance agricultural performance, particularly in globally important crops such as rice. The application of C-dots can positively influence plant metabolism, leading to significant productivity gains. This study aimed to investigate the effects of C-dots on the metabolism of field-grown rice, analyzing the physiological and biochemical behavior of treated plants. The research was conducted at the experimental area of the Federal University of Pelotas, where C-dots synthesized from Spirulina biomass (S-CDs) were applied to the plants by spraying at three different stages: V4, R0, and R4, at a concentration of 0.2 mg mL-1. Arbolina (a commercial C-dots product) was used as a positive control. Physiological evaluations (stomatal conductance, apparent transpiration, electron transport rate, and quantum yield of photosystem II) were assessed using a LICOR porometer/fluorometer (LI-600). All the results presented include only the data obtained 24 hours after the second application (R0 stage) and post-harvest parameters. The results showed no significant difference between treatments in terms of physiological parameters evaluated at the R0 stage. However, there was a 20% and 18% increase in total phenolics and flavonoid contents in plants treated with S-CDs, along with a slight improvement in starch, carbohydrate, and amino acid content in plants treated with Arbolina. There were no significant differences between treatments in terms of carotenoid content, total soluble sugars, proteins, antioxidant activity, and productivity. Regarding grain quality, a slight increase in starch content was observed in plants treated with both C-dots, but there was a reduction in protein and lipid contents. These preliminary results suggest that further field studies are necessary to validate the use of C-dots as a tool to enhance crop productivity and resilience, especially under adverse climate change conditions.

ENHANCING PHOTOSYNTHETIC EFFICIENCY TO INCREASED RESILIENCE AND YIELD IN SOLANUM LYCOPERSICUM THROUGH PHOTOMORPHOGENIC MUTATIONS

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The pursuit of increased crop yield is a becoming increasingly essential, driven by the rising demand for food and the inputs required for industrial development. However, the advances made in recent years through conventional breeding techniques have been modest and may have reached their maximum potential. Consequently, there is a pressing need to explore new sustainable approaches to maximize crop productivity, primarily focusing on reducing the amount of inputs required. Among these, studies on Rubisco engineering, gene introgression from C4 to C3 species, and optimization of the Calvin-Benson cycle are gaining prominence.

In this context, the present study focuses on enhancing photosynthesis in Solanum lycopersicum (tomato) plants through photomorphogenic mutations that increase photosynthetic pigment levels, with the goal of boosting biomass production. We used the previously characterized high pigment (hp1 and hp2) mutants and a wild type (WT) control genotype, all of which were subjected to different levels of shading and water deficit conditions in a greenhouse environment. Our results indicate that, although the shaded mutant plants exhibited higher photosynthetic rates, stomatal conductance and maximum Rubisco carboxylation rate compared to WT plants, they showed altered metabolite profiles and reduced total biomass and fruit yields. This suggests that the biosynthesis of these excess pigments may impose a cost on the overall photosynthetic balance. However, under conditions of water deficit during anthesis, the hp mutant genotypes demonstrated enhanced resilience in their photosynthetic apparatus, which is likely associated with an increased capacity to manage water limitation, potentially resulting from the elevated synthesis of photoprotective pigments.

Epiphytes in ecological restoration: a functional approach to forest enrichment

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The Atlantic Forest faces historic and intense environmental degradation and habitat loss, and epiphytic enrichment emerges as a promising strategy to restore its ecological complexity. This study evaluated ecophysiological traits of 140 individuals of Monstera adansonii (Araceae) and Aechmea nudicaulis (Bromeliaceae) introduced in the Reserva Biológica de Poço das Antas (REBIO-POÇO) and Parque Ecológico Mico-Leão-Dourado (PEMLD), Rio de Janeiro state. The former has a shaded understory and more than 20 years of restoration, while the latter has a heterogeneous understory regarding light availability and six years of restoration. We focused on photosynthetic-photoprotective pigments (Chlorophyll a, b, and carotenoids) and chlorophyll a fluorescence (FV/FM and FV/F0). These traits were measured at 8 am and 12 pm in March (end of the rainy season), May (dry season), and November 2023 (rainy season). For both species, total carotenoids were higher in PEMLD than in REBIO-POÇO, while the opposite was observed for total chlorophylls. As expected, the higher irradiance in PEMLD resulted in lower fluorescence values. FV/FM values did not indicate stress. However, FV/F0 was more sensitive for detecting stress for species in both forests. Species in PEMLD showed FV/F0 values that suggest stress in March and May 2023 (M. adansonii: March = 2.3 unitless and May = 1.8; A. nudicaulis: March = 1.7 and May = 1.8), but not in November 2023. Species in REBIO-POÇO presented FV/F0 values lower than 4 only in November 2023 (M. adansonii: 1.2 and A. nudicaulis: 1.6). A principal component analysis showed the clustering of samples across forests and over time. We conclude that the pigments and chlorophyll a fluorescence of the species studied can adjust to each forest's local conditions, showing that it is possible to promote epiphytic enrichment to accelerate forest restoration.

EVALUATION OF THE ROLE OF AUXIN IN THE DEVELOPMENT OF CONILON COFFEE

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The coffee plant is of great economic importance, with the species Coffea canephora standing out for its rusticity and high caffeine content in the beans. Usually, it is propagated by cuttings, a method that has advantages, such as the reproduction of the characteristics of the parent plants and high productivity. However, the capacity for adventitious rhizogenesis is a limiting factor for the success of clonal propagation, may be different between clones. Strategies are being implemented to improve the spread of C. canephora, but there are gaps in the application of plant hormones. Auxins are fundamental in the rooting process of several species, however, specific studies on their use in conilon coffee are scarce. Thus, the objective of this study was to evaluate the impact of indolebutyric acid (IBA) doses on the development of clone 143. The experiment was conducted in Linhares - ES, between June 14 and October 23, 2023. The bases of the cuttings were immersed in 10 mL of IBA solution, at the following doses: 0, 200, 600, 1000 and 2000 mg L-1. After the treatments, planting was carried out in 280 cm3 tubes filled with Tropstrato®, with Basacote mini 3M. The design was completely randomized, with 4 replications of 20 plants. After 130 days, the quality of the seedlings was evaluated, considering aspects of the aerial part and the root system. The analysis of variance indicated that the increase in IBA doses resulted in a linear increase in the number and thickness of roots, but also in a reduction in the number of leaves. The 2000 mg L-1 dose promoted root development but inhibited shoot growth. Therefore, it is recommended to evaluate other doses of IBA to optimize root development without compromising the aerial part of the seedlings.

EXTRACTION OF LEAF PIGMENTS WITH DIMETHYLSULFOXIDE IN COMMERCIAL HOP VARIETIES

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Humulus lupulus (hops), a climbing species of the Cannabaceae family traditionally used as an ingredient in beer production, has been expanding its cultivation area in Brazil due to its high demand from the domestic market. This study aimed to determine the extraction profile of leaf pigments in four hop varieties using the organic solvent dimethyl sulfoxide (DMSO). Three 5 mm discs were removed from leaves of the same age, from four varieties (Hallertau, Zeus, Fuggle and Cascade), placed in flasks containing 7 mL of DMSO, saturated with 5% calcium carbonate and incubated in a water bath for 1 hour at 65 ºC. The absorbance of the samples was determined using a spectrophotometer, in wavelengths appropriate for calculating the concentration of chlorophyll A, B, and pheophytinization index. The extraction process was considered complete, as indicated by the 'ghost-like' appearance of the disks. The pheophytinization index was lower than 1, indicating that the extraction method did not lead to significant chlorophyll degradation. Regarding concentrations of chlorophyll A, it was noted that the variety with the highest content was Zeus (6.25 µg cm-2) followed by Fuggel (6.25 µg cm-2), Hallertau (4.32 µg cm-2) and Cascade (3.60 µg cm-2). For chlorophyll B, the levels followed the same pattern with values from Zeus (18.52 µg cm-2), Fuggel (16.89 µg cm-2), Hallertau (16.68 µg cm-2) and Cascade (15.31 µg cm-2). In terms of total chlorophyll (A/B), Zeus had the highest level at (0,34 µg cm-2) followed by Fuggel (0,29 µg cm-2), Hallertau (0,26 µg cm-2) and Cascade (0,24 µg cm-2). The results of this study suggest DMSO as a good solvent option for extracting photosynthetic pigments in hop leaves.

Flux Balance Analysis reveals a limited impacts of reduced Irrigation on the Soybean Seed Metabolic Network

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Flux Balance Analysis (FBA) is a powerful approach for studying plant metabolic networks, enabling modeling and prediction of metabolic flux distributions. This study examined differences in metabolic fluxes between soybean seed metabolic (SSM) models under drought versus well-irrigated conditions and explored how light availability variations affect seed metabolism. We reconstructed the SSM model using the RAVEN toolbox, focusing on drought-stressed soybeans. Experimental data from plants grown under four irrigation levels and harvested at three time points were used to establish 14 simulation scenarios. The original genome scale soybean model was manually curated and refined and the resulting model comprised 2,984 reactions, five subcompartments, and 6,118 genes. Parsimonious FBA was conducted for each scenario, with fixed seed biomass compositions and minimization of the sum of uptake fluxes (sucrose, asparagine, glutamine, nitrate and ammonia). FBA correctly predicted known features of soybean seed metabolism, including high flux to pyruvate production and CO2 re-fixation by Rubisco. Sucrose and glutamine uptake rates varied across water supply levels and periods, while the number of active reactions remained relatively stable. Standard deviation analysis identified reactions with the most significant flux changes across the scenarios. During the 70-82 DAP (days after planting) period, heterotrophic simulations showed minimal flux alterations under different irrigation levels, unlike the 82-97 DAP period, where greater flux through cytosolic and glycolysis pathways was predicted under lower irrigation conditions. For phototrophic 82-97 DAP simulations, increased flux through fatty acid synthesis, photosynthetic electron transport, and Calvin cycle reactions was observed, while mitochondrial electron transport and malate dehydrogenase decreased. FBA predictions suggest that the metabolic network exhibits a degree of robustness under reduced irrigation, with limited alterations observed.

FREQUENCIES ENHANCE CHLOROPHYLL CONTENT IN SOYBEAN PLANTS

Fernanda Miotti, Muryllo Benevente Batista, Rodrigo Lemos Lovato, Tiago Tezotto, Ricardo Ferraz de Oliveira

Management that optimize the physiological parameters of crops can be applied in agriculture to achieve higher productivity with sustainability. The use of sounds and frequencies has been reported by researchers who have demonstrated that exposure to sounds can enhance yield, photosynthetic rate, drought tolerance, gene expressions, hormone levels and other physiological parameters. The aim of this study was to evaluate a nutritional treatment using extremely low frequencies (ELF) (<100 Hz) on seedlings of soybean plants under different concentrations of nutrient solutions. Conducted under controlled environmental conditions, the experiment included a control and two nutritional ELF treatments (TA and TB), Effatha®, along with three dilutions of Hoagland and Arnon nutrient solution (50%, 75%, and 100%), resulting in nine treatment levels. Each treatment had 4 replicates, in a factorial design 3x3x4, corresponding to 36 soybean plants, which were cultivated for 45 days. At the end, the total chlorophyll content was collected in triplicates from each plant using a ClorofiLOG Falker® CFL1030. The data were compared using an ANOVA and Tukey test at a 99% confidence level, implemented in the programming language Python. TB significantly differed from TA and the control at all solution concentration. Within TB, there was no significant difference among the 50%, 75%, and 100% solution levels. The results indicate that it may be possible to increase nutrient uptake, which may enhance the chlorophyll content (~20%) in soybean plants as a secondary response to using ELF, and reduce the concentration of nutrients provided via solution (by 25% and 50% less N and Mg respectively), optimizing nutritional recommendations and enhancing yield. Future studies may test these treatments on the nutrient uptake kinetics related to chlorophyll, such as N and Mg.

Gas exchange of Dipteryx alata seedlings under different light levels

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The growth and productivity of plant species depend on the photosynthetic rates of the plant, which in turn are influenced by microclimatic conditions, development phase, leaf maturity, and species cycle, among others. In this sense, the gas exchange of seedlings of the species Dipteryx alata Vogel was evaluated in different quantitative solar radiation levels during the dry season of the Cerrado-Amazon transition region of Mato Grosso. The study was conducted for 125 days during the dry season in Sinop, Mato Grosso. The baru seedlings were acclimated in polyolefin screens in quantitative levels (35, 50, 65, and 80%) of light attenuation and in full sun. The photosynthetic rate - A, stomatal conductance - gs; transpiration - E and leaf temperature - Tleaf were evaluated every fifteen days between 08:00 and 11:00 hours using the third and/or fourth leaflet of the median leaf of each plant with a portable photosynthesis analyzer, model LCi-SD from ADC BioScientific at a light intensity of 1839 µmol s-1. The experimental design was completely randomized with four replicates (seedlings). Gas exchange of baru seedlings showed variations at different light levels, with increased A, gs and E under the screens, especially under the 50% shading screen (3.74 µmol m-2 s-1; 0.04 mol m-2 s-1; 1.55 mol m-2 s-1), while the full sun condition provided the lowest average values 3.44 µmol m-2 s-1; 0.03 mol m-2 s-1; 0.99 mol m-2 s-1, in this order. The microclimatic conditions significantly influenced the gas exchange and leaf temperature of the seedlings. We concluded that greater gas exchange occurs in shading of 35 to 80% and higher photosynthetic rates under 50% and 80% black screens.

Gas exchange of fig cv. Roxo de Valinhos subjected to foliar sprays of calcium chloride

Jackson Mirellys Azevedo Souza, Danilo Alvarenga Martins Guerra, Sarita Leonel, Elizabeth Orika Ono, Marcelo de Souza Silva, Andrew Kim Lopes Ferraz, Wellington Souto Ribeiro

This study investigated the impact of different calcium chloride ($CaCl_2$) concentrations on gas exchange in the fig tree ‘Roxo de Valinhos,’ given that calcium, essential for fruit firmness, is poorly mobile within the plant, and its effect on plant metabolism is still underexplored. While foliar application of calcium is common, high doses can trigger oxidative stress, generating reactive oxygen species (ROS) and necrotic lesions on leaves. The experiment was conducted at an experimental farm in São Manuel, São Paulo. Foliar sprays of $CaCl_2$ were applied at concentrations of 0%, 0.5%, 1.0%, 1.5%, and 2.0%, with 10 applications at 15-day intervals. Gas exchanges (CO2 assimilation rate, transpiration, stomatal conductance, internal CO2 concentration and water use efficiency) were monitored using an infrared CO_2 and water vapor analyzer (LI-6400, Li-Cor Inc., Lincoln NE, USA). Results indicate that stomatal conductance and transpiration increased quadratically up to a concentration of 1.0% $CaCl_2$ (Gs: 0.2 mol m-2 s-1; E: 2.8 mmol H2O m-2 s-1), while water use efficiency decreased. This increase in transpiration was due to greater stomatal opening, allowing higher gas exchange. However, at concentrations above 1.0%, stomatal closure was observed, accompanied by a reduction in transpiration. This phenomenon may be associated with oxidative stress caused by the accumulation of Ca^{2+} in the cell cytoplasm, activating enzymes such as NADPH-oxidase, which promote the formation of reactive oxygen species (ROS), leading to necrotic lesions, especially in mature leaves when concentrations of 1.5% and 2.0% were used. It was concluded that $CaCl_2$ application at concentrations up to 1.0% provides benefits in managing gas exchange, while higher concentrations cause phytotoxicity and stress in plants, indicating that doses below 1.0% are safer and more efficient for fig tree cultivation.

HALOPHYTE-BASED INDEX FOR MONITORING PHYSIOLOGICAL STRESS IN COASTAL ECOSYSTEMS USING PAM FLUOROMETRY

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Halophytic species found in coastal regions, such as in Restinga, thrive in saline conditions while acting as sinks for contaminants like heavy metals. This capability is linked to shared tolerance mechanisms under overall mineral stress conditions. Therefore, the development of indices capable of distinguishing environmental quality levels and providing useful information for managing impacts in Restinga areas is of great importance. Chlorophyll fluorometry using Pulse Amplitude Modulation (PAM) was employed on five halophytic species (Blutaparon portulacoides, Canavalia rosea, Ipomoea pes caprae, Ipomoea imperati, and Scaevola plumieri) subjected to different saline conditions in controlled cultivation. This included incorporating components of the quantum yield of energy into three photochemical indices aimed at environmental monitoring (Photochemical Damage Index (PDI), Photochemical Tolerance Index (PTI), and Photochemical Response Index (PRI)). Application of these indices distinguished the most saline-tolerant species, B. portulacoides and S. plumieri, due to their significant and progressive increase ($p>0.05$) in PTI and PRI, indicating effective regulation of non-photochemical quenching (NPQ) components in energy dissipation. Although a similar pattern was observed in I. pes caprae and C. rosea, PDI values suggested NPQ was insufficient to mitigate effects under higher saline conditions. Furthermore, increased PDI underscored greater sensitivity in I. imperati. The differential tolerance observed in this study could serve as a basis for exploring responses to various contaminants. Thus, given these species' distribution across nearly all coastal regions worldwide, the use of PAM fluorometry to generate indices emerges as a promising tool for investigating impacts in these ecosystems.

HYBRID VIGOR BOOSTS PHOTOSYNTHETIC EFFICIENCY UNDER NITROGEN STRESS IN CLEOMACEAE

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The optimization of nitrogen (N) use in agriculture is essential for both environmental and economic sustainability. Reducing N inputs can help mitigate pollution of air and water bodies, protect ecosystems, and reduce costs, while maintaining crop yields is critical for economic viability. Genetic advancements, combined with integrated management practices, offer a pathway to improving N use efficiency (NUE) without sacrificing productivity. Hybrids between C3 and C4 plants hold potential for boosting NUE in agriculture by coupling the beneficial traits of both types, enhancing physiology and N uptake, transport, and assimilation. This study aimed to investigate the photosynthetic and primary metabolic responses of C3, C4, and hybrid Cleomaceae plants under three N regimes. The experiment involved one C3 species (Tarenaya longicarpa), one C4 species (Gynandropsis gynandra), two interspecific hybrids (TlxGg 02 and 04), subjected to three N doses (0, 25, and 100 mg/L) as NH4NO3. N-deprivation severely affected plant growth and yield. However, the hybrids exhibited greater dry leaf biomass than both parental species at 25 and 100 mg/L N. At 25 and 100 mg/L N, the hybrids had intermediate photosynthetic rates (A) between the C3 and C4 species, with electron transport rates like G. gynandra, which had the highest values. The hybrids exhibited greater efficiency in photosystem I electron transfer, along with enhanced energy dissipation capacity and greater leaf area index at 25 and 100 mg/L of N. Notably, the hybrids showed more efficient biomass allocation to roots and leaves, particularly under N limitation (25 mg/L), indicating improved photosynthetic efficiency. These results suggest that hybridization between C3 and C4 species enhances photosynthetic efficiency and biomass partitioning, especially under suboptimal N conditions. This study provides valuable insights into the metabolism of C3 and C4 species of Cleomaceae family, with implications for Brassicaceae N metabolism and potential crop yield improvements.

Impact of Inorganic Carbon Sources on the Growth and Toxin Production in Cyanobacterial Strains

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The phylum Cyanobacteriota (domain Bacteria) consists of Gram-negative prokaryotes capable of oxygenic photosynthesis. Certain cyanobacterial strains produce biocompounds that can adversely affect animals, including the cyanotoxin microcystin. This toxin is particularly known for its hepatotoxic effects in mammals and birds and poses a significant threat to water reservoir quality. Cyanobacteria utilize various forms of inorganic carbon (Ci), such as bicarbonate (HCO_3^-) and carbon dioxide (CO_2), to drive photosynthesis and support cellular functions. Variations in Ci concentration can influence not only growth rates but also the production of secondary metabolites, including toxins. In this study, we assessed the effects of different Ci sources on the metabolism of two filamentous heterocystous microcystin-producing strains: Scytonemataceae CCM-UFV057 and Neowestiellopsis sp. CCM-UFV026. We examined their growth, pigment content, photosynthesis, and microcystin production in response to the treatments. The strains were grown in BG-110 medium and modified BG-110 medium with $NaHCO_3$ concentrations ranging from 0 $g \cdot L^{-1}$, 0.016 $g \cdot L^{-1}$, 0.032 $g \cdot L^{-1}$, 0.16 $g \cdot L^{-1}$, 0.8 $g \cdot L^{-1}$, and 1.6 $g \cdot L^{-1}$. For Neowestiellopsis sp. CCM-UFV026, growth parameters were negatively affected at 0.016 $g \cdot L^{-1}$ of $NaHCO_3$ but were not significantly impacted at higher Ci. In contrast, Scytonemataceae CCM-UFV057 exhibited reduced growth at 0.8 $g \cdot L^{-1}$ of $NaHCO_3$. At the highest Ci, both strains demonstrated decreased pigment levels (chlorophyll a and phycobiliproteins). Neowestiellopsis sp. CCM-UFV026 showed less metabolic disruption and maintained a higher growth rate at elevated Ci concentrations compared to Scytonemataceae CCM-UFV057. Scytonemataceae CCM-UFV057 produces more microcystin than Neowestiellopsis sp. CCM-UFV026. Both strains exhibited increased microcystin production during the stationary growth phase. While the direct effect of Ci concentration on microcystin production remains unclear, factors such as photoperiod and current cellular photosynthetic demand appear to correlate with microcystin production.

IMPACT OF THIOREDOXIN SYSTEM DEFICIENCY UNDER ENVIRONMENTAL STRESS CONDITIONS

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Global warming has been the subject of extensive study, particularly due to the observed intensification in the amplitude and frequency of heat waves, which exert a significant impact on plant metabolism. It has been demonstrated that elevated temperatures and light intensity contribute to the exacerbation of oxidative stress. Consequently, this elevates the probability of damage to the photosynthetic apparatus, which may result in a reduction in plant productivity. Plants thioredoxins (Trx) could act as a mechanism to maintain cellular redox homeostasis and mitigate the effects of stress conditions. These enzymes are involved in the formation of disulfide bonds in target proteins, regulating their function and structure. In this context, Trx performs its activity in various proteins related to essential metabolic pathways, such as the TCA cycle and photorespiration. To better understand the interactions between Trx and extreme environmental conditions, we used Arabidopsis thaliana plants double mutants for the NADP-dependent Trx reductase types A and B (ntra/b) and mutants for the respective Trx cytosolic and mitochondrial isoforms h2 and o1, that were subjected to high temperature and radiance. The results obtained here demonstrate that, under these conditions, there was a significant reduction in the potential quantum efficiency of photosystem II, which is the ratio between variable fluorescence and maximum fluorescence (Fv/Fm). In this regard, the mutant plants for the different Trx isoforms, particularly the ntra/b, exhibit a reduction in the range of values observed compared to those of the wild-type plants. Furthermore, the same trend was observed in productivity-associated traits, with the ntra/b double mutant displaying a higher number of siliques and flowers. These findings support the hypothesis that the absence of a functional Trx system result in the activation of alternative metabolic pathways that can compensate for its absence, thereby enabling these plants to thrive under stress conditions.

INCORPORATION OF THE ABILITY TO PRODUCE SESQUITERPENE-DERIVED NATURAL INSECTICIDES INTO CULTIVATED TOMATO CV. MICRO-TOM

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The incorporation of pest resistance into cultivated tomatoes (Solanum lycopersicum L.) aims to reduce the use of insecticides, benefiting the health of farmers, consumers, and the environment. In previous studies, two tomato genotypes were developed introgressing the Zgb and Sst2 alleles from S. habrochaites, a wild species resistant to arthropod pests, into the cv. Micro-Tom (MT) genetic model. The genotypes, designed MT-Zgb and MT-Sst2, were obtained through successive backcrosses (BC6Fn) using S. habrochaites PI127826 as a donor parent for Zgb and S. habrochaites LA1777 for Sst2 alleles. The Zgb allele is responsible for the production of the sesquiterpene 7-epizingiberene, while the Sst2 allele drives the production of α-santalene, α-bergamotene, and β-bergamotene. Although the levels of these compounds in MT-Zgb and MT-Sst2 were even higher than in their wild progenitors, this did not result in increased pest resistance. This may be due to the fact that, in wild species, a portion of the sesquiterpenes is converted into alcoholic and acidic forms, which have demonstrated efficacy against herbivores. We used gas chromatography and mass spectrometry (GC-MS) to screen F1 plants derived from the cross MT-Zgb x PI127826. The results indicated that the alleles responsive for converting 7-epizingiberene into 9-hydroxyzingiberene (9vHZ) and 9-hydroxy-10,11-epoxyzingiberene (9H10epoZ) are dominant. In contrast, the F1 generation from the cross MT-Sst2 x LA1777 did not express the derivatives α-bergamotenoic acid, α-santalenoic acid, and β-bergamotenoic acid (collectively known as "sesquiterpene carboxylic acids" or SCAs) observed in the wild parents, indicating that the relevant alleles are recessive. Further crosses to obtain MT genotypes that synthesize sesquiterpene derivatives will help identify the genes responsible for their production and uncover new metabolic pathways that can be used to develop pest-resistant commercial tomatoes.

INFLUENCE OF NITRATES ON GAS EXCHANGE IN PAPAYA PLANTS

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Papaya (Carica papaya) gas exchanges can be significantly affected by various environmental conditions. Calcium and potassium nitrate are substances that can improve the efficiency of gas exchange, due to their importance in cell signaling, enzyme regulation, osmotic regulation and transport of nutrients. Thus, the objective of this study was to evaluate the impact of doses of calcium nitrate and potassium on gas exchange in C. Papaya cv alliance. The experiment was conducted in Linhares, ES, between July and September 2023. The seeds were immersed for 12 hours in solutions with the doses (0, 0.1%, 0.2%, 0.3%, 0.4% and 0.5%) of calcium nitrate and potassium nitrate. After the treatments, the seeding was performed in tubes with volume of 50cm3 filled with the substrate Bioplant enriched with Osmocote 3M. The design was completely randomized, with 4 replications containing 12 plants. The gas exchanges were evaluated in fully expanded sheets, using the infrared LI-COR 6400 - IRGA gas analyzer (LI-COR Inc., Lincoln, NE, USA). The photosynthetic rate (A), transpiration (E), internal carbon (Ci), relationship between internal and external carbon (Ci/Ca) and stomatal conductance (gs) were determined by Irga and water use efficiency (WUE= A/E) was calculated. The data were submitted to analysis of variance, in which the means referring to the dose products were compared by the Tukey test, and the doses, submitted to polynomial regression ($p < 0.05$). The treatment with calcium nitrate obtained significant responses in all variables analyzed, presenting interaction between dose and product in the variables Ci, Ci/Ca and WUE. Thus, calcium nitrate can be used for better efficiency of gas exchange, as it showed good results when compared to potassium nitrate.

INFLUENCE OF PLANTING METHODOLOGIES ON PHOTOSYNTHESIS AND GROWTH OF SEEDLINGS FOR RESTINGA RESTORATION

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The present study objective to evaluate the photochemical performance and growth of four species (Eugenia astringens Cambess., Guapira opposita (Vell.) Reitz, Psidium cattleianum Sabine and Clusia hilariana Schltdl.) in the restoration of restinga vegetation in an area degraded by sand extraction. The species were arranged in an Anderson nucleation system consisting of four treatments: T1 - without weeding and without hydrogel, T2: weeding + hydrogel, T3: weeding + nurse plant (bromeliad) + hydrogel and T4: weeding + fertilization + hydrogel. At 0 and 90 days of implementation of the experiment, we determined the energy efficiency parameters in a portable fluorometer (Handy PEA - Plant Efficiency Analyzer, Hanstech) from 08:00 to 10:00 hours on leaves adapted to the dark for 40 min. With these parameters, we performed the JIP test. We also measured the height and diameter of the stem. After 90 days, in general, the Fo/Fm (Initial Fluorescence by Maximum Fluorescence) of the species declined, indicating stress due to reduced energy utilization between absorption (F0), capture and transport of electrons (Fm) in all treatments. In contrast, the Fv/Fm (quantum yield of photosystem II) increased in all treatments, suggesting greater energy aptitude. No difference was observed in height growth. On the other hand, stem diameter increased in all treatments. We conclude that the species used, regardless of the treatment, have shown the capacity for photochemical acclimation and growth without compromising survival under field conditions. These preliminary results indicate the promising potential of the species used and the treatments in recovery in degraded restinga areas.

Influence of sodium on photosynthesis, nutrition and production of rice grains in high CO2

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The effects of climate change are increasingly worrying the food security of the world population, due to the effects of plant production. Among the crops of great socioeconomic importance, rice deserves to be highlighted and, as it is a C3 metabolism plant, it will be greatly influenced by the increase in CO_2. The objective of this work was to evaluate the influence of sodium on photosynthesis modeling and grain yield in a rice strain under high CO_2 concentration. The experimental design was in completely randomized blocks in a double factorial scheme, with the first factor being the CO_2 concentrations (400 µmol mol-1 (C1) or 700 µmol mol-1 (C2)) and the second factor being the NaCl supplementation (0 mmol L-1 NaCl (S1) and 3 mmol L-1 NaCl (S2)). The following traits were evaluated: nitrogen (N), potassiun (K) and sodium (Na) leaf content; Gas-exchange parameters; Chlorophyll fluorescence and grain weight per plant (GWP). Under conditions C1S2 there was a decrease in N content, treatment C2 increased K; in relation to the gas exchange parameters, in C2 under 2% O_2 condition, there was an increase of J under C2S2 compared to C2S1. For J / Vcmax C1S2 was higher than C1S1. In relation to Fv/Fm, C1S1 was greater than C1S2 and C2S1 greater than C2S2. In the parameters from A / PAR curves there was no difference between treatments. GWP C1S2 was greater than C1S1 and C2S1 was greater than C2S2. It was possible to prove that a low dose of NaCl influences the photosynthetic and grain production processes of an upland rice line.

INFLUENCE OF TOMATO ASSOCIATION WITH Azospirillum brasilense ON ASCORBATE SYNTHESIS, CHLOROPHYLL FLUORESCENCE, AND PLANT GROWTH

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The synthesis of ascorbic acid (AA) in higher plants involves the enzyme L-GalLDH. Although plant growth-promoting bacteria (PGPB) can enhance plant growth, their effect on AA synthesis and L-GalLDH function is still unknown. This study aimed to evaluate the effect of PGPB on growth, chlorophyll fluorescence, and AA synthesis in two tomato genotypes (wild-type and L-GalLDH mutant) subjected to three treatments: non-inoculated plants, plants inoculated with A. brasilense, and plants inoculated with A. brasilense and Trichoderma. The plants were grown in 700 mL cups and 3.5 L pots, with assessments of fresh weight (FW) and dry weight (DW) of roots and shoots, root length (RL), plant height (h), number of leaves (Nº leaves), leaf area (LA), and leaf thickness (LT). Leaf greenness was also measured with SPAD, and chlorophyll fluorescence was evaluated using the following parameters: qL, Fv/Fm, Phi2, PhiNPQ, and PhiNO. In pots, the inoculated plants showed higher values in all measured variables. Shoot FW, LA, SPAD, and height were greater in bacteria-inoculated plants. qL was consistently lower in the mutant, regardless of the treatment. In cups, LT was unaffected, but SPAD was higher in inoculated plants, and overall, bacterial inoculation increased values for all measured variables. The presence of A. brasilense stimulated plant development, but in the mutant genotype, growth was slower in plants grown in cups, where space is limited, compared to the wild-type genotype. Inoculation with PGPB reduced L-GalLDH activity in leaves, with no effect on roots. This is likely due to the higher demand for AA in the shoots and the enzymatic regulation by light.

INOCULATION OF Bacillus amyloliquefaciens BV03 AND PHOSPHORUS SOURCES: EFFECTS ON CORN GAS EXCHANGE

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The use of bio-inputs is a sustainable alternative to conventional agriculture. The objective was to evaluate the effects of applying the bacterium Bacillus amyloliquefaciens (Ba) BV03 in combination with phosphorus sources on corn physiology. The experiment was conducted in a greenhouse at FCA/UNESP, Botucatu, SP, Brazil, in 2023. The experimental design was completely randomized, in a 2 x 4 factorial scheme: without and with Ba, and four forms of P fertilization (without phosphate fertilization; triple superphosphate – TSP; Bayóvar reactive phosphate – BRP; Pratápolis natural phosphate – PNP), with four replications. The evaluation included chlorophyll a (Chl a) and b (Chl b), carotenoids, net CO2 assimilation rate (A), stomatal conductance (gs), and transpiration rate (E) during the phenological stages V10 and R1. The data were subjected to analysis of variance, and the means were compared using Tukey test ($p<0.05$). Interaction between Ba BV03 and P sources was observed for E, Chl a, and carotenoids at V10, and Chl a, Chl b, carotenoids, A, gs, and E at R1. There were isolated effects for A, gs, and Chl b (V10). Inoculation with Ba BV03 benefited the physiology of corn at V10, including A (7.03%), Chl a (26.04%), Chl b (19.81%), and carotenoids (17.84%). In R1, Ba BV03 increased Chl a (37.22%), Chl b (27.98%), and carotenoids (29.95%). The application of SFT positively influenced A (26.90%), gs (14.03%), and E (18.12%), while FRB affected the levels of photosynthetic pigments at V10. In R1, without P + Ba, there was an increase in A (38.15%), gs (56.88%), E (52.68%), and SFT + Ba of Chl a (32.58%), Chl b (12.44%), and carotenoids (29.57%). The inoculation with Ba BV03 combined with SFT and FRB positively impacted the corn gas exchanges and photosynthetic pigments.

INTERACTION BETWEEN PHOSPHORUS AND ZINC ON THE METABOLISM AND INITIAL GROWTH OF *Schizolobium parahyba*

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Brazil, home to the largest tropical forest in the world, faces the challenge of balancing socioeconomic development with environmental conservation. In this context, reforestation emerges as an essential tool for recovering degraded areas and restoring ecological balance. This study aimed to evaluate the impact of the interaction between phosphorus (P) and zinc (Zn) on the metabolism and initial growth of the species Schizolobium parahyba (Vell.) Blake and its varieties S. parahyba var amazonicum and S. parahyba var parahyba. To achieve this, greenhouse experiments were conducted using specific nutrient solutions to induce P and Zn deficiencies in the plants. Biometric parameters, photosynthetic aspects, and the metabolite profile of the varieties subjected to four treatments were evaluated. The results indicated that the combined deficiency of Zn and P had a negative impact on plant growth and metabolism, particularly in S. amazonicum, which was more sensitive to the lack of these nutrients. On the other hand, S. parahyba var parahyba demonstrated greater resistance under nutritional stress conditions, maintaining growth even in the face of deficiencies. These findings suggest that, for reforestation programs in degraded soils, S. parahyba var parahyba may be a more suitable option due to its higher nutrient use efficiency and adaptability.

Investigating the photosynthetic induction in tropical tree species growing under contrasting irradiances

Maria Teresa Portes, Daniel Santa Cruz Damineli, Gustavo Maia Souza

Light availability in tropical forests is a constantly changing resource and tree species rely on its light utilization capacity to cope with such high spatio-temporal variability. The efficiency of light utilization depends essentially on the photosynthetic induction state, determined by the light–mediated activation of photosynthetic enzymes, mainly Rubisco, stomatal opening and their maintenance under low–light. Here, we focused on characterizing the species abilities to respond to an increase in light availability when acclimated to different light environments. We compared photosynthetic responses of four species widely found in Brazilian forests and classified into distinct ecological groups. To assess acclimation capacity, photosynthetic induction time courses were compared among plants grown in three light environments: 10%, 50% and full sun light. Photosynthetic parameters such as induction state (IS), maximum CO2 assimilation rate (Amax) and time to attain 50% (T50) and 90% (T90) of Amax were estimated. Chlorophyll content (Chl), electron transport rate (ETR) and specific leaf weigh (SLW) were also measured and compared. Principal component analysis (PCA) and shade adjustment coefficient (SAC) were used to estimate overall physiological responses. Three acclimation responses were detected: i) Schinus terebinthifolius is light-demanding but with high acclimation capacity to low light, ii) Hymenaea courbaril is shade-tolerant but with low acclimation capacity to high light, iii) Cecropia pachystachya and Tabebuia impetiginosa are light-demanding, but with low acclimation capacity to low light. T. impetiginosa presented high acclimation to high light while C. pachystachya showed low acclimation to low light. S. terebinthifolius had high light utilization efficiency under low light, while T. impetiginosa showed low photosynthetic acclimation to low light. Thus, although the different acclimation capacities observed indicate the potential to occupy different light environments, the actual occurrence in distinct habitats is further conditioned by trade-offs not reflected in the leaf level light acclimation.

LEAF STARCH CONTENT IN YOUNG MANGO PLANTS UNDER WATER DEFICIT AND EXOGENOUS NITRIC OXIDE

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Although mango (Mangifera indica L.) is considered to be drought tolerant plant, water stress can be particularly detrimental when it occurs after transplanting seedlings to the field, as it limits initial growth and can be crucial for the survival of young plants. Osmoregulation in plants under water deficit depends on the accumulation of osmolytes to increase the osmotic potential at the cellular level. Osmolyte accumulation as soluble sugars, in turn, depends on starch hydrolysis. Nitric oxide (NO) is a redox-active, low molecular weight molecule and a gaseous hormone with an important role in plant development. Generally, exogenous NO has been reported to improve the tolerance of plants to abiotic stresses, since it acts on the osmolyte accumulation improving plant water status. A greenhouse experiment was conducted with six-month-old mango plants using a completely randomized design, in a 2 × 5 factorial scheme, with four replicates and one plant per pot. We performed leaf starch content analyses on plants under well-watered and water-deficit irrigation regimes and pre-treated with sodium nitroprusside (SNP) application, as a NO donor, at 50, 100, 150, and 200 μM, plus a control treatment with no SNP. The results showed that in well-watered plants the starch content was not significantly altered by the application of SNP. However, under water deficit conditions, starch content was reduced by 71% with SNP application, but only at 200 μM, compared to well-watered plants. These findings allow us to conclude that the SNP application in well-watered young mango plants does not favor a decrease in starch content, whereas in plants under water deficit conditions this decrease can occur with SNP application at 200 μM, thus allowing an accumulation of osmolytes for osmoregulation, which can improve plant tolerance to water deficit.

Light conversion and biomass accumulation in Humulus lupulus L.: effects of silicon supplementation

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The efficiency of light conversion in the photochemical stage of photosynthesis is the key driver carbohydrate biosynthesis by providing reducing power (NADPH) and energy (ATP) for the biochemical stage. Supplementation with exogenous silicon (Si) has shown positive effects in modulating photosynthesis in various agriculturally importante species. However, little is known about the effects on hops (Humulus lupulus L.), a raw material in beer production. Seeking to understand the effects of Si on hops, the study sought to analyze the growth and photochemical stage of photosynthesis in the Zeus variety. The design was completely randomized, with two Si doses in 7 replicates, totaling 21 plants. The seedlings produced by cuttings were transplanted after 30 days to pots containing 10 L of substrate. The Si doses (0, 2 e 6 mmol L-1) were applied biweekly, using potassium silicate (K2SiO3). The photochemical stage of photosynthesis was evaluated using a portable fluorometer and growth analysis was performed considering classical methodology. Si did not affect the chlorophyll a fluorescence parameters, except for the transfer per reaction center (ETo/RC) that was 4% higher at the 6 mmol dose when compared to the control. For growth, the 6 mmol dose favored an increase of 42 and 12% in the dry mass of stem and leaf in relation to the control, respectively. Biomass allocation was significant only for stem mass ratio (SMR) with a 33% increase at 6 mmol of Si. Similarly, the relative growth rate (RGR) increased by 7.2% when compared to the 2 mmol dose. Overall, these results suggest remarkable homeostasis of the electron transport chain since there were no significant effects of Si application. On the other hand, Si supplementation appears to be a promising alternative for improving biomass accumulation performance during the vegetative stage in hops.

LIGHT SUPPLEMENTATION IMPROVES PHOTOSYNTHETIC AND PRODUCTIVE PERFORMANCE OF TOMATO VARIETIES UNDER PROTECTED CULTIVATION

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With the rise of urbanization, strategic measures must be taken to ensure food security, reduce global malnutrition, and maintain the nutritional quality of food. The implementation of more resilient and sustainable food production systems, such as vertical farming, is emerging as a viable solution to meet these demands. Tomatoes, being widely consumed worldwide, rank as the second most produced crop. Their pleasant flavor, low caloric content, and bioactive potential make tomatoes a promising candidate for cultivation in vertical farming systems with light supplementation. In this context, light supplementation with varying spectral qualities (RBW, Blue, Red, and White) was applied to the cultivation of two tomato cultivars, Frutilla (conventional) and Black Pear (heirloom), with the aim of enhancing physiological attributes and boosting productivity. The results demonstrated that light supplementation significantly influenced the photosynthetic performance and yield profiles of the tomatoes under different light conditions. Frutilla plants exposed to RBW light (combined spectrum) showed superior performance in stomatal conductance (gs), transpiration rate (E), photosynthetic rate (A), and the maximum quantum efficiency of photosystem II (Fv/Fm), leading to higher fruit production and weight across four biweekly harvest cycles compared to those grown under monochromatic blue and red lights. Conversely, the Black Pear variety exhibited enhanced physiological and productive parameters when supplemented with broad-spectrum white light, while red monochromatic light limited its potential. These findings indicate that light quality plays a critical role in the photosynthetic adjustment of plants, significantly impacting fruit number and weight. The differential responses of conventional and heirloom tomato cultivars to light quality underscore the importance of selecting the appropriate cultivar and light spectrum to optimize productivity.

METABOLIC INSIGHTS ON PRIMING TECHNIQUE

Mateus Moreira Bernardes, Elisa Monteze Bicalho, Toshihiro Obata

Priming is a well-established methodology applied to seeds of crops and native species with the capability to increase both rate and uniformity of germination and improve seedling establishment. However, the mechanism of responses activated by priming is still not fully understood. Thus, the objective of this work is to evaluate the major metabolic alterations occurring in two cultivars of sorghum seeds (Btx623 and Rtx430) throughout priming. Priming was defined as an 8-hour imbibition followed by a 28-hour drying period, based on imbibition and drying curve developed from four replicates of 25 seeds each, that took place at 25 and 30º C, respectively. Germination was evaluated at control (25 ºC) and cold stress (10 ºC) conditions. During priming, metabolic evaluations were conducted at eight sampling points: dry seeds, 2, 4 and 8 hours after the onset of imbibition, 2,4,10 and 28 hours after the onset of drying. Metabolites were analyzed by GC–MS (7200 GC-QTOF) and intensity values of each metabolite were normalized to internal standard ribitol and sample fresh weight. Priming promoted increased germination during cold conditions in Btx623 cultivar. During imbibition, there were decreases in lactate, sucrose, phosphoric acid and tricarboxylic acid cycle (TCA) intermediates (malate, isocitrate and citrate), while levels of acetoacetate, glycerol and glucose-6-P increased in this phase. An accumulation of amino acids (glycine, serine, proline) and mono and disaccharides (glucose, fructose and maltose) occurred during the drying phase. Metabolites alteration during priming indicated a progression of energy obtainment for germination during imbibition that can be a result of different rate of storage reserves consumption in seeds. Also, changes in drying phase might be due to an osmoregulation mechanism that remained higher at the end of priming. Taken together, priming induces distinct metabolites changes in specific phases, suggesting their role in germination improvement exhibited by primed seeds.

Metabolic Regulation Induced by Biostimulants in Mitigating Salt Stress in Soybean

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Soybean is a globally significant oilseed, widely cultivated across diverse regions, including the semi-arid northeast of Brazil. However, its productivity is notably compromised by abiotic stresses, particularly salinity. Salinity-induced osmotic imbalance triggers the synthesis of primary and secondary metabolites, which function as antioxidants and osmoregulatory agents, thus aiding in the maintenance of cellular homeostasis. Given the adverse impacts of salt stress, biostimulants derived from Ascophyllum nodosum and fulvic acids offer potential for mitigating these effects. The objective of this study was to assess the differential metabolic responses of soybean to salt stress and the application of a biostimulant based on Ascophyllum nodosum and fulvic acids. The experimental design utilized a completely randomized factorial scheme (2x2), incorporating two irrigation treatments: water with an electrical conductivity (EC) of 0.5 dS m^{-1} (control) and water with an EC of 4.0 dS m^{-1} (saline), combined with two biostimulant treatments: application (V3 + R1) and non-application. GC/MS technique was employed to identify and quantify primary metabolites in soybean leaves, while MetaboAnalyst software was utilized for multivariate analysis. A total of 79 metabolites were identified, encompassing amino acids, carbohydrates, organic acids, fatty acids, and other groups. The analysis revealed 14 significant metabolites affected by saline stress and biostimulant application. Notably, levels of compatible solutes, including mannitol and glycerol, were elevated in response to both biostimulant application and saline stress, underscoring their role in osmotic regulation. Among the amino acids that increased under these conditions, glycine and cysteine were identified as key contributors to oxidative stress defense. The study demonstrated that biostimulant application activated the production of essential metabolites involved in the soybean's response to saline stress. Thus, it can be concluded that the biostimulant effectively facilitated metabolic regulation to alleviate the adverse effects of salt stress in soybeans.

Methylobacterium symbioticum modulates nitrogen assimilation enzymes and grain yield in soybean plants

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In recent decades, management strategies have been explored to optimize nitrogen fixation in plants, particularly in soybean (Glycine max), leguminous that forms a symbiosis with nitrogen-fixing bacteria (Bradyrhizobium spp.), either through direct inoculation of seeds or in the planting furrow. Recently, a strain of Methylobacterium symbioticum known for its high capability to fix atmospheric nitrogen, has been registered on the market as a solid biological inoculant for corn, applied via foliar treatment. This study aimed to investigate the role of M. symbioticum in physiological performance, nitrogen assimilation processes and grain yield in soybean plants. The experiment was conducted on a commercial farm in Parnarama, Maranhão, Brazil, and consisted of five inoculation treatments: i) Seed inoculation with Bradyrhizobium spp. (commercial inoculant for leguminous); ii) Co-inoculation of seeds with Bradyrhizobium spp. and Azospirillum brasilense (commercial inoculant for grass); iii) Seed inoculation with Bradyrhizobium spp + foliar application of M. symbioticum at R1 stage (beginning of soybean flowering); iv) co-inoculations of seeds with Bradyrhizobium spp. and A. brasilense + foliar application of M. symbioticum at R1 stage; and v) foliar inoculation with M. symbioticum at R1 stage. Inoculation with M. symbioticum significantly increased the foliar activity of nitrate reductase (NR), nitrite reductase (NiR), and glutamate synthase (GOGAT) in soybean plants compared to other treatments. This enhancement in enzymes activities was associated with improved net photosynthesis, stomatal conductance, and transpiration. These physiological improvements resulted in greater plant growth and grain yield compared to other inoculation methods. Additionally, co-inoculation of seeds combined with foliar application of Methylobacterium symbioticum at the beginning of soybean flowering increased the activity of nitrogen-related enzymes, which was associated with enhanced photosynthetic efficiency and growth. In conclusion, our findings clearly demonstrate that inoculating soybean plants with M. symbioticum is an effective strategy for improving growth and grain yield under field conditions.

MYCORRHIZAL SYMBIOTIC ASSOCIATION IN CHERRY TOMATOES INFLUENCES ROOT, LEAF AND FRUIT RESPIRATION.

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The mycorrhizal symbiotic association is a beneficial relationship between the plant and the fungus that promotes various benefits to the plant, resulting in greater productivity in various crops of economic interest. Despite being restricted to the root, fungi promote a greater area of nutrient absorption, protect the root system from pests and diseases, favor photosynthetic activity, respiratory metabolism and the flow of energy in plants. Associated with the mitochondrial electron transport chain (EMTC), the enzyme L-galactono-1,4-lactone dehydrogenase (L-GalLDH) links the synthesis of ascorbic acid (AA) to cellular respiration. Considering the use of mycorrhizae as biofertilizers, few is known about the effect of the symbiosis on mitochondrial respiration at the energetic cellular level and the activity of CTEm. This study evaluated mitochondrial respiration by O2 consumption via Clark's electrode in mitochondria isolated from roots, leaves and fruit of tomato plants in association with Claroideoglomus etunicatum. A wild-type genotype (WT) and a genotype with under-expression of the L-GaLDH enzyme (P35S:SlgalldhRNAi) were used. Respiration was also analyzed using the substrate of the L-GalLDH enzyme, L-galactono-1,4-lactone (L-GalL) in unripe fruit, with the hope of relating mitochondrial respiration to AA synthesis. The results show that respiration in roots has a greater participation of cytochrome c oxidase (COX) in both genotypes while in the leaves of the P35S:SlgalldhRNAi genotype there was a greater participation of alternative oxidase (AOX). The results show that mycorrhizal symbiosis increases mitochondrial respiration in tomato roots, leaves and fruit. For mitochondrial respiration sustained by L-GalL, mycorrhizal association decreases cellular respiration, with the AOX pathway prevailing in total respiration, unlike the control where COX plays the greatest role in respiration. These results suggest that the effect of mycorrhizal symbiosis is systemic, influencing the respiration of roots, leaves and fruit and may have an effect on the energy ratio in these tissues.

NANOEMULSION CONTAINING ESSENTIAL OIL FROM BRAZILIAN PEPPER TREE FOR ANTIBACTERIAL ACTIVITY AGAINST SENSITIVE BACTERIA

Nataly Senna Gerhardt Barraqui, Gabriel Amorim Lopes, Caio Pinho Fernandes, Quézia Moura, Hildegardo Seibert França

Schinus terebinthifolia, also known as the Brazilian peppertree, belongs to the Anacardiaceae family and is a native plant of South America. It is notable for its high essential oil content and medicinal properties. The objective of this study was to assess the antibacterial activity of a nanoemulsion of essential oil extracted from fruits. This nanoemulsion was developed to enhance the bioavailability of active compounds and their biological activity. Tests were conducted on Escherichia coli 25922, Pseudomonas aeruginosa, Staphylococcus aureus and Proteus mirabilis. The antibacterial activity was quantified by determining the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). Serial dilutions of the pure essential oil and nanoemulsion were prepared in concentrations ranging from 21.5 to 0.002 mg mL-1. The nanoemulsion exhibited superior antibacterial activity against all tested bacteria, with the exception of P. mirabilis, which was not affected by the nanoemulsion and pure essential oil. The MIC and MBC of the nanoemulsion against E. coli and S. aureus were 0.005 and 0.39 mg mL-1, respectively, while the MIC of the nanoemulsion against P. mirabilis was 6,25 mg mL-1. However, MIC and MBC of the oil pure against E. coli were 0,01 and S. aureus 1,56 mg mL-1. The nanoemulsion demonstrated superior efficacy compared to the pure essential oil, likely due to its higher particle count and prolonged contact time with the microbial cell surface. The nanoformulations obtained may have a significant impact on improving the biological activities of S. terebinthifolia essential oils, with potential use in medicinal products

Nickel foliar application increases photosynthesis of maize plants

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This study investigated the effect of foliar application of Ni doses on photosynthesis in maize plants, aiming to improve the photosynthetic rate. A randomized block design (RBD) was used, with five Ni doses (0, 20, 40, 80, and 160 g ha-1) applied in two splits, with four replicates, totaling 20 plots. Photosynthesis was measured at the phenological stage (VT) on the first fully developed leaf. A portable infrared gas analyzer (IRGA) was used to assess the net photosynthesis rate (A, µmol CO2 m-2 s-1). Net photosynthesis in year I increased to a peak at a dose of 84.10 g ha-1 of Ni, representing an increase of 46.10% over the control. In year II, A increased to a maximum at 83.69 g ha-1 of Ni, an increase of 45.13% over the control. Ni functions as an enzymatic cofactor, promoting greater nitrogen use efficiency and, consequently, enhancing photosynthesis. However, excessive doses of Ni induce plant stress, leading to a reduction in photosynthesis rates. The data confirm the importance of an optimal Ni dosage to improve photosynthetic performance without inducing toxicity. Therefore, foliar application of Ni is a promising strategy to enhance photosynthesis in maize plants when applied at a dose of 84.10 g ha-1, doses exceeding cause toxicity and adversely affect photosynthesis in maize plants.

NITROGEN METABOLISM IN SUGARCANE GROWN UNDER HIGH CO2 PARTIAL PRESSURE

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Carbon dioxide (CO_2) is a gas emitted by the burning of fossil fuels and suggests that the partial pressure of CO_2 in the atmosphere (pCO_2) will continue to increase. This leads to increase in photosynthesis in C3 plants, but in C4 plants this response is variable. Increased photosynthetic activity is exhibited temporarily due to photosynthetic acclimation. Acclimation causes a gradual reduction in photosynthesis and is associated with a reduction in nutrient concentration, especially nitrogen concentration in plant tissues. The hypothesis was tested that an increase in pCO_2 would cause an increase in photosynthesis, as well as changes in nitrogen metabolism, in sugarcane plants (Saccharum spp.). Young sugarcane plants were grown for 45 days in open-top chambers (OTCs), and exposed to two concentrations of pCO_2: 400 and 700 ppm, in a completely randomized design. Data were subjected to analysis of variance with means compared using the Scott-Knott test ($P<0.05$). High exposure to pCO_2 did not cause an increase in photosynthesis. However, there was a reduction in the amount of nitrate in roots and leaves, associated with a reduction in total nitrogen, Chlorophyll A and B in the leaves. Although there was a reduction in nitrogen, there was a more efficient use of nitrogen in plants exposed to high pCO_2. Furthermore, the reduction in the amount of nitrate in the roots was accompanied by a reduction in the activity of nitrate reductase, but there was no reduction in the activity of glutamine synthetase, meaning that this enzyme maintained its activity as a result of the assimilation of ammonium. Our data suggest that exposure to high pCO_2 causes changes in nitrogen metabolism in sugarcane, independently of changes in carbon assimilation, with a reduced amount of nitrate in the root and ammonium assimilation increased.

PHOTOCHEMICAL RESILIENCE OF FERNS UNDER DROUGHT

Vitória Caroline Pereira Kühl, Gabriel Ferraz Guimarães, Milton Costa Lima Neto

Climate change, characterized by extreme events as prolonged droughts, poses a significant threat to biodiversity. Various biomes, composed of a variety of species, contain bioindicators that assist in evaluating environmental quality. Ferns, such as Nephrolepis exaltata, are promising examples, as they are present in many biomes in Brazil and environmental changes can directly affect their physiology. N. exaltata, a cosmopolitan species in tropical regions, plays a crucial role in maintaining the health and stability of these ecosystems. However, scientific literature on the response of this species to environmental stresses is still limited. This study aims to investigate responses of N. exaltata to drought. Seedlings of N. exaltata, from vegetative propagation, were cultivated in a greenhouse, in 2.8 L pots containing a substrate composed of potting soil, coconut fiber, and bovine manure. After a 4-week acclimation period, the plants were subjected to two treatments: one group was irrigated to field capacity, and the other group was subjected to water deprivation. After 4 weeks of drought, plant harvest was performed when the drought group plants exhibited chlorosis and necrosis symptoms. Biometric indicators, water status parameters, membrane integrity, photosynthetic pigment concentrations, and chlorophyll a fluorescence were evaluated. Drought decreased fresh matter by 44% and the relative water content by 34% compared to control. The membrane damage was increased by 28% by drought. Pigments presented an interesting modulation with decreasing content of chlorophyll a, b, total and the a/b ratio. In contrast, the potential (FvFm) and effective [Y(II)] quantum yields of PSII and the non-photochemical quenching (NPQ) did not change in plants exposed to drought compared to control. The results obtained so far highlight the robustness of PSII apparatus in N. exaltata exposed to drought. However, further studies on the physiology and ecology of this species are needed to develop effective conservation strategies.

PHOTOSYNTHESIS INDUCTION AND PHOTOPROTECTION IN THE CANOPIES OF *Sorghum bicolor* AND *Zea mays*

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Light variability along the canopy profile requires a sophisticated control for the induction of photosynthesis and the deactivation of photoprotective mechanisms, which could optimize the CO_2 assimilation and crop yield. This study aimed to investigate the genotypic variation in photosynthesis induction and the relaxation of non-photochemical quenching (NPQ) across the canopy of five maize (BM3069 PRO2, AG8701 PRO4, K7500 VIP3, DKB355 PRO3 and B2401 PWU) and sorghum (DKB560, Enforcer, IAC 7021, Brandelisa and Santa Elisa) cultivars. Measurements of CO_2 uptake, stomatal conductance and NPQ dynamics were taken during the induction of photosynthesis (changing light from 0 to 2,000 μmol m^{-2} s^{-1}) in three canopy strata: top, middle and the bottom canopy positions. The maize cultivars DKB355 PRO3 and AG8701 PRO4 exhibited higher dry matter and faster light responses, which were attributed to the synchrony among CO_2 assimilation, stomatal conductance, quantum yield efficiency of photosystem II, and fast deactivation of NPQ in the middle and bottom canopy layers. In contrast, sorghum cultivars exhibited negative or weak correlations between dry matter and photosynthetic traits. DKB560 was the slowest cultivar in terms of light response, showing no NPQ relaxation throughout the canopy. Interestingly, sorghum dry matter correlated positively with leaf area in the Brandelisa and Santa Elisa cultivars, indicating a compensation mechanism for slower photosynthetic induction and NPQ relaxation compared to maize. These findings provide valuable insights for breeding programs aiming to select new cultivars with improved photosynthesis, light responsiveness and increased leaf area - key traits for enhancing crop productivity under field conditions.

PHOTOSYNTHESIS THERMOTOLERANCE IN TROPICAL FOREST SEEDLINGS USED IN ECOLOGICAL RESTORATION CORRELATES WITH PRODUCTIVITY

João Paulo Taranto Vasques, Carolina Reis de Brito, Jerônimo Boelsums Barreto Sansevero, Dulce Mantuano

Ecological restoration is the process of assisting the recovery of an environment that has been degraded. Such environments present stress factors such as high temperatures intensified by climate change. High temperatures can disrupt photosynthesis by altering membrane fluidity, gas solubility, and enzyme specificity. Previous studies have shown that canopy leaves in tropical forests routinely exceed the photosynthesis thermal limits. However, in a restoration scenario, seedlings often deal with temperatures higher than those in canopies, and understanding their response to this stress is the purpose of this study. We exposed leaves from seedlings of 8 tree species from Atlantic Forest to heat curves from 25°C to 55°C at 5°C intervals using an infrared gas analyzer. Responses of carbon assimilation and chlorophyll a fluorescence (Fv/Fm) were modeled in response to leaf temperature. Maximum carbon assimilation rate, LMA and leaf thickness were used as productivity indicators. The studied species showed an overall initial drop (Tcrit) around 35°C for Fv/Fm and 30°C for assimilation. Temperatures of 50% loss of maximum Fv/Fm and assimilation were around 53°C and 35°C, respectively. Although these values for thermal limits were close to those found for canopy leaves of tropical trees, considering the difference in total number of leaves and the presence of leaves autoshading, we believe thermal stress is much more intense to seedlings than adult plants. Values of thermal limits to photosynthesis showed a correlation with productivity indicators. Species with more productive leaves exhibited lower Tcrit values. However, they remained productive for longer, with higher T50 values. We conclude that increased air temperature can reduce carbon fixation rates in seedlings used for tropical forest restoration, potentially delaying initial forest development. Additionally, we show that thermotolerance in these species is related to leaf traits, which could help for more thermotolerant species selection for restoration purposes.

Photosynthetic dynamics and Stay-Green effect in corn: Modifications mediated by Azospirillum brasilense

André Sarabia Zamarian, Andre Gustavo Battistus, Danielle Mattei, Ana Laura Topanott Nunes, Vandeir Francisco Guimarães

The pursuit of sustainable technologies in agriculture has paved the way for the use of plant growth-promoting bacteria of the genus Azospirillum in crops of high relevance. Its application in maize is usually carried out at the time of sowing; however, there is the possibility of adopting aerial spraying after crop establishment. Therefore, this study aimed to evaluate the development, gas exchange, stay-green effects, and yield of maize inoculated with A. brasilense via seed or foliar spray. Maize plants under the control, seed inoculation, foliar spray, and seed inoculation + foliar spray treatments were evaluated regarding morphometric variables, gas exchange, and SPAD index in a pot experiment, as well as in relation to production components and yield in four field trials. Root volume, root dry mass, and total dry mass were increased by inoculation + spraying. Photosynthesis and stomatal opening were enhanced in leaves near the ear when Azospirillum was sprayed, and inoculation increased transpiration in the leaves of the upper third of the plants. The same treatment reduced water use efficiency, while isolated or combined spraying increased carboxylation efficiency systemically. All treatments provided a stay-green effect, with more prominent effects on the leaves near the ear. Under conditions of low water availability between stages V4 and VT, ear diameter was increased by all treatments, while only isolated spraying increased grain mass under reduced rainfall conditions during the cycle. In summary, the use of A. brasilense in maize promotes greater soil exploitation, enhanced gas exchange, and a stay-green effect at the end of maturation, thereby enhancing grain mass.

PHOTOSYNTHETIC EFFICIENCY IN Solanum lycopersicum cv. Micro-Tom IN RESPONSE TO FRASS BIOFERTILIZATION

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Agricultural production is among the most affected sectors by climate change, pushing industry to adopt more sustainable practices. Frass, a nutrient-rich by-product of larvae fed on poultry residues, has shown potential as a biofertilizer capable of improving soil health and promoting plant growth. However, limited knowledge exists regarding its effects on plant physiological processes, particularly photosynthesis. This study aimed to evaluate the in vivo photosynthetic responses of micro-Tom tomato plants grown in substrates with increasing doses of frass, applied in solid form and as an extract. Photosynthetic parameters were assessed using the MultispeQ v2.0 portable chlorophyll meter (PhotosynQ Inc.) on fully expanded leaves, 30 days after transplanting, during the vegetative phase. Principal component analysis (PCA) was used to identify variables explaining the most variance in the data. The analysis revealed that 77% and 77.6% of the variance in the solid and extract treatments, respectively, were explained by the selected variables. In the solid frass treatment, maximum photochemical efficiency of photosystem II under light conditions (FvP/FmP) had the highest explanatory power, indicating better photosynthetic integrity at higher biofertilizer doses, likely due to improved plant nutritional status. In the extract treatment, controlled non-photochemical quenching (ΦNPQ) was the most significant variable, suggesting increased light stress sensitivity and susceptibility to photo-oxidative damage at lower doses. These findings suggest that frass, whether used as a biofertilizer or bioproduct, can enhance plant nutritional status and improve photosynthetic efficiency, particularly at higher doses. This could make frass a valuable tool for sustainable agriculture, offering greater resilience to environmental stressors.

PHOTOSYNTHETIC ELECTRON TRANSPORT IN ALTHERNANTHERA TENELLA COLLA. UNDER WATER STRESS SIMULATED BY PEG-6000 IN VITRO

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Alternanthera tenella Colla. (Amaranthaceae) is a phytoremediation species important to recovery of degraded and degraded areas, increasing the soil quality. Polyethyleneglycol (PEG-6000) is used to simulates osmotic stress in plants, being useful in the evaluation of plant responses to water stress (WS). The objective of these study was to evaluate the photochemical capacity of A. tenella under diferent levels of WS simulated by PEG-6000. Five concentrations of PEG-6000 were tested in in vitro conditions: 0 MPa (considered as control), -0,5 MPa, -1 MPa, -2 MPa and -4 MPa. After 15 days, the chlorophyll a fluorescence was measured in 20 plants per treatment, using a fluorometer Handy-PEA (Hanstech, UK). The data were subjected to analysis of variance (ANOVA), followed by the Tukey test ($p<0.05$). Net rate of photosystem II (PSII) closure (M0) values were reduced in those plants cultivated under -1MPa, -2MPa and -4MPa. Higher M0 is an indicative of closure of RC associatedo with PSII, showing that the quantum yield of electron transport was impaired by WS, reflecting in low maximum quantum yield of primary photochemistry (ΦP0). Plants submitted to 0 MPa and -0.5 MPa showed higher capacity to convert the light energy absorbed by photosystems in chemical energy (Adenosine triphosphate, ATP) and nicotinamide-adenine dinucleotide phosphate (NADPH), without major losses in light conversion and higher functionallity of PSII (SFIabs). In conclusion, the lower SFIabs values obtained in -1 MPa, -2 MPa and -4 MPa show us that the WS is compromising the functional structure of the FSII of A. tenella.

Photosynthetic light response curve of Pontederia crassipes

Bianca Jaqueline Santos Rodrigues, Eduardo de Bastos Pazini, Marcos Antonio Bacarin, Junior Borella

Pontederia crassipes Mart., commonly known as water hyacinth, is a perennial monocotyledonous floating aquatic macrophyte from the Pontederiaceae family. This species exhibits a high reproductive capacity, capable of both sexual reproduction via seeds and asexual reproduction through stolons. The significant reproductive capacity and substantial biomass may be associated with the availability of high light intensities and temperatures in its natural habitats. This study aimed to characterize the photosynthetic responses of P. crassipes leaves under varying light intensities. The plants were acclimated in a greenhouse under natural light conditions at a temperature of 25 ± 5°C. Light response curves were measured using a portable infrared gas exchange system coupled with a LI-COR 6400-40 Leaf Chamber, with a block temperature set at 25 ± 3.0°C, an air flow rate of 300 µmol s-1, relative humidity of 50.0 ± 3.0%, and a CO2 concentration of 400 µmol mol-1. Incident photon flux densities (PFD) up to 2000 µmol photons m-2 s-1 were employed, and the data were fitted to the rectangular hyperbola model. Simultaneously, fluorescence intensity was measured, allowing for the calculation of modulated fluorescence parameters. The maximum net CO2 assimilation rate was 43.48 ± 1.25 µmol CO2 m-2 s-1. The electron transport rate in PSII exhibited a steady increase until reaching an incident radiation level of 1000 µmol photons m-2 s-1. The relationship between the effective quantum yield of PSII (φPSII) and the quantum yield of CO_2 (φCO2) was curvilinear. P. crassipes demonstrated the ability to adapt to varying light environments and intensities, exhibiting good photosynthetic efficiency, as indicated by the net CO2 assimilation rate, continuous electron transport rate up to 1000 µmol photons m-2 s-1 and a positive relationship between φPSII and φCO2.

Photosynthetic mechanisms modified by macroalgae extract in tomato plants under water restriction

Isabelle Mary Costa Pereira, Beatriz Zamboti, Luan Victor Maia, Andel Cabral Nery, Enéas Gomes Filho, Márjory Lima Holanda Araújo, Humberto Henrique de Carvalho

The increase in population growth and food demand have been a constant concern, prioritizing the production of pesticide-free. The use of biofertilizers has been fundamental for the productivity of organic products due to their nutritional properties and potential to condition plants in stressful situations. Natural resources such as water are finite and crucial for plant development, making it necessary to find alternatives for food production under conditions of water restriction. This study aimed to investigate the effects of the Gracilaria birdiae bioinput on the photosynthetic machinery of tomato plants subjected to water restriction. The macroalgae aqueous extract was freeze-dried and diluted in water at four concentrations (0.0, 0.5, 1.0, and 2.0 g.L-1) for application under two irrigation conditions (80% and 40% of pot capacity) in plants at the V3 stage, with 3 replications in a completely randomized factorial design (4 x 2). Fresh and dry biomass, photosynthetic pigments, photosynthesis, transpiration, stomatal conductance, carboxylation efficiency, water use efficiency, and electrolyte leakage were assessed. The fresh weight of the plants treated with the 0.5 and 1.0 g/L concentrations was higher than that of the untreated plants under deficit conditions, with no significant differences in dry weight. Photosynthesis, carboxylation efficiency, chlorophyll a and b, and cell damage in the extract treatments were significantly improved compared to the well wattering, with the 1.0 g.L-1 concentration being the most effective. Maintaining photosystem-related variables directly influences the capture of energy resources that support plant development. Among the concentrations used, 1.0 g.L-1 provided the greatest reduction in harmful effects, helping to modulate the photosynthesis of tomato plants under conditions of low water availability. However, more studies are needed to define the number of applications and doses required for other crops.

PHOTOSYNTHETIC VARIATION IN BACKCROSS POPULATION OF C3 AND C4 SPECIES IN THE CLEOMACEAE FAMILY

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The species Gynandropsis gynandra (GG) and Tarenaya longicarpa (TL) are species with C4 and C3 photosynthetic mechanisms, respectively, both from the Cleomaceae family, which also owns species intermediate C3-C4 metabolism. The C4 photosynthesis is optimized by the mechanism of CO2 concentration around rubisco, the enzyme responsible to fix CO2 in all plants and, then, oxygenation reaction is significantly reduced in these species. For this reason C4 plants are adapted to high light intensities, warmer temperatures and dryness. In this work, three different hybrids (H2, H4 and H5) were obtained by crossing GG and TL, and by backcrossing these with GG, three backcrossing populations were obtained: BK H2 GG, BK H4 GG and BK H5 GG. All these populations were investigated with a field fluorometer, thus obtaining the following parameters: Non Photochemical Quenching (NPQT), Maximum Photosynthesis (FmPrime), Maximum Quantum Efficiency in Light Conditions (Fvp_Fmp), Photo-Inhibitory Quenching (PhiNPQ), Electrochromic Shift (EcsTau), Proton Conductivity (gH+), Dark-Interval Relaxation Kinetics (Dirk), Oxidized Photosystem 1 (PS1_oxidized), Steady-State Proton Flux (vH). This data was submitted to the Principal Components Analysis (PCA), which was capable of clearly separating GG, TL, the hybrids F1 lines and the backcrossing population. Hence, PC1 and PC2 were capable of explaining 59,3% of the variability, being influenced primarily by Fvp_Fmp, NPQT and PhiNPQ. Results showed proximity between the backcrossing population and GG, explained primarily by NPQT and PhiNPQ, which are not parameters that imply photosynthesis efficiency. For this reason, the conclusion is that more strict analyses should be made with this population in order to study the evolution from C3 to C4 photosynthetic mechanism in Cleomaceae.

PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSE OF Aechmea nudicaulis (L.) GRISEB. (BROMELIACEAE) TO LIGHT AVAILABILITY

Carolina Vilela Vasconcelos, Angela Pierre Vitória, Jônatha De Sousa Reis, Tifanny Laís Teles Silva, José Luiz Alves Silva

Vascular epiphytes have different adaptations to cope with light availability below the forest canopy. This study compared the leaf physiology and morphology of the bromeliad Aechmea nudicaulis (L.) Griseb between greenhouse and field conditions and after abrupt changes in light availability simulated by active relocations. An experiment was carried out on the UENF campus using 24 bromeliad individuals attached to the trunk of trees with more or less shaded canopies to create two light treatments. Leaf discs were collected in September 2023, November 2023, and January 2024 to measure seven leaf traits (total chlorophylls, total carotenoids, chlorophylls/carotenoids ratio, specific area, dry matter content, succulence, and water content). To compare treatments, we performed principal component analysis (PCA), one-way ANOVA, and Tukey's test for PCA axis scores. Greenhouse individuals differed significantly from those under field conditions. Individuals presented lower total chlorophylls and succulence and higher dry matter content under less shaded canopies, as opposed to individuals under more shaded canopies. After active relocations, significant changes occurred in individuals relocated from less to more shade, increasing total chlorophylls and water content, but not from more to less shade. These results reveal a high short-term plastic capacity of the studied bromeliad to light and adjustments to sudden changes in light availability. Due to functional differences between individuals in natural and greenhouse conditions, we suggest a hardening-off stage before reintroducing bromeliads into forests to ensure successful establishment. Furthermore, experimental approaches have proven crucial in understanding the species' behavior under field conditions, contributing to restoration initiatives. We emphasize that long-term functional responses should complement the short-term results obtained.

PHYSIOLOGICAL MECHANISMS ASSOCIATED WITH LOW SOIL WATER AVAILABILITY IN CASHEW TREES

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The cashew tree (Anacardium occidentale L.) is well adapted and cultivated in Brazil's Northeast conditions due to its evolutionary history and genetic improvement programs aiming for productive and tolerant genotypes. It represents an important genetic resource for understanding the physiological mechanisms that regulate the delicate balance between growth and tolerance to associated environmental changes. Thus, this study aimed to understand the physiological mechanisms associated with cashew resilience to drought. Cashew seedlings, carrying clones of the BRS226 and CP009 genotypes, were subjected to one and two cycles of drought (12 days of stress and 4 days of recovery each). Subsequently, fully expanded leaves were used to obtain the net photosynthetic rate (A), stomatal conductance (gs), efficient water use (A/gs), malondialdehyde (MDA) and hydrogen peroxide (H2O2) content. The results showed that drought decreased the photosynthesis and stomatal conductance parameters of both genotypes, even one or two stress cycles. However, after two cycles CP09 presented a better gas exchange recovery than one cycle, as well as better efficiency of water use. It indicated an increase in recovery capacity in relation to successive drought periods. The two genotypes did not show changes in MDA content after 12 days of drought regardless of the cycles. However, BR226 showed a 56% reduction in MDA after recovery from a stress cycle compared to the control. Additionally, there was greater H2O2 content after the first stress cycle for BRS226 and after two cycles for CP009, with no variation after recovery. Thus, it is concluded that the genotypes present resilience to drought, with CP009 standing out the most, through maintenance and redox adjustment, as well as the photosynthetic apparatus. However, it is important to carry out new studies to improve the data related to cashew tree responses to stress.

PHYSIOLOGICAL PERFORMANCE OF SORGHUM GENOTYPES UNDER EDAPHOCLIMATIC CONDITIONS OF NORTHERN ESPÍRITO SANTO STATE

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In this study, we analyzed the chlorophyll a fluorescence (Handy-PEA, Hansatech, UK) and growth of 4 sorghum (Sorghum bicolor L. Moench) genotypes in order to screening genotypes showing high performance. The experiment was carried out in the field, in a randomized block design, with four genotypes (CMSXS7058, CMSXS7059, CMSXS7054 and AGRI001E) and five replicates. CMSXS7058 showed the highest growth parameters values among the sorghum genotypes evaluated [fresh mass (FM=0.52 kg), dry mass (DM=0.14 kg), stem diameter (SD=21.75 mm) and height (H=3.22 m)], which were 126.09%, 133.33%, 41.96% and 41.85% higher than those observed in CMSXS7059 genotype, characterized by the lowest growth (FM=0.23 kg, DM=0.06 kg, SD=15.3 mm and H=2.27 m). Both CMSXS7054 and AGRI001E sorghum genotypes showed similar intermediate MF, DM and H values. However, SD values were higher for AGRI001E and CMSXS7058 (≅20.23 mm) and lower in CMSXS7059 and CMSXS7054 (≅15.55 mm). The highest performance index (PIABS), maximum photochemical (ΦP0) PSII electron transport (ΦE0) quantum yield values were obtained in AGRI001E and CMSXS7058 sorghum genotypes,. In contrast, the CMSXS7054 and CMSXS7059 genotypes showed the lowest PIABS, ΦP0 and ΦE0 values. Initial fluorescence (F0) values were similar among the genotypes. These results showed us that the four sorghum genotypes evaluated differ in photochemical and growth characteristics. In general, the higher growth of the CMSXS7058 genotype was associated with the higher photochemical performance, indicating high photosynthetic efficiency and energy conservation capacity. In contrast, the sorghum genotype with lower growth (CMSXS7059) was characterized by the lowest photochemical parameters. In conclusion, the comparison of physiological performance between sorghum genotypes allows us to indicate the CMSXS7058 genotype for cultivate in the edaphoclimatic conditions of northern Espírito Santo state.

PHYSIOLOGICAL RESPONSES OF GLYPHOSATE TOLERANT GENETICALLY MODIFIED EUCALYPTUS SPP.

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Weed competition is one of the main factors reducing the productivity of eucalyptus stands. Current weed control practices relies on the application of the herbicide glyphosate. Given the sensitivity of eucalyptus to glyphosate, existing weed control methods in young eucalyptus farms predominantly rely on protected mechanical spraying and labor-intensive manual operations. Both methods contribute to herbicide drift, which compromises tree yield and increases chemical waste due to uneven spraying. FuturaGene/Suzano has developed glyphosate herbicide tolerance (HT) eucalyptus, enabling the direct mechanical application of glyphosate over the young eucalyptus plants to control weeds, including within the planting rows. The GM HT eucalyptus was approved for commercial use in Brazil by CTNBio and has been proven safe to the environment. This study was conducted to evaluate the physiological responses of HT GM eucalyptus and their wild-type (WT) counterparts under two treatments: i – Control - without herbicide and ii – Sprayed - plants were sprayed over the top with 1.8 kg a.e/ha of glyphosate 30 days after planting. All plants were evaluated one day before herbicide application and then daily for five days following herbicide application. The physiological parameters (Light compensation point, maximum net photosynthetic rate, Apparent quantum yield, for example) of the herbicide-treated GM eucalyptus remained comparable to those under control treatment. In contrast, the conventional eucalyptus displayed significant reductions in all photosynthetic parameters. The ability of the HT GM eucalyptus to maintain stable physiological parameters after glyphosate application highlight its high level of tolerance, supporting the safe deployment of this technology.

PHYSIOLOGICAL RESPONSES OF THE TRANSGENIC NICOTIANA TABACUM UNDER WATER STRESS.

Karla Villena, Pedro Boscariol, Helaine Carrer, León A. Bravo

Colobanthus quitensis (Kunth) Bartl. (Caryophyllaceae) is the only dicot species that naturally colonized Maritime Antarctic. This species has developed resistance to adverse environmental conditions (such as water stress or low temperatures). The aim of this research was to stablish whether a transgenic approach using genes from C. quitensis confer water stress tolerance to N. tabacum plants. Previously, differentially expressed genes were identified in the transcriptome analysis performed from a severe water stress experiment in C. quitensis. Two of these were: UF3GT gene and SGS1 gene, which present characteristics related to anthocyanin synthesis, plant defense and development, and abiotic stress. Tobacco plants (transgenic and wild type) were subjected to controlled irrigation limitation reaching two level of moderate stress (moderade 70% and moderade II 50% pot weight) Relative water content (RWC), photosynthetic capacity (Amax), intrinsic water use efficiency (iWUE), and instantaneous intrinsic water use efficiency (WUE) were measured in each treatment. The RWC in the experiment decreased from 83% to 60% in transgenic and WT plants from the control to moderate stress. The transgenic plants with the UF3GT gene showed a 74% of residual Amax, the transgenic plants with the SGS1 gene showed a 90%, and the wild-type plants showed an 86%. iWUE and WUE did not exhibit significant differences between the transgenic plants, only between water treatments. These results revealed that the transgenic strategy in the species N. tabacum was not successful to validate candidate stress tolerance genes. There were several limitations to this experiment, such as the use of only two genes, the study including other selected genes is under way.

PHYSIOLOGICAL RESPONSES OF TOMATO PLANTS TO THE APPLICATION OF NANOENCAPSULATED ESSENTIAL OILS FROM Xylopia aromatica

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Essential oils from plants are considered a promising alternative for global agricultural pest control. Nanoencapsulation of these natural compounds enhances their protection against environmental degradation and prolongs their activity through gradual release. However, the physiological responses of plants to these compounds are not well understood. This study assessed the physiological and metabolic effects on tomato plants (Solanum lycopersicum L.) in response to essential oils from Xylopia aromatica, which have potential repellent properties against Bemisia tabaci. Four-week-old tomato plants were used, and essential oils extracted from leaves and fruits via hydrodistillation were applied in their raw form and as nanoencapsulated versions at concentrations of 1% and 2%. GC-MS and GC-FID analyses showed that the essential oils from leaves were predominantly composed of limonene (37.76%), bicyclogermacrene (13.59%), α-pinene (7.75%), and β-pinene (8.11%), while the oils from fruits mainly contained limonene (65.44%), β-pinene (8.44%), α-pinene (7.66%), and β-myrcene (3.29%). Nanoencapsulation in a polymeric matrix (PCL) resulted in smooth, monodisperse nanoparticles with encapsulation efficiencies of 94% to 98%. The application of these essential oils did not cause physiological damage to the tomato plants, with no changes observed in gas exchange parameters or chlorophyll fluorescence. There were also no significant alterations in plant height, total leaf area, specific leaf area, leaf dry mass, or biomass allocation. Levels of sugars, starch, malate, chlorophyll a and b, amino acids, proteins, and nitrate remained stable. These results indicate that essential oils from X. aromatica, whether applied raw or nanoencapsulated, do not adversely affect tomato plant growth or metabolism. This study demonstrates the potential of PCL nanoparticles as carriers for active compounds with minimal impact on plant growth and photosynthesis.

Phytochrome-dependent signaling regulates flavonoid accumulation in tomato fruits in a tissue-specific manner

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Alongside carotenoids, flavonoids contribute to determining the color and antioxidant properties of tomato (Solanum lycopersicum) fruits. With few exceptions, flavonoids accumulate in tomato fruit in a tissue-specific manner, being predominantly found in the fruit skin/peel. Light is one of the most critical environmental factors affecting flavonoid biosynthesis in plants, but a self-shading effect within the flesh fruit tissue is expected to occur as sunlight passes through the flesh of green fruits. Here, we explore the role of phytochromes (PHY) and phytochrome-interacting proteins (PIFs) in controlling fruit-surface and pericarp accumulation of flavonoids in tomato. Flavonoid profiling in peel samples of Slphya, Slphyb1 and Slphyb2 single and double mutants revealed that SlPHYB1 loss-of-function markedly reduced the accumulation of naringenin chalcone and other major flavonoids. Interestingly, the overexpression of a constitutively active missense allele of SlPHYB1 (SlYHB1) increased more than 20 times the levels of naringenin chalcone and total flavonoids in the peel tissues but completely failed to modify the flavonoid accumulation in the pericarp tissues. In addition, SlPIF3-silencing significantly promoted and repressed flavonoid accumulation in peel and pericarp tissues, respectively. Transcriptome analysis performed in peel samples of Slphy mutants and SlPIF3-silenced plants revealed extensive changes in the expression of flavonoid biosynthetic genes and regulatory genes typically linked to flavonoid accumulation in tomato fruits. Our findings indicate that SlPHYB1 and SlPIF3 are important regulators of flavonoid accumulation in tomato fruits, with distinct roles depending on the fruit tissue under consideration. Moreover, as SlYHB1-overexpressing fruits failed to overaccumulate flavonoids in pericarp tissues, constitutively active SlPHYB1 molecules are not sufficient to promote flavonoid accumulation in inner fruit tissues.

POST-HARVEST QUALITY OF GRAPES CV. NIAGARA ROSADA IN TWO ANNUAL PRUNING

Gislane Chaves Oliveira Silvares, Cássio Vinícius de Souza, Lucas Pimentel Pereira, José Aires Ventura, Sabrina Garcia Broetto, Mariela Mattos da Silva, Diolina Moura Silva

The Niagara rosada cultivar has grown in vitiviniculture sector in the state of Espírito Santo due to its adaptability to the tropical climate associated with fertile soils, which has allowed high quality harvests, through the use of more than one annual pruning. Double grapevines pruning allows continuous crop productivity, increasing the profitability for producers in the Guarapari/ES region. However, little is still known about the quality of the fruits obtained between different pruning times. Thus, the objective of the work was to evaluate bioactive compounds (anthocyanins and phenolic compounds) and antioxidant activity (by the methods of scavenging the radical 2,2-diphenyl-1-picrylhydrazyl – DPPH and iron reducing power – FRAP) of Niagara rosada table grapes obtained in two pruning seasons: rainy (first pruning) and dry season (second pruning). The results showed a significant difference between pruning times for anthocyanin content, which was higher in the dry period. For the other attributes, although without significant difference between pruning, a higher concentration of phenolic compounds and antioxidant capacity by the FRAP method were found in fruits obtained in the first pruning. The results showed that regardless of the pruning time, the phenolic composition and antioxidant activity, an important attribute of table grapes, prevailed in both pruning and indicates the importance of this management practice, fundamental to guarantee the continuous harvest of grapes without loss of cultivar quality.

PROLINE CONTENT IN YOUNG PASSION FRUIT PLANTS UNDER WATER DEFICIT AND APPLICATION OF GROWTH REGULATORS

Gustavo Kawan Almeida Costa, Raul Antonio Araújo do Bonfim, Milton Carriço Sá, Camila Valentim Silva Sousa, Paulo Araquém Ramos Cairo

Yellow passion fruit (Passiflora edulis Sims), a typical plant of tropical and subtropical climates, is usually grown in nurseries, for subsequent planting in the field. Water deficit, one of the abiotic stress factors most commonly related to climate change, is particularly detrimental when it occurs after transplanting yellow passion fruit seedlings to the field, as it limits initial growth and can be crucial for the survival of young plants. Osmoregulation in plants under water deficit depends on the synthesis and accumulation of osmolytes to increase the osmotic potential at the cellular level. Proline is one of the most relevant osmolytes under stress conditions since it also acts as osmoprotectant and can help with the adaption of the plant under water constraint conditions.

A greenhouse experiment was conducted with young yellow passion fruit plants using a completely randomized design, in a 4 × 2 factorial scheme, with five replicates and one plant per pot, thereby totaling 40 experimental units. We performed proline content analyses on plants under well-watered and water-deficit irrigation regimes and pre-treated with three plant growth regulators (PGRs) application — Stimulate®, an agrochemical composed of auxins, gibberellins, and cytokinins; salicylic acid (SA); and sodium nitroprusside (SNP), a nitric oxide donor — and a control group with no PGRs.

The results showed that in well-watered plants the proline content was not significantly altered by the application of regulators. On the other hand, under water deficit conditions, proline content was reduced by 11% with SA application, and by 41% with Stimulate® and SNP applications, compared to control plants. These findings allow us to conclude that the application of PGRs does not favor an increase in proline content in well-watered plants and even makes it less possible for this osmolyte to accumulate and improve osmoregulation in plants under water deficit conditions.

PYROLIGNEOUS EXTRACT: A GROWTH PROMOTER IN CLONAL MINIGARDENS OF Eucalyptus spp.

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Currently, the Brazilian forestry sector contributes to the green economy by adhering to the principles of ESG (Environmental, Social, and Governance). In this context, new technologies for utilizing by-products of forestry activities are highly relevant. Among these by-products is pyroligneous extract (PE), a by-product of wood carbonization for charcoal production, which has demonstrated positive effects on plants. This research aimed to evaluate the morphophysiological characteristics of a Eucalyptus urophylla clone fertigated with PE (2.5% v/v) derived from two carbonization processes: continuous carbonization process Carboval (CCPC) and kilns-furnace system (KFS). Clonal seedlings, 100 days old, were planted in 5 L pots filled with washed sand, maintained in a greenhouse with daily fertigation of macro and micronutrients (20 mL/pot), and treatments applied three times per week (T1: control; T2: PE from CCPC; T3: PE from KFS collected up to 160°C; T4: PE from KFS collected between 171-270°C; T5: PE from KFS collected between 271-350°C; and T6: PE from KFS collected between 351-400°C). After 30 days, no significant differences were observed between treatments. T3 exhibited the highest mean values for stomatal conductance (gs), photosystem II photochemical efficiency, shoot dry mass, and Dickson quality index (DQI). Preliminary results suggest that positive outcomes may be achieved with the use of PE in fertigation for managing clonal mini-gardens of Eucalyptus spp. Further studies are needed to assess the long-term effects of PE on clonal seedlings and to elucidate its mechanism of action on plant development.

QUALITY ATTRIBUTES AND ARRHENIUS PLOT TO EXPLAIN PAPAYA RIPENING

Ana Paula da Silva Costa, Isabela Salles Foryta, Isabelle Faria Matos, Glória Andréia Ferreira Hernández, Marcelo Gomes da Silva, Jurandi Gonçalves de Oliveira

Due to their plasticity, plants can adjust their metabolism, within certain limits, to adapt to ambient temperatures. The shelf life of fruits and vegetables is inversely proportional to their storage temperature. This work aims to determine the activation energy involved in the transformations associated with papaya ripening. The study seeks to understand the changes related to fruit development, which can guide post-harvest conservation of the fruit with minimal impact on product quality. Papaya fruits of the 'Aliança' variety, harvested at the green-mature stage and sanitized, were stored at temperatures of 10°C, 12°C, 20°C, 25°C, and 30°C ± 2°C, with a relative humidity of 80% ± 5%. For each treatment, a batch of three fruits was analyzed periodically. The evaluated physical and chemical parameters were: fresh mass loss (FML), hue angle (hue), fruit firmness (FF), mesocarp cell integrity (MCI), as well as the activation energy (Ea) determined from the Arrhenius plot. Storage of the fruits at 10°C inhibited and delayed the qualitative changes involved in the papaya ripening process. Temperatures of 20°C, 25°C, and 30°C had a similar effect on FF, MCI, and hue. On the other hand, FML was similarly influenced in fruits stored at 20°C and 10°C. From the Arrhenius plot, it can be concluded that during papaya ripening changes in MCI require the highest activation energy (Ea = 17 kcal mol^{-1}), followed by FML (Ea = 14.5 kcal mol^{-1}). Through the Ea it is possible to infer the dependence of storage temperature on the transformations inherent to ripening that are related to fruit quality. This information can be useful for determining which quality attributes are most susceptible to changes due to storage temperature and for guiding post-harvest management of the fruit according to market demand.

QUANTUM EFFICIENCY OF PHOTOSYSTEM II IN ALTERNANTHERA TENELLA COLLA (AMARANTHACEAE) UNDER STRESS INDUCED BY CADMIUM AND ATTENUATING ACTION OF COPPER

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Alternanthera tenella Colla is a herbaceous plant with great bioremediation power that is present in mining areas throughout Brazil. Cadmium (Cd) is a heavy metal that is highly harmful to several physiological processes in plants, while copper (Cu) is an essential micronutrient for plant development. These study evaluated the mitigator effect of Cu in A. tenella cultivated in vitro under Cd stress. MS medium with 0.75 µM Cd suplemented with 25 µM Cu was used. Treatments without Cd was used as control. After 30 days, chlorophyll a fluorescence were performed using a Pocket-PEA (Hansateck, UK). Six parameters were evaluated: FSII performance index (PItotal), maximum quantum yield (φP0), electron dissipation quantum yield (φD0), quantum efficiency of electron transfer from QA (φE0), variable relative fluorescence at 2ms (VJ) and variable relative fluorescence at 30ms (VI). Cd had a negative effect on the plant, since Cd directly interfered with photosystem II (PSII). φP0, φE0, and PItotal values increased under 25 µM Cu while VJ and VI were reduced. Cd reduced φP0, φE0, and PItotal but increased φD0, VJ and VI. The co-exposition of Cd and Cu increased φP0, φE0, and PItotal indicating the mitigator effect of Cu, which improved the efficiency of light absorption by the antenna system to produce adenosine triphosphateand (ATP) and nicotinamide adenine dinucleotide phosphate (NADPH). Higher φD0 shows that the energy dissipation that should be used to produce ATP and NADPH is being lost as heat. The higher VJ and VI values observed in the treatment with Cd indicate that electron transport was impaired. However, lower φD0, VJ and VI values obtained after the co-exposition with Cu indicates better functioning in electron transport by the photosystems. In conclusion, 25 µM Cu is suitable to mitigate the harmful effects of 75 µM Cd in A. tenella.

REDOX METABOLISM OF SOYBEAN IN RESPONSES TO COMBINED STRESS OF WATER DEFICIT AND PESTICIDE

Julia Renata Schneider, Andressa Carlot de Bona, Mariele Müller, Tanise Luisa Sausen, Wesley Borges Wurlitzer, Noeli Juarez Ferla, Geraldo Chavarria

Water deficit situations are becoming more frequent, and under field conditions, the occurrence of combined stresses is increasingly prevalent. The use of fungicides (xenobiotics), can exacerbate stress conditions. Our objective was to evaluate if combined stress of water deficit and xenobiotics impair the metabolism of soybean plants. The experiment was conducted in a controlled environment, in a randomized block design, in a factorial scheme. Soybean plants were grown until the V8 stage, at which point irrigation was stopped for some plants, leaving them without water for seven days. After this period, fungicides and biostimulants (XEN1 - Fox Xpro®, XEN2 - Unizeb Gold®, BIO - Foltron Plus®) were applied, followed by the evaluations. Pearson correlation analyzes were performed between the analyzed variables, using the corrplot package, and the heat map using the clustering method with Euclidean distance, with gplots, RcolorBrewer and preprocessCore packages. Clustering analyzes of the heat map divided the treatments into three main groups: all well-irrigated treatments, combinations of XEN1+BIO and XEN1+XEN2 under water deficit, and the other water deficit treatments. The heat scale separate two groups with high photosynthesis, stomatal conductance, carboxylation efficiency, instantaneous water use efficiency, photosynthetic pigments and relative water content (RWC) for well-irrigated plants, and increases in temperature, membrane damage, electrical conductivity, lipid peroxidation, glutathione (GSH), proline and nitrite for water deficit treatment. The strongest positive correlations were found between stomatal conductance and photosynthesis with chlorophyll a, and GSH and proline with leaf temperature. Negative correlations were between leaf temperature, transpiration, GSH and proline with RWC. Fungicide application induced physiological changes in well-watered soybean plants. Application of these xenobiotics in a water deficit condition lead to the intensification of stress. Unizeb Gold® and biostimulant acted minimizing effects caused by oxidative stress due to water deficit and xenobiotic combined stress.

RELATIONSHIP BETWEEN ETHYLENE SENSITIVITY AND ALTERATIONS IN NITROGEN SOURCES UNDER TOMATO GROWTH AND PRODUCTION

Rayssa Pamela S. Da Silva Santos; Adrian. M Contreras Garcia; Eduarda S. Andrade; Dinorah Moraes S. Marçal; Vitor L Nascimento

Ethylene is a phytohormone crucial for plant growth, affecting their development, senescence, and responses to stresses. Nitrogen (N) is an essential macronutrient for plant growth and development, found in the soil as nitrate ($NO3^{-}$) or ammonium ($NH4^{+}$), preferably absorbed as nitrate. The interaction of N with ethylene can influence plant growth and production. The Never ripe (Nr) mutant, with loss of function in the SlETR3 receptor, is insensitive to ethylene. This study evaluates the effect of ethylene perception on tomato growth and production under different N sources. Tomato plants (Solanum lycopersicum L. cv. Micro-Tom) of the wild type (WT) and the Nr mutant, grown in sand with fertigation system, Hoagland solution at 1 strength (control), and modified (Solution I: $NH4^{+}$ and Solution II: $NO3^{-}$), following a double factorial design, with 2 genotypes (WT and Nr) and 3 nutrient solutions (control, Solution I, and Solution II). Growth analyses were performed between 35-40 days after treatment application, during the vegetative period, and production was evaluated at the end of the experiment. Growth characteristics (height, root length, number of leaves, total leaf area) and biomass (leaf, stem, and root dry mass) for Solution I decreased, regardless of genotype, compared to treatments under control solution, compromising production characteristics (number of fruits and fruit biomass). However, the Nr genotype showed greater leaf and root biomass gain and higher production compared to Wt under Solution I. Under Solution II, Wt plants showed no changes in growth and biomass but a reduction in production, while Nr showed greater growth, biomass gain, and production compared to their respective genotypes under control. Thus, the better performance of the Nr genotype was noted under different N sources, demonstrating a direct relationship between ethylene and nitrogen fertilization.

RESPIRATION IN ISOLATED MITOCHONDRIA AND IN WHOLE PINEAPPLE TISSUE REVEALS THE FRUIT'S RESPIRATORY PATTERN

Isabelle Faria Matos, Eduardo Augusto Carlos Conceição, Ana Paula da Silva Costa, Isabela Salles Foryta, Glória Andréia Ferreira Hernández, Sandy Castro da Silva Baia, Jurandi Gonçalves de Oliveira

Fruit ripening is closely related to their respiratory patterns. Climacteric fruits undergo significant transformations during the ripening phase, even after being detached from the plant. The transformation is always associated with an increase in respiration and greater involvement of the alternative respiratory pathway (AOX), a phenomenon not observed in non-climacteric fruits. The pineapple, originating from an inflorescence, is considered a non-climacteric fruit, as no respiration peak is detected during its ripening. Based on the fruit's ontogeny, this study evaluated the respiratory activity in isolated mitochondria from the pulp and the respiratory rate of the whole fruit, as well as from three specific regions of the fruit: the apical, median, and basal thirds. Ripe, green, and intermediate ripening stage fruits were analyzed. The respiratory rate was quantified using gas chromatography, and respiration in isolated mitochondria was assessed with a Clark electrode. The results indicate that the mitochondrial respiration of pineapple exhibits a pattern similar to that of climacteric fruits, with a higher AOX contribution during the early ripening stage. In ripe fruits, the main respiratory pathway was through cytochrome c oxidase activity, which overshadowed the AOX contribution. In whole fruits, mitochondrial respiration was found to be higher in those at the intermediate stage, possibly indicating a respiratory peak associated with ripening. When respiration was evaluated in isolated parts of the fruit, higher mitochondrial respiration was observed in the apical part of green-stage fruits, with AOX activity prevailing. Over a 7-day period, the respiratory rate quantified via gas chromatography increased in green and intermediate fruits, but decreased in ripe fruits. These findings suggest that the respiratory pattern of 'Pérola' pineapple does not align with the typical pattern of non-climacteric fruits, instead resembling that of climacteric fruits.

RESPONSES OF COFFEA ARABICA TO HIGH CO2 CONCENTRATION AND INOCULATION WITH ARBUSCULAR MYCORRHIZAL FUNGI

Thiago Oliveira Ribeiro

Atmospheric concentrations of CO2 (Ca) have been increasing in recent years, in parallel with increases in the global average temperature and changes in precipitation patterns, causing damage to natural and agricultural ecosystems. Several studies have focused on understanding the effects of climate change on crops, but little is known about the effects of using arbuscular mycorrhizal fungi (AMF) and how these fungi could modulate plant responses in a scenario of increased Ca. Coffee is a C3 plant characterized as sensitive to climate change and can benefit from high Ca. In this study, Coffea arabica plants were inoculated with AMF and exposed, in open-top chambers, to two Ca levels: 425 and 700 ppm. After one year of cultivation, several parameters were evaluated, with emphasis on growth and photosynthetic parameters. Morphologically, plants inoculated with AMF and exposed to high Ca levels showed greater height growth and stem diameter, as well as greater total biomass and greater biomass partitioning to the root system. A more extensive root system provides plants with greater absorption of water and nutrients from the soil. Inoculation with AMF led to increases in photosynthetic rates (A) of plants, regardless of the magnitude of Ca, in parallel with a lower stomatal conductance; additionally, higher A was also observed under high Ca. As a whole, the data suggest that the combination of high Ca and mycorrhization can synergistically increase growth and photosynthetic performance, with obvious reflections in the greater resilience of coffee plants in a climate change scenario.

SEASONAL VARIATION IN ANTIOXIDANT ACTIVITY OF MANILKARA SALZMANNII (A.DC.) H.J.LAM. IN RESPONSE TO METAL CONTAMINATION

Rebeca Matos Groner, Gabriel Rosa de Sousa, Mariela Mattos da Silva, Diolina Moura Silva

Mining tailings carried into the Doce River after the collapse of the Fundão dam in 2015 increased the levels of heavy metals in the course of rivers close to the dam, reaching the river's mouth in the Atlantic Ocean and coastal environments, including the Restinga, where the tree and endemic specie of the Atlantic Forest Manilkara salzmannii is present. Plant metabolism is quite susceptible to metal toxicity and the availability of these elements in environment can vary seasonally. Therefore, this work aims to evaluate how the species' antioxidant system acts in response to the presence of metal(loids) in the environment, in different periods and locations on the coast of Espírito Santo-BR. Sample collections took the rainy and dry seasons of 2022, in two Conservation Units to north and south of the mouth of the Doce River. The enzymatic and non-enzymatic antioxidant system, as well as oxidative damage were evaluated, in addition to soil and plant tissue contamination. Higher metal concentrations were observed in the dry period, with increases in leaf concentrations associated with variations in enzymatic and non-enzymatic antioxidants and oxidative damage in both locations. In contrast, increases of metals in the soil during the rainy season promoted accumulations of antioxidant metabolites. Thus, these results show the capacity of the evaluated species to seasonally vary the antioxidant system in response to the concentrations of metals present in the soil and leaves, indicating a broad ability of its antioxidant components. However, even with these mechanisms, oxidative damage was associated with greater foliar accumulations of metals, especially in Restingas located north of the Doce River.

Seasonality in the photosynthetic performance of Eugenia patrisii phenotypes under cultivation conditions

Pedro Paulo dos Santos, Josiane Celerino de Carvalho, Elmer Viana Gonçalves, Douglas Aziz Filho, Karen Cristina Pires da Costa, José Francisco de Carvalho Gonçalves

Eugenia patrisii, known as ubáia, is a fruit-bearing shrub that is being prospected for cultivation in the Brazilian Amazon, contributing to local food security. Consequently, an experimental plantation has been installed on the Marabá campus of the Federal Institute of Pará since 2017. However, there is still no data on the ecophysiology of the different phenotypes found in this orchard during periods of drought and rain in the Amazon, it is a gap that, once solved, would contribute to the domestication of the species. The aim of this study was to investigate the photosynthetic performance, chloroplast pigments and specific leaf area of seven phenotypes under cultivation conditions. Photosynthesis, transpiration and stomatal conductance were collected using the handheld infrared gas analyzer (IRGA), while leaf aliquots were collected for the determination of chlorophyll a and b contents, by means of maceration analyzed in a spectrophotometer, and for the purpose of determining specific leaf area, through leaf area and dry mass, during the year 2023. Photosynthetic performance did not differ significantly between the dry and rainy periods. However, when compared in the same season, stable values were observed in the rainy period, while differences in values were observed in the dry period. Photosynthesis values in the rainy season to Phenotype 07 (9.84 µmol CO2 m-2 s-1) were significantly higher than in the dry season (3.44 µmol CO2 m-2 s-1). For photosynthetic pigments and specific leaf area, there were no significant differences in the phenotypes between the seasons. The average total pigment content values for Phenotypes 06 and 07 doubled from the rainy season (0.274 and 0.223) to the dry season (0.709 and 0.773), while those of the others remained stable. The data analyzed indicates different strategies in the physiological parameters of the phenotypes over the two seasons, especially for Phenotype 07.

SECONDARY SEXUAL DIMORPHISM, GROWTH RHYTHMICITY AND PHOTOSYNTHESIS IN Ilex paraguariensis

Miroslava Rakocevic, Eunice Reis Batista, Rafael Leonardo de Almeida, Rafael Vasconcelos Ribeiro

Yerba mate (Ilex paraguariensis) is a dioecious species characterized by secondary sexual dimorphism (SSD). Its growth is rhythmic, expressed in annual formation of two growth units (GU1 and GU2) and two rest (R1 and R2) periods. Here, we aimed to follow the expression of secondary sexual dimorphism (SSD) in photosynthesis over one-year rhythmic growth. Four clones (two males and two females) cultivated in monoculture (MO) and also in agroforestry (AFS) were followed. The incoming photosynthetic photon flux density (PPFD) at yerba mate grown in AFS was reduced by 92-95% compared to MO. All parameters estimated from light photosynthetic response curves [maximum net photosynthesis (Amax), respiration rate in the dark (Rd) and light (RL) and RL/Rd ratio (inhibition of dark respiration by light)] had higher rates under MO than under AFS conditions, varying over the periods of rhythmic growth. In all clones and during all evaluation periods, the reduction of Amax under AFS compared to MO was about ~21-45%, with higher RL/Rd ratio under MO than AFS. Despite the strong differences in estimated parameters induced by light availability, no difference in SSD was observed between the two systems of cultivation. The SSD was observed during the R1 and GU1 periods for Amax (higher in females than in males), and during the R2 period for RL/Rd (higher in males than in females), while Rd and RL did not vary among the two genders. Higher Amax in females than males, with similar respiration rates (Rd and RL) in the two genders during the vegetative phases after pruning (herein R1 and GU1) and higher inhibition of Rd by light (lower RL/Rd ratio) in females than males during R2, could be considered as a fitness strategy of female plants in their additional effort to produce seeds and fruits in later phenophases.

Silicon supplementation improves rice photosynthesis and productivity under normal and deficient nitrogen conditions

Felipe Rodrigues Miranda, Jailson Sousa De Castro, Raylla Pollyana Barbosa de Sousa, Antônio Henrique De Souza, Leonardo Bomfim de Moura Macedo, Thiago Oliveira Ribeiro, Fábio Murilo DaMatta

Rice, a cereal essential for world nutrition and the global economy, is highly dependent on the nitrogen (N) supply, that increases crops growth and yields. In turn, silicon (Si) supplementation improves tolerance to various stresses, and when associated with adequate N supply, increases in both grain yields and N-use efficiency are expected. Here, we grew rice plants (cv. 'Oochikara' (WT) and its mutant defective for silicon uptake (lsi1)) in hydroponics with two Si (0 or 2 mM) and two N (80% reduction relative to the adequate level and adequate supply) levels (hereafter designated as -Si and +Si plants, and -N and +N plants, respectively) to evaluate the effects of Si supplementation on photosynthetic and yield performance in response to N limitation. It was found that Si and N alone led to increases in net photosynthetic rates in both genotypes. The +Si WT plants displayed higher light-saturated photosynthetic rates and light saturation points than their mutant counterparts. Regardless the N supply, +Si plants had lower light compensation points in both genotypes and increased biomass, but only in WT individuals. The number of grains (NG) was affected by both N and Si; it increased in +N plants, but more pronouncedly in +Si individuals. The percentage of filled grains (PFG) also increased in +Si plants, but decreased in +N condition, still the increase on NG in the +N is greater than the reduction in the PFG, increasing total production. The PFG decreased more in lsi1 than in WT under +N and +Si conditions. Taken together, our results suggest that Si application improved the photosynthetic and productive performance in rice plants independently of the N supply, and thus Si was able to mitigate, at least partially, the negative effects caused by the N limitation, in addition to improving the N-use efficiency.

SOLUBLE SUGAR CONTENT IN YOUNG PASSION FRUIT PLANTS UNDER WATER DEFICIT AND GROWTH REGULATORS APPLICATION

Camila Valentim Silva Sousa, Paulo Araquém Ramos Cairo, Raul Antônio Araújo do Bonfim, Milton Carriço Sá, Gustavo Kawam Almeida Costa

Water deficit resulting from climate change significantly reduces crop yield. For yellow passion fruit plants (Passiflora edulis Sims), water deficit is particularly detrimental when it occurs after transplanting seedlings into the field, because in addition to limiting initial growth, it can be crucial for the survival of young plants. The typical first response of all plants to water stress is osmoregulation, which relies on synthesis and accumulation of osmolytes to increase the osmotic potential at the cellular level. Soluble sugar is one of the most common osmolytes under stress conditions since it also acts as osmoprotectant and can help with the adaption of the plant under water deficit. We hypothesized that plant growth regulators (PGR) act on the osmolyte accumulation, improving plant tolerance to water deficit. Thus, a greenhouse experiment was conducted with young yellow passion fruit plants using a completely randomized design, in a 4 × 2 factorial scheme, one plant per pot. We performed soluble sugar content analyses on plants under well-watered and water-deficit irrigation regimes and pre-treated with three PGR application — Stimulate®, an agrochemical composed of auxins, gibberellins, and cytokinins; salicylic acid (SA); and sodium nitroprusside (SNP), a nitric oxide donor — plus a control group with no PGRs. The results showed that in well-watered plants the soluble sugar content was higher with SNP application than in the other treatments. In water-deficit plants, an increase in soluble sugar content was observed, whether in control or with Stimulate® and SA application, compared to well-watered plants. With SNP application, the soluble sugar content did not change, comparing the irrigation regimes. We conclude that in young yellow passion fruit plants under water-deficit conditions the soluble sugar content usually becomes higher, which may induce osmoregulation, with or without the application of these three PGRs.

Synthesis and characterization of Spirulina-derived carbon nanoparticles and further evaluation in rice plants

Henrique caldeira machado, Luana Vanessa Peretti Minello, César Aguzzoli, Raul Antonio Sperotto

Fertilizer nanotechnology is essential for sustainable agriculture, providing efficient and controlled nutrient release while reducing waste and environmental impact. In this study, the biomass of the cyanobacterium/microalga Arthrospira platensis (Spirulina) was used to produce carbon nanoparticles, known as carbon dots (C-dots). The synthesis involved the slow pyrolysis of the biomass in a muffle furnace at 300°C for 2 hours, followed by grinding to obtain a fine powder (biochar). The biochar was then solubilized in distilled water at 100°C for 15 minutes in a water bath and subsequently vacuum filtered to obtain the nanoparticles. The experimental design included: T1: control condition (only distilled water); T2-T5: Spirulina or Arbolina (KrillTech) at 0.2 or 0.4 mg/mL applied via seed nanopriming + foliar spraying at the V4 stage; and T6-T7: only foliar spraying of Spirulina or Arbolina at 0.2 mg/mL. Ten days after spraying, physiological parameters were assessed using a LICOR porometer/fluorometer (LI-600). Microscopy characterization of the C-dots showed that the nanoparticles are rich in C, N, O, K, Na, P, S, Ca, Mg, and Cl, essential nutrients for plant development. Zeta size analysis indicated a nanoparticle size distribution around 6.7 nm, with a polydispersity index of 0.62, a pH of 6.6, and a zeta potential of -42.3 mV, indicating a remarkable solution stability. An increase in apparent transpiration rate was detected in all treatments when compared to control condition, reaching 43% and 50% increase in T6 and T7, respectively. Electron transport rate also increased in all treatments when compared to control condition, reaching 87% increase in T5. No significant differences were found for stomatal conductance and quantum yield of photosystem II. Therefore, this preliminary study indicates successful synthesis of high-quality C-dots, which effectively stimulated physiological processes related to photosynthesis in plants treated via nanopriming and foliar spraying.

THE EFFECTS OF THE INTERACTION BETWEEN TWO AMAZONIAN AQUATIC SPECIES: ISOËTES CANGAE AND HELANTHIUM TENELLUM

THAIS FERREIRA DE FREITAS, Antônio Jesus Dorigheto Cogo, Anderson da Rocha Gripp, Emiliano Nicolas Calderon, Mirella Pupo Santos, Francisco Cleilson Lopes Costa, Evenilton Pessoa Costa, Allysson Cavalcante, Francisco Assis Esteves, Daniel Basílio Zandonadi

Isoëtes cangae (IC) is a lycophyte species endemic to the Brazilian Amazon, found exclusively in Lake Amendoim, within the Carajás National Forest, in the state of Pará. In the same lake, the submerged plant species Helanthium tenellum (HT), which is widespread throughout the American continent, can also be found. Depending on factors that are not yet understood, H. tenellum can overshadow I. cangae at the bottom of the lake, suggesting deleterious effects for Isoëtes. To understand the relationship between these two species, this study aimed to analyze them in ex-situ cultivation, within a mesocosm system, to identify whether there are competitive effects between them. Both species were cultivated under five different treatments, each containing different proportions of individuals (32IC, 32HT, 24IC:8HT, 16IC:16HT, 8IC:24HT). We present the results of photobiological analyses (effective quantum yield of photosystem II - $\Delta F/Fm'$, potential quantum yield of photosystem II - Fv/Fm), evaluated monthly from September 2023 to April 2024, using a portable pulse-amplitude fluorimeter (DIVING-PAM-II, Waltz, Effeltrich, Germany). The data were assessed using analysis of variance and Tukey's test (both at $p \leq 0.05$). From the evaluation of the average data, we found that I. cangae in any proportion relative to H. tenellum maintained stable Fv/Fm values compared to the control (containers with only I. cangae). However, H. tenellum, when exposed to treatments with higher quantities of I. cangae, showed increased potential photosynthetic efficiency (16IC:16HT or 8IC:24HT). This increase suggests that the presence of I. cangae benefits photosynthesis in H. tenellum. The possible mechanisms explaining this phenomenon need to be further studied but may involve the interaction of exuded metabolites and the utilization of mineral nutrients by I. cangae.

The gradient in bundle sheath cells dimensions from C3 to C4 photosynthetic types

Joyce Pereira Alvarenga, Ane Marcela das Chagas Mendonça, Rowan F. Sage, João Paulo Rodrigues Alves Delfino Barbosa, Tammy L. Sage

In the process of photosynthesis evolution there are intermediate species (C3-C4) which possess both C3 and C4 characteristics and these are posited to be the bridge in the evolution from C3 to C4. Important anatomical and biochemical modifications occurred to create the CO2 concentrating mechanism that differentiates a C3 to C4 species. Regarding anatomical modifications the traits related to bundle sheath cells (BS) are greatly important for further involvement of biochemical pathways. The aim of this work was to characterize the anatomical traits related to BS in different species in the C3 to C4 gradient. Five grasses along the photosynthetic gradient (C3, C3-C4 and C4) were chosen to be studied. It was used four species from Homolepis (C3 and C3-C4 species) and one species from Mesosetum (C4) genus. Light and confocal microscopy was used with paradermal sections to take measurements of BS dimensions. Considering the BS size, once these cells will accommodate more organelles in C4 species they tend to be bigger. However, the results demonstrate an opposite finding. The C3 species H. glutinosa has the biggest BS volume and length, H. isocalycia (C3Proro-Kranz) and H. longispicula (C2) has intermediate values while H. aturensis (C2) and M. loliiforme (C4) has the smallest volume and length. Therefore, BS cell volume and length in paradermal view of Homolepis species declined in tandem with reductions in compensation point. So, C4 species (M. loliiforme) has an increase in leaf chloroplast area in BS tissue, however these cells have a decrease in volume possibly increasing the number of cells along the vascular tissue.

THE POTENTIAL OF FRAGILE ECOSYSTEMS: RESTINGA PLANTS UNDER CONTROLLED CONDITIONS

Mariela Mattos da Silva, Gustavo Henrique Alves Silva, Rebeca Matos Groner, Gabriel Rosa de Sousa, Gislane Chaves Oliveira, Diolina Moura Silva

Due to their location in coastal regions, the restinga ecosystem, a Brazilian mosaic of plant formations that cover the sandy coastal plains, is susceptible to the progressive increase of various anthropogenic and geogenic activities, leading to declines in plant growth and productivity, and resulting in extremely fragile ecological environments. Many human communities make sustainable use of these areas, using plants as raw materials to make handicrafts and prepare typical dishes, delicacies and medicinal teas, or as ornamentals. However, little is still known about the patterns of plant development, primary productivity and phytochemical potential of several restinga species. Therefore, the present work aimed to characterize the productive potential of restinga plants under greenhouse conditions. For this, stem cuttings were collected between 2020 and 2021 on the northern coastal region of Espírito Santo state, southeastern Brazil, and cultivated under controlled light intensity, temperature and humidity. The plants were evaluated for changes in photosynthetic energy absorption and use, through chlorophyll fluorescence analysis (Hand-PEA, Hansatech Instruments, UK), a non-invasive method to estimate primary productivity, as well as the species antioxidant activity and bioactive compounds. Eugenia astringens and Schinus terebinthifolius showed greater biological activity, as well as higher primary productivity between the species evaluated. Coccoloba alnifolia, Chrysobalanus icaco, Myrciaria strigipes and Psidium cattleyanum also showed functional and antioxidant properties. In contrast, Guapira pernambucensis presented a decreased photochemical activity, such as reduced connectivity between Photosystem II (PSII) and smaller pool of plastoquinone, as well as sensitivity at the level of Oxygen Evolution Complex on the PSII donor side. These results indicate the productive viability of these restinga species under cultivation conditions, and reveal their potential as sustainable sources of antioxidants and provide alternative ecosystem services to this susceptible Brazilian environment, which can be strategic in contributing to coastal management, reducing the social vulnerability of traditional communities.

The redox metabolism response of soybean plants infested by phytophagous mites is modular

Wesley Borges Wurlitzer, Joaquim Albenisio G. Silveira, Julia Renata Schneider, Noeli Juarez Ferla

Biotic factors, such as mites, have been frequently found in soybean crops. Considering the increasing cases of Tetranychus ludeni Zacher (Acari: Tetranychidae) infestation and the scarcity of information on this subject, we evaluated the redox metabolism based on the activity of oxidative enzymes, ascorbate peroxidase (APX), glutathione S-transferase (GST) and concentration of hydrogen peroxide (H2O2) in two soybean cultivars infested for 14 and 24 days by T. ludeni. The experiment consisted of 24 pots containing three plants. Twelve pots were allocated to control plants and 12 to infested plants. These were made up of six from the Monsoy cultivar and six from Brasmax, three evaluated at 14 days, and the other at 24 days. For infestation, 120 adult mobile forms of T. ludeni from the stock were transferred with a fine-tipped brush to each plant of each treatment at the V2 stage. Oxidative enzymes were evaluated only in the apical region of the plants, while H2O2 was assessed in both the apical and basal regions. Ascorbate peroxidase (APX) activity increased for infested plants, especially at 14 days of infestation, in both cultivars. In contrast, GST activity was significantly reduced in infested plants of Brasmax and Monsoy, both at 14 and 24 days of infestation. Quantified H2O2 in the apical region of Monsoy remained the same between treatments, whereas for Brasmax, the concentration was lower for infested plants. Conversely, H2O2 assessed in situ in the basal region of the plants was marked for infested plants of both cultivars and infestation times. Our study showed that redox metabolism in soybean plants infested by T. ludeni was altered and varied between cultivars and infestation times. Additionally, it is understood that soybean plants infested by T. ludeni respond in a modular manner, as the levels of H2O2 differed between the apical and basal regions.

THE USE OF PHYSIOLOGICAL CHARACTERISTICS AND MACHINE LEARNING FOR THE CLASSIFICATION OF SOYBEAN GENOTYPES.

João Lucas Gouveia de Oliveira, Regimar Garcia Dos Santos, Dthenifer Cordeiro Santana, Cid Naudi Silva Campos, Larissa Pereira Ribeiro Teodoro, Paulo Eduardo Teodoro

Soybean is one of the most important agricultural crops for the economy, and is therefore the target of many genetic improvement programs. It is a crop with a great diversity of genotypes, and classification according to their physiological behavior can assist improvement programs. The objective of this study was to find machine learning algorithms and inputs with the best performance for classifying soybean genotypes based on physiological characteristics. The experiment was implemented in the field in randomized blocks with three replications. Thirty-two soybean genotypes were evaluated. Multispectral and hyperspectral reflectance data were obtained and grouped into 20 representative band intervals. The physiological characteristics analyzed were: net photosynthesis, internal CO2 concentration, stomatal conductance, and transpiration. The grouping of genotypes based on their physiological performance was performed using the k-means algorithm and principal component analysis, forming two groups. After that, the formed clusters were used as output variables of the machine learning models. The following input variables were tested: wavelengths and spectral means of the selected bands. The machine learning algorithms tested were: artificial neural network, J48 decision tree algorithms, REPTree, support vector machine (SVM), random forest and logistic regression (SL), used as control. The statistical metrics used to evaluate the accuracy of the models were the percentage of correct classification and F-score. A correlation network was generated to express the correlations between the physiological traits and the spectral bands separated by cluster. The machine learning algorithms with the best performance in classifying genotypes were SVM and SL. Using spectral bands as predictor variables, the two algorithms (SVM and SL) present similar results. When the predictor variable used is wavelengths, the SL has a superior result.

TOLERANCE TO DEHYDRATION IN NATIVE PLANT SPECIES OF FERRUGINOUS RUPESTRIAN FIELD

Paola Coelho Rocha, Eduardo Gusmão Pereira,, Camilla Oliveira Rios

The ferruginous rupestrian field (canga) is a rocky ecosystem located at high altitudes. These environments harbor a vast diversity of plants, characterized by shallow soils and seasonal climate, with hot and humid summers and long, dry winters. The current scenario of climate change further affects precipitation patterns. Therefore, native vegetation exhibits adaptive strategies to survive these periods. In this context, our objective was to understand the extent of the physiological dehydration tolerance strategy developed by native ironstone species, based on the capacity for maximum quantum yield recovery of photosystem II (Fv/Fm). Ten representative species of ironstone were selected in ten 10 m² plots, spaced 10 m apart. The most expanded branches were collected and evaluated for Fv/Fm values to determine their health. These were wrapped in moistened paper, placed in black bags, and then taken to the laboratory. The experiment was conducted in 50 ml Falcon tubes, where water and MgCl2 solution were used to create an atmosphere with relative air humidity of 100% and 50%, respectively. This served to hydrate and dehydrate the leaves. The studied species exhibited different patterns of Fv/Fm recovery, allowing the observation of a dehydration tolerance gradient in ironstone vegetation. Two out of the ten evaluated species showed recovery values above 30%, being considered dehydration tolerant (DT), while the other species failed to reach such values, being classified as dehydration sensitive (DS). DT classified species demonstrate higher photosynthetic efficiency and, consequently, given the current scenario of climate change, will have a greater chance of success in these environments. This reinforces that the resilience of native species is an important survival strategy in these environments, highlighting the urgent need for climate change mitigation, as it could entail a significant loss of biodiversity in ironstone fields.

UNDERSTANDING EUCALYPTUS RESPONSES TO ELEVATED CO_2 AND HIGHER TEMPERATURE

Isabela Mirian dos Santos Barros, João Pedro Laurindo Rocha, Welson Júnior Silva, Gabriel Vilela Ferreira, Carolina Pessanha Alonso, Robson Luciano Ribeiro, Yasmin Vercosa Kramer, Adriano Nunes Nesi, Wagner L. Araújo

In recent years, the area planted with tree species, particularly eucalyptus, has expanded significantly. Although climate change influences carbon dioxide ([CO_2]) levels, water availability, and temperature, the impact of these factors on seedling physiology remains poorly understood. This study evaluated the physiological responses of two eucalyptus clones: E. grandis x unknown parent (Clone A) and E. grandis x E. urophylla (Clone B), under Mini-Face and Mini T-Face conditions. The clones were transplanted into 8-liter pots with fertilized soil and were irrigated daily. After a 30-day acclimation period, they were subjected to four treatments: [CN] Control; [HT] Ambient CO_2 concentration with approximately 2°C warming; [hCO_2] high CO_2 concentration (700 ppm) at ambient temperature; and [hCO_2/HT] high CO_2 concentration (700 ppm) with approximately 2°C warming. The experiment was conducted from June to August 2019, a period characterized by mild temperatures and low precipitation. Climatic and physiological analyses were performed throughout the experiment. The climatic conditions observed during the experiment were consistent with previous studies and reflected the local conditions. The average temperature was 19.7°C, with two precipitation events totalling 12.7 mm and 2.1 mm. The average relative humidity was 78.1%, and the average solar radiation was 15,609.1 KJ m-2. The average wind speed was 0.8 m/s. Clone A exhibited significantly higher photosynthesis rates across all treatments, indicating greater carbon fixation efficiency and better utilization of available CO_2. Both clones exhibited similar stomatal conductance, internal CO_2 concentration, and leaf transpiration, suggesting comparable water-use efficiency. Accordingly, the differences in photosynthesis were not related to variations in stomatal conductance or transpiration. Therefore, Clone A proved to be more efficient and productive than Clone B, which, despite having similar stomatal conductance and transpiration characteristics, displayed lower photosynthetic efficiency. Both clones showed similar responses to [hCO_2/HT], suggesting minimal adverse effects on Eucalyptus growth under climate change scenarios.

USE OF P4TREE IN THE PRODUCTION OF NATIVE SEEDLING IN THE ATLANTIC FOREST

Larissa dos Sanos, Eduardo Gusmão Pereira, Juliana Cristina Tristão, Camilla Oliveira Rios, Isadora Rodrigues Medina Santana

Alternative phosphate fertilizers have been gaining prominence in scientific research due to the need for sustainable nutrient utilization. P4tree is a new technology for phosphorus (P) adsorption derived from human urine, with the potential to be used as fertilizer in the production of forest seedlings intended for the restoration of degraded areas. Our objective was to evaluate the feasibility of P4tree in supplying P to the species Peltophorum dubium and Parapiptadenia rigida, and to investigate possible alterations in phosphorus fractions, phosphatase enzyme activity, and nutritional status of the species. The experiment was conducted in a greenhouse, with six treatments: no P application; 100% MAP (Monoammonium phosphate); 50% MAP; 25% MAP; P4tree with urine; and P4tree without urine. Nutrient application was through fertigation. Morphofunctional aspects, gas exchange and chlorophyll A fluorescence were investigated. We did not obtain enough mass for P fractions and phosphatase enzyme analyses. Dry mass was used for P quantification in the species. To determine the best application method for P4tree, we conducted an ecotoxicity test. Our results showed that P4tree in NaOH solution does not promote seed development, and the best option for use is the application of solid P4tree along with the substrate. Additionally, when applied in solid form, Peltophorum dubium showed greater sensitivity to the application of P4tree with urine, resulting in lower values in height, leaf area, diameter, and total dry mass. We conclude that, based on the material available and the application of solid P4tree, both species had compromised growth when the source of P was P4tree with urine.

Using Hydrogen Peroxide for Cyanobacteria Control: Insights into the Response of Microcystis aeruginosa Strains

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Cyanobacteria, belonging to the phylum Cyanobacteria, are Gram-negative prokaryotic microorganisms capable of performing oxygenic photosynthesis. These organisms can proliferate into harmful algal blooms in eutrophic environments, such as lakes and reservoirs. Cyanobacteria are especially noted for their production of secondary metabolites, including bioactive compounds. Among these, cyanotoxins are of particular concern due to their toxicity. Microcystins, a type of cyanotoxin, are notorious for causing acute liver damage upon ingestion, posing a substantial threat to human health. This study aimed to investigate the response of two Microcystis aeruginosa strains (Ibot 3060 and Ibot 3070), provided by the Botanical Institute of São Paulo and maintained in the Cyanobacteria and Microalgae Collection at the Federal University of Viçosa (CCM-UFV), to varying concentrations of hydrogen peroxide (H2O2) (100 mg/L, 10 mg/L, 1 mg/L, and 0.5 mg/L). We assessed physiological, molecular, and growth kinetic parameters. Molecular analysis using PCR confirmed the toxic potential of these strains by detecting the presence of the mcyD and mcyG genes. Growth was monitored by measuring optical density, and biomass samples were collected for metabolite analysis at two distinct time points: 4 and 16 hours post-treatment. Phylogenetic trees were constructed for the 16S and mcyG genes of both strains. The growth curves and chlorophyll content analysis revealed a gradual chlorosis within the first few hours post-treatment, with more pronounced effects at higher H2O2 concentrations. Treatments with 0,5 mg/L and 1 mg/L of H_2O_2 were sufficient to induce cell death, although this effect occurred more slowly than with higher concentrations. Understanding the bactericidal properties of H2O2 could lead to alternative water treatment strategies in reservoirs, potentially offering fewer impacts on water quality parameters compared to conventional methods.

Using leaf physiology to monitor reintroduced epiphytes in restored forests

José Luiz Alves Silva, Jônatha Souza Reis

Active epiphyte restoration has emerged very recently and perhaps explains why practical assessments still focus on individuals' growth, survival, and reproductive success rather than their physiological adjustments. This study evaluated how reintroduced epiphytes adjust and acclimate over time through changes in physiological traits in forests aged six and more than 20 years in the Atlantic Forest, Brazil. Approximately 400 individuals of Monstera adansonii (Araceae), Aechmea nudicaulis (Bromeliaceae), and Cattleya harrisoniana (Orchidaceae) were monitored over the course of one year in October 2022 (rainy season), February 2023 (rainy), May 2023 (dry), August 2023 (dry), and November 2023 (rainy). Total chlorophylls (ab), total carotenoids (Car), and the ab/Car ratio were measured for each individual and time. Two-way ANOVA assessed the effects of forest age and time on trait variation. All species showed higher Chl ab in the older forest, because its shaded understory required greater interception of diffuse light. Araceae had higher carotenoids in the younger forest, which helped to dissipate excess energy absorbed in the light-exposed understory and protect the plant's photosynthetic apparatus from damage. Bromeliaceae showed an opposite response, and Orchidaceae showed no difference in carotenoids between forests. All species invested more in photosynthetic than photoprotective pigments in the older forest, even Aaraceae, as suggested by higher ab/Car ratios. All physiological traits varied significantly over time, and the ab/Car ratio showed particular sensitivity to climatic seasons, with a peak in the dry season in the older forest. We conclude that active restoration initiatives should understand the species' physiological responses before deciding where to reintroduce individuals, as this will influence their functional pathways over time. Furthermore, an acclimation phase would be recommended to harden off individuals in nurseries facilities under conditions that mimic those of the forest where they will be reintroduced.

VARIATION AND COVARIATION OF LEAF TRAITS IN Euterpe edulis MART. ALONG A LIGHT GRADIENT

Emanuelle Gonçalves Cabral, Amanda Freitas Cerqueira, José Luiz Alves Silva, Marcelo Schramm Mielke, Angela Pierre Vitória

Traits are morpho-physio-phenological characteristics that impact individual fitness through indirect effects on growth, survival, and reproduction. The ability to shape the phenotypic expression of these traits may be related to environmental variation and genetic factors. Leaf traits often show strong covariation in stressful environments, which means they tend to vary in a coordinated manner. In contrast, traits tend to vary more independently under milder conditions. Habitat fragmentation can affect several species, including Euterpe edulis, a palm native to Brazil with great ecological and economic value but at high risk of extinction. Excess light can affect its performance and ability to regenerate and grow naturally in understory environments. This study used an experimental approach to 1) determine the influence of light intensity on the variation and covariation of photosynthetic traits of E. edulis, and 2) evaluate whether seed origin influences trait expression. Ten leaf traits (C and N isotopes and elements, nitrogen use efficiency, area, thickness, specific mass, toughness, chlorophyll index, and maximum quantum efficiency of photosystem II) were measured in 462 healthy juvenile individuals under controlled light conditions (light transmittance levels: 63%, 43%, 29%, 15%, and 2% of full sunlight). The variation index and principal component analyses showed that the seed origin did not influence the seedling's trait expression. The light gradient influenced trait variation, but neither the covariation index nor the trait interaction network. The absence of trade-offs between trait variation and covariation indicates that the species can adjust to different light conditions, which may be crucial for its survival in fragmented and changing areas.

WHOLE CANOPY GAS EXCHANGE IN Coffea canephora PLANTS: RESPONSES TO ENVIRONMENTAL CONDITIONS

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Monitoring gas exchanges at the single-leaf scale provides insights and understanding of the fundamental ecophysiological responses of plants. However, these responses can rarely be extrapolated to the whole-canopy scale without adequate architectural modeling of these plants and considering dynamics of their growth and functioning. In this study, we aimed at using a multi-chamber system to measure whole-canopy gas exchanges in Coffea canephora plants in response to environmental conditions such as photosynthetic active radiation (PAR), air temperature (Tair), relative humidity (RH), and soil matric potential (ψm). For this, C. canephora plants with two orthotropic axes were cultivated for six months in 80-liter pots. After this period, the plants were enclosed in transparent Mylar® plastic chambers, connected to an IRGA (CIRAS-DC, PPSystems, USA) for continuous monitoring of CO2 and water vapor concentrations. During the measurements, the environmental conditions were monitored, and plant scale net CO2 assimilation rate (An) and transpiration (E) were calculated. The increases in An and E were observed in response to the VPDair, Tair, and PAR increases, reaching the maximum values when those environmental factors were in intervals 1 - 3 kPa, 30 - 40 °C, and 500 - 800 μmol m^{-2} s^{-1}, respectively. Regarding ψm, the response dynamics of irrigated plants was stable over a time, while non-irrigated plants reduced An by 75% and E by 50% 16th day of irrigation suspension. These responses were reflected in the reduction of daily An and E by the plants, obtained by integrating the gas exchange curves throughout the day. Results are demonstrating the efficiency of the multi-chamber system in gas exchange monitoring, helping at understanding the whole plant scale responses to drought stress and gas exchange response dynamics in C. canephora.

Plant-Pathogen Interactions

Antiviral domains of the AtWWP1 protein: nuclear bodies formation and proviral protein interaction.

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WW domain-containing protein 1 (AtWWP1) is a well-known 463 amino acid protein, formed by two conserved tryptophan domain that recognizes proline-rich motifs (PRM) and phosphorylated threonine-proline sites. AtWWP1 plays an antiviral role, which promotes the relocation of pro-viral cytoplasmatic protein Nuclear shuttle protein (NSP)- interacting GTPase (NIG) to nuclear bodies, decreasing the begomovirus infection process. The Arabidopsis thaliana protein-protein interactions network connected to the COP 9 Signalosome 5A (CSN5A) immune hub revealed that, in addition to NIG, AtWWP1 is also connected to methyl CpG binding domain 2 protein (AtMBD2), a protein that recognizes CpG methylated island. The nuclear body-forming cyclin-dependent kinase 2 (CDKC2) co-localizes with AtWWP1-derived nuclear bodies. CDKC2 phosphorylates the RNA polymerase II C-terminus (CTD) and AtMBD2 is associated with repressor transcription factors and DNA demethylases, raising the hypothesis that AtWWP1-derived nuclear bodies are transcriptionally active. To delimit the domains on AtWWP1 that interact with CDKC2 and AtMBD2, we performed in vivo and in planta experiments using AtWWP1 mutants and truncated AtWWP1. These results indicate that AtWWP1 interacts with CDKC2, in yeast, via the conserved tryptophan domain and AtMBD2 via the C-terminal domain of AtWWP1 in vitro and in vivo. Functional studies of AtMBD2 implicate AtWWP1 in infection by begomovirus. Firstly, AtMBD2 participates in the CSN5A-derived immune hub and is induced by CabLCV (cabbage leaf curl virus) infection. Additionally, AtMBD2 overexpression enhanced susceptibility to the vírus, whereas AtMBD2 inactivation in the mbd2 – Salk 069448 knockout line decreased significantly the viral DNA accumulation compared to the control line, Col-0. These results indicate that AtMBD2 participates in the virus infection process and displays a proviral activity. AtNIG and AtMBD2 cannot form nuclear bodies but is redirected to nuclear bodies when co-expressed with AtWWP1, confirming the immune intrinsic activity of the AtWWP1-derived nuclear bodies.

Assessment of Resistance in Snap Bean Varieties to Anthracnose Caused by Colletotrichum lindemuthianum

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Snap bean (Phaseolus vulgaris L.) is a vegetable of great economic and social importance. However, diseases affecting bean pods can lead to reduced productivity and quality, hindering their commercialization. Anthracnose, caused by the fungus Colletotrichum lindemuthianum, is the main disease found in beans and affects the leaves, stems, and pods of the crop. The objective of this study was to evaluate the resistance of snap bean lines to anthracnose. For this purpose, 32 snap bean genotypes from the Agricultural Engineering Laboratory at UENF were used. The fungal isolate was obtained from infected pods and was manually inoculated through a suspension containing 10^6 spores/mL into plants at the V3 stage in a controlled environment. Subsequently, the severity of anthracnose on the plants was quantified using two scale methodologies: a descriptive and a diagrammatic one, developed by Pastor Corrales et al. (1989) and Godoy et al. (1997). The scales were compared to determine which best met the needs of the study. The collected data were subjected to analysis of variance at a 5% probability level using the F test, and the means were compared using the Scott-Knott test at a 5% probability level. The scale developed by Pastor Corrales et al. (1989) proved to be more suitable, and the first symptoms of the disease appeared four days after inoculation. According to the analysis of variance, there was a significant effect among the lines. In the mean comparison test, the group with the lowest means consisted of 22 lines. The lines L27, L29, and L37 stand out when compared to the others, as they possess phytosanitary characteristics of interest, making them promising candidates for further exploration in plant breeding programs.

Compensatory photosynthetic response in rice variety under Curvularia lunata infection

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Leaf spot caused by Curvularia lunata is an emerging disease in rice fields in Brazil, with the first reports of occurrence in the state of Maranhão. Considering the change in the behavior of this fungus, which usually attacks only the rice panicle, this study aimed to investigate the photosynthetic efficiency and greenness intensity of two rice varieties, BRS Primavera and IRGA 424, subjected to different levels of C. lunata inoculation. The experiment was conducted in a greenhouse, using a completely randomized design in a 2x6 factorial scheme, with two genotypes and six treatments (0 to 4 C. lunata inoculations). Greenness intensity was evaluated using the SPAD (Soil Plant Analysis Development) and CO_2 photosynthetic assimilation using the IRGA (Infra Red Gas Analyzer). The data were subjected to normality and homogeneity tests, followed by analysis of variance (ANOVA), and means were compared using Tukey's test at a 5% probability level. The results indicated that there was no significant difference in greenness intensity between treatments; however, the BRS Primavera variety showed significantly higher greenness intensity compared to IRGA 424 across all treatments. Surprisingly, CO_2 photosynthetic assimilation was higher in the treatments with more inoculations (21.4 and 24.6 µmol m^2 s^{-1} for T4 and T5, respectively) in the IRGA 424 variety, suggesting that this variety may have compensatory mechanisms to maintain photosynthesis even under severe pathogenic stress. This behavior is unusual and differs from what is generally reported in the literature, where photosynthesis tends to decrease under pathogen-induced stress. These findings highlight the need for future investigations to elucidate the physiological mechanisms that enable this adaptive response in rice plants infected by C. lunata.

Coupling proteome-transcription analyses to unravel Pathogenesis-Related Proteins (PR) in Plant-Insect-Fungus Interactions

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Fusarium verticillioides is a phytopathogen that highly impacts crops, such as maize (Zea mays) and other grasses, causing stalk and ear rot, which also leads to mycotoxin production. Recent studies revealed its intimate association with the borer Diatraea saccharalis, an insect pest of great relevance to the same crops. Similarly to the mentioned interactions, in the field, plants are exposed to a great variety of various multitrophic interactions, which can influence or alter their defense response. To cope with these various biotic stresses, plants have developed constitutive and inducible defense responses, among which are pathogenesis-related proteins. This study aims to investigate proteomic changes in Zea mays in response to agronomically relevant multitrophic interactions, focusing on the differential expression of genes encoding PR proteins identified from the altered proteome. Maize plants at the V10 vegetative stage were exposed to different biotic stress treatments with F. verticillioides and D. saccharalis and monitored over 24, 48 and 120 hours. Proteins from the 120 hours infection were extracted, precipitated, digested with trypsin and desalted prior to LC-MS/MS using TIMS-TOF Pro. The analyses were carried out using MaxQuant software, R and PERSEUS software. To analyze gene expression across infection times, samples from 24 and 48 hours were used. The genes prp3 (PR-4, endochitinase) and prp9 (PR-10, ribonuclease) were selected from the total proteome. Total RNA was extracted, cDNA synthesized, and qRT-PCR performed, using b-tubulin2 as a reference gene. The results showed increased expression of both genes during the combined F. verticillioides and D. saccharalis treatment. However, prp3 responded more strongly to D. saccharalis, while prp9 showed higher expression in response to F. verticillioides.

Electrochemical Gradients Generated by Plasma Membrane H+-ATPases Modulate Biofilm Formation in Diazotrophic Bacteria and Rice Root Tissue Interactions

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"Bacterial biofilms are aggregates of cells associated with a self-produced extracellular polymeric matrix. During interactions with plants, various bacteria, both beneficial and pathogenic, have the ability to form biofilms, facilitating adhesion and colonization of the host. Despite recent advances, the mechanisms coordinating biofilm formation remain poorly understood. Previous studies have revealed that ion fluxes across the plasma membranes of root cells play essential roles not only in plant nutrition but also in energy transduction and ionic signaling during symbiotic interactions between microorganisms and plants. We hypothesize that plasma membrane H+-ATPases (MP), essential enzymes in plant physiology, play a key role in signal transduction during bacterial-plant interactions. In this study, we investigated whether plasma membrane H+-ATPases in rice seedling root cells influence adhesion and biofilm formation by diazotrophic bacteria of the genus Herbaspirillum. The bacteria H. seropedicae strain HRC54 and H. rubrisubalbicans strain M4 were used. Biofilm formation was assessed spectrophotometrically in culture without root hosts and in interaction with rice roots, through microscopic analyses. Root adhesion and colonization were evaluated by bacterial population counts and scanning electron microscopy. Root proton flux was analyzed using the Scanning Ion-Selective Electrode Technique (SIET), and the involvement of plasma membrane H+-ATPases was estimated with the addition of sodium orthovanadate, an inhibitor of H+-ATPases. Data indicate that M4 bacteria adopt a colonization strategy that seems dependent on biofilm formation modulated by the host, while HRC54 exhibited reduced biofilm synthesis. Additionally, we demonstrated that vanadate significantly reduced both adhesion and biofilm formation of both bacteria on rice root surfaces, with a more pronounced effect on interaction with M4. These findings highlight the complexity of the communication mechanisms between bacteria and plants, broadening our understanding of these interactions and the generation of bioelectrical signals that may modulate biofilm formation.

EVALUATION OF BACTERIA ABLE TO CONTROL TOMATO DAMPING-OFF AND ENHANCING GROWTH WITH *Trichoderma longibrachiatum* UENF-F476

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Tomato damping-off disease caused by Pythium spp. leads to significant yield losses in tomato production. Traditional agriculture extensively relies on synthetic agrochemicals to manage diseases and increase crop yield. However, these chemicals pose risks to non-target organisms and the environment and contribute to developing pesticide resistance. Here, we investigated the potential of different bacterial isolates to inhibit the pathogen Pythium sp. and promote the growth of tomato plants in a mutualistic interaction with the beneficial fungus Trichoderma longibrachiatum UENF-F476. The bacterial isolates triggered ROS accumulation in Pythium sp and effectively reduced up to 80% of the pathogen mycelial growth. Promising isolates demonstrate the ability to fix nitrogen and produce hydrolytic enzymes, including glucanases, proteases, and amylases. When used in consortium with T. longibrachiatum UENF-F476, the microorganisms enhanced the basal resistance of the tomato plants. The results indicated that the microbial combination induced the expression of genes involved in the jasmonic acid, salicylic acid, ethylene, and auxin signaling pathways and increased the production of pathogenesis-related proteins (1 and 5) and antioxidant enzymes. Scanning electron microscopy revealed a reduction in pathogen hyphae on the roots of plants treated with the beneficial inoculum. The treated plants showed a significant increase in root dry mass and shoot growth, highlighting the potential of the bacterial-fungal consortium as an effective strategy for sustainable disease management and growth promotion in tomato plants. Based on the results obtained, it is expected to generate a viable, sustainable, and low-cost biotechnology capable of reducing the use of pesticides in tomato crops through the biocontrol and the promotion of plant growth.

Exploring the Metabolic Modulation of Beauveria bassiana in Enhancing Eucalyptus Defense Against the Gall Wasp Leptocybe invasa

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The gall wasp, Leptocybe invasa Fisher & La Salle (Hymenoptera: Eulophidae), poses a significant threat to eucalyptus production, causing considerable damage to seedlings and young plantations, and potentially leading to the death of susceptible genotypes. The use of the fungus Beauveria bassiana as an endophytic agent has been investigated to enhance plant resistance against herbivores and pathogens. However, the tri-trophic interaction between plants, fungi, and wasps remains poorly understood. This study evaluated the potential of the entomopathogenic fungus B. bassiana as a biological control agent, focusing on its ability to induce resistance in an Eucalyptus hybrid in response to parasitism by L. invasa. Changes in the plant's primary metabolism were analyzed in both fully expanded leaves and leaf apices, which are sites of oviposition and wasp development. The results revealed distinct metabolic responses in Eucalyptus plants following inoculation with B. bassiana, suggesting a possible activation of defense mechanisms against L. invasa. Infestation by the wasp led to the accumulation of soluble sugars and malate, indicating a reallocation of resources for defense and repair. Inoculation with B. bassiana modulated the plant's metabolism, altering levels of sugars and amino acids. In addition, an increase in total phenol levels was observed in inoculated and infested plants, suggesting a synergistic effect in activating defense mechanisms. While inoculation did not entirely prevent the damage caused by the wasp, our results indicate that the fungus plays a crucial role in modulating the plant's response to infestation. This finding could contribute to the development of new biological control strategies. Given the complexity of this tri-trophic interaction, further studies on the molecular mechanisms involved will be essential to gain a deeper understanding and identify effective alternatives for the management of this pest.

Foliar application of a resistance inducer to control white mold on soybean plants

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Introduction: White mold (WM), caused by the necrotrophic fungus Sclerotinia sclerotiorum, is one of the most aggressive diseases in soybean and causes significant yield losses. The use of resistance inducers increases the resistance of plants against a plethora of pathogens by mechanical (e.g., thicker cuticle layer and strengthening of the cell wall) and or biochemical (e.g., great activity of defense-related enzymes and increased pool of antimicrobial compounds) pathways. This study aimed to determine the potential of using a product containing copper (Cu) complexed with polyphenols [Mantus® (296 and 15 g of Cu and nitrogen L-1, respectively) and referred to as resistance induced (IR) stimulus hereafter] to reduce the symptoms of WM. Material and Methods: Soybean plants (growth stage V4) were sprayed with water (control) and IR stimulus (2.5 mL/L) 48 hours before inoculation with S. sclerotiorum. The severity of WM and the parameters of chlorophyll a fluorescence [maximum photosystem II quantum efficiency (Fv/Fm), photosystem II quantum yield (Y(II)), regulated energy dissipation quantum yield (Y(NPQ)), yield quantum of unregulated energy dissipation (Y(NO)), and electron transport rate (ETR)] were evaluated at 24, 72, and 96 hours after inoculation (hai). Data from disease severity was used to calculate the area under WM progress curve (AUWMPC). Results and Discussion: The IR stimulus-sprayed plants displayed lower WM severity at 72 and 96 hai and reduced AUWMPC compared to water-sprayed plants. On top of that, less impairment of the photosynthetic apparatus occurred IR stimulus-sprayed and infected plants compared to water-sprayed and infected ones as indicated by the greater values for Fv/Fm, Y(II), and ETR and lowest values for Y(NPQ) and Y(NO). Conclusion: The use of the IR stimulus contributed to reduce WM symptoms and, consequently, ensured a better photochemical performance of soybean plants facing infection by S. sclerotiorum.

In Silico Dissection of WRKY45: A Key Player in Arabidopsis Immunity Against Pseudomonas syringae

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The WRKY family of transcription factors has been described as essential for signaling biotic and abiotic stresses in several plant species. Studies report the positive regulation of several WRKY members on isochorismate synthase 1 (ICS1), a key enzyme in the synthesis of the phytohormone salicylic acid (SA), which is important in plant immunity. A systemic increase in SA plays a crucial role in the induction of pathogenesis-related proteins. Given the gap of knowledge concerning the function of the WRKY45 factor, we set out to evaluate its in silico expression pattern in A. thaliana under attack by Pseudomonas syringae using the online tool ePlant. The expression of WRKY45 increased 236.1-fold after 24 h of pathogen inoculation, while its levels were not altered after exogenous application of SA, indicating that WRKY45 acts upstream of the SA biosynthesis pathway. Additionally, we found that WRKY45 can interact with the proteins isochorismate synthase 1 (ICS1) and enhanced disease susceptibility 1 (EDS1), the latter being responsible for the modulation of the R gene in A. thaliana. In vivo, significant increases in the levels of branched-chain amino acids (Val, Leu, and Ile), aromatic amino acids (Phe, Try, and Trp), and Lys have been reported in A. thaliana leaves inoculated with P. syringae. Therefore, we also used ePlant to evaluate the potential interaction between WRKY45 and enzymes involved in amino acid metabolism. We found that WRKY45 can regulate the enzymes isovaleryl-CoA dehydrogenase and (D)-2-hydroxyglutarate dehydrogenase, both electron donors for electron transfer flavoprotein-ubiquinone oxidoreductase (ETFQO). Moreover, WRKY45 can also regulate the expression of the bifunctional enzyme lysine-ketoglutarate reductase/saccharopine dehydrogenase, which is involved in the two initial reactions of the lysine degradation pathway. In conclusion, the WRKY45 transcription factor is a potential regulator of plant responses to pathogens, modulating AS biosynthesis and amino acid homeostasis.

Key Proteins in Rice Defense Mechanisms Revealed by Differential Proteomics during Magnaporthe oryzae Infection

Priscila Ariane Auler, Giovanna Rossetto Veronez, Christian Montes, Justin Walley, Marcio C. Silva-Filho

Proteins are essential for cellular processes, including growth, reproduction, and stress responses. Transcriptome analyses offer insights into potential cellular activities, whereas proteome analyses provide a more accurate picture of real-time cellular functions. Proteomic technologies are particularly useful in studying plant-pathogen interactions, revealing the biological pathways involved in infection, plant response, and disease progression. This project aimed to identify differentially expressed proteins in rice plants during infection by Magnaporthe oryzae in two genotypes: IRGA 409 (susceptible) and IRGA 424 (resistant) at 12-, 24-, and 48-hours post-inoculation (hpi). Rice plants were infected, and proteins were extracted, digested into peptides, and labeled using TMTpro 18plex reagents. Peptides were analyzed with an Orbitrap Exploris 480 mass spectrometer, and spectra were searched using the Andromeda Search Engine against the Oryza sativa database, using MAXQUANT software. Differential expression analysis was performed with the Pseq algorithm, using a q-value < 0.1 as a threshold. Principal component analysis (PCA) revealed distinct protein expression patterns between genotypes. In the resistant genotype, clear separation between treatments was observed at all time points, while the susceptible genotype only showed differentiation at 48hpi. A total of 438 proteins were differentially expressed between Mock vs. 12hpi in the susceptible genotype and 62 in the resistant one. At 24hpi, 105 proteins were differentially expressed in the susceptible genotype and 474 in the resistant one. After 48hpi, 37 proteins were differentially expressed in the susceptible genotype and 322 in the resistant one. Only 5 proteins were consistently differentially expressed across all time points in the susceptible genotype, compared to 11 in the resistant genotype. Notably, the resistant genotype showed upregulation of pathogenesis-related thaumatin-like protein and Pathogenesis-related protein 5 (PR5) at all time points, suggesting their potential significance in the plant's defense mechanism. Further analyses will focus on post-translational modifications.

Metabolic alterations in eucalyptus clones: The critical role of Trichoderma harzianum in mitigating Leptocybe invasa infestation

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The cultivation of eucalyptus in arid and semi-arid regions is significantly constrained by the damage caused by galling wasp Leptocybe invasa. This pest induces galls on the petioles and main veins of the leaves, disrupting sap circulation and compromising the photosynthetic process. Currently, effective control methods for this pest are unavailable. Among potential alternatives, fungi of the genus Trichoderma may serve as valuable biocontrol agents. In this study, we examined the late-stage metabolic responses (80 days post-inoculation and 35 days post-oviposition – gall stage) of two eucalyptus clones with differential susceptibility to the wasp attack (resistant and susceptible), following inoculation with T. harzianum and subsequent infestation by L. invasa. The resistant clone exhibited significantly higher levels of phenolic compounds compared to the susceptible clone, both in the presence of the wasp alone and in combination with the fungus. The presence of the fungus and/or wasp led to a marked reduction in amino acid content in the resistant plants, while no changes were observed in the susceptible plants relative to their respective controls. This pattern did not extend to protein content. In terms of carbohydrates, starch content remained unchanged across comparisons, although a trend towards reduction was noted in inoculated and infested plants of both clones. However, the most significant variations were observed in fructose and sucrose levels in both clones when the wasp was present, either alone or alongside the fungus, particularly compared to the presence of the fungus alone. Taken together, these findings underscore the profound impact of L. invasa on the metabolism of eucalyptus plants. Future studies focusing on earlier responses may provide deeper insights into the potential of Trichoderma during gall development.

POTENTIAL OF MUGWORT AND FENNEL ESSENTIAL OILS TO CONTROL THE FUNGUS FUSARIUM OXYSPORUM

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Medicinal plants produce metabolites commonly used as therapeutic resources and may also have potential for use in the control of phytopathogenic fungi of agricultural importance. This study aimed to evaluate the potential of essential oils of Foeniculum vulgare (fennel) and Artemisia herba-alba (mugwort) against Fusarium oxysporum. The essential oils were acquired commercially from Lazlo and diluted in culture medium containing potato-dextrose-agar (BDA) with dimethyl sulfoxide (DMSO), at a ratio of 1 mL of DMSO to 100 mL of BDA at concentrations of 0, 250, 500, 1000 and 3000 mg L-1, with 0 mg L-1 being the control. The medium was poured into disposable sterile Petri dishes. A 5.23 mm disc of Fusarium oxysporum mycelium was placed in the center of each plate, then incubated at 26°C under a 12h photoperiod. The experiment was made in a completely randomized design with four replications. The diameter of the colonies was obtained by taking the average of two diametrically opposed measurements using a digital scale for seven days starting after 24 hours of incubation. The percentage reduction in mycelial growth, compared to the control, was calculated according to the different concentrations of essential oils tested. Fennel oil at concentrations of 250, 500, 1000 and 3000 mg L-1 reduced growth by 5.15%, 11.69%, 83.86% and 88.44% respectively. Mugwort oil at concentrations of 250, 500, 1000 and 3000 mg L-1 reduced growth by 8.04%, 19.88%, 63.20% and 81.70% respectively. Total growth inhibition at the highest concentration for fennel occurred up to the fifth day and for mugwort, up to the fourth day. It was concluded that the essential oils of fennel and mugwort have the potential to be used in formulations aiming to control the fungus Fusarium oxysporum.

THE ROLE OF RALFS IN THE INTERACTION BETWEEN SOLANUM LYCOPERSICUM / FUSARIUM PROLIFERATUM

Halisson Marques Silva

Signaling molecules are essential for coordinating processes in multicellular organisms. At approximately 5 kDa, RALF peptides are present in plants, phytopathogenic fungi, bacteria and nematodes. RALFs interact with receptors on the plasma membrane, influencing processes such as plant growth, reproduction and defense. Overexpression of AtRALF1 in Arabidopsis resulted in semi-dwarf plants. Our work focused on the role of RALF peptides in the immune system of tomato plants (Solanum lycopersicum) and their interaction with the pathogen Fusarium proliferatum. The aim was to understand the role of RALFs in the immune response of tomato plants to fungal infections. To this end, infection trials with F. proliferatum were carried out on tomato plants, comparing the wild-type genotype with mutants that lack functional SlRALF1 or SlRALF2. Infected or control plants were evaluated using pathogenicity level scores and morphological measurements (plant height and number of leaves). The absence of SlRALF1 or SlRALF2 increased the damage caused after infection by F. proliferatum. Changes in plant height and leaf number were not statistically significant. The slralf1 mutant showed 133% greater susceptibility to the pathogen compared to the wild type ($p<0.1 = 0.07$). On the other hand, slralf2 showed 119% greater susceptibility compared to slralf1 ($p<0.1 = 0.04$). Similar results were observed in three independent infection experiments, indicating that, despite the absence of morphological differences, RALF peptides play an important role in modulating the tomato immune response against F. proliferatum. These results advance the understanding of the role of RALFs in plant defense and may help in the development of new strategies for disease management in agricultural crops.

Stress Physiology and Systems Biology

A STRESS-MITIGATING FORMULATION PROTECTS SOYBEAN PHOTOSYNTHESIS UNDER HIGH IRRADIANCE

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Changes in irradiance levels directly affect the efficiency of Photosystem II (PSII), leading to the degradation of photosynthetic pigments. This study investigated the effects of different irradiance levels and stress-mitigating formulations on chlorophyll a fluorescence and photosynthetic pigments in soybean plants (Glycine max). The experiment was conducted in a growth chamber using a randomized block design with a 3x3 factorial scheme, including three treatments: Water (control), foliar fertilization with magnesium and manganese sulfate, copper, iron, ammonium polyphosphate (APP), and adjuvant (Agriultra sill®), and the same formulation at 1.5-fold concentration, along with three irradiance levels (300, 1200 and 2800 µmol m–2 s–1). Formulations were applied at the reproductive stage R1, with irradiances starting 48 hours post-application and continuing for 13 days, when chlorophyll fluorescence and photosynthetic pigment concentrations were analyzed. Plants exposed to 1200 and 2800 µmol m–2 s–1 had lower Fv/Fm and Phi_ABS values compared to those at 300 µmol m–2 s–1, indicating reduced quantum efficiency in photosystem II. In terms of energy dissipation (Dlo_Rc and Phi_Do), the control plants exposed to 1200 and 2800 µmol m–2 s–1 showed higher values than those exposed to 300 µmol m–2 s–1. Stress-mitigating formulations, regardless of concentration, reduced the negative effects of high irradiance by increasing Fv/Fm and Phi_ABS and decreasing Dlo_Rc and Phi_Do compared to the control. Chlorophyll a, chlorophyll b, and total chlorophyll levels were lower at 2800 µmol m–2 s–1 and higher at 300 µmol m–2 s–1, indicating photoinhibition at high irradiance and plant adaptation to low irradiance. However, the most concentrated formulation increased photosynthetic pigments at 2800 µmol m–2 s–1, confirming the chlorophyll fluorescence results and indicating a protective effect against pigment degradation under high irradiance.

ABIOTIC STRESS IN Lippia alba: EFFECTS OF SALINITY IN THE GENE EXPRESSION AND ESSENTIAL OIL PRODUCTION

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Monoterpenes, the primary components of the essential oil of Lippia alba, vary in composition based on genome size: diploids and tetraploids predominantly contain citral (a combination of geraniol and neral), while triploids are rich in linalool. Environmental stress, such as saline stress, can influence metabolic pathways and potentially alter the relationship between genome size and essential oil composition. This study evaluated how saline stress affects essential oil production as well as the expression of genes involved in monoterpene synthesis across different ploidy levels of L. alba. We cultivated diploid, triploid, and tetraploid accessions in vitro under saline stress for 40 days. A microextraction of essential oil was performed, and the major compounds was analyzed in a gas chromatograph coupled with a mass spectrometer. The expression of candidate genes related to terpene biosynthesis was estimated by real-time quantitative PCR. Our findings reveal that diploid accessions were most susceptible to saline stress, exhibiting significant changes in metabolism. In contrast, triploid accessions demonstrated chemical plasticity by increasing linalool content. Tetraploid accessions showed superior stress tolerance and vigor compared to diploids and triploids. For the diploid accession, an increase in gene expression suggested activation of the geraniol degradation pathway, potentially enabling future storage of citral in leaf trichomes as a stress response. While saline stress increased linalool content in triploids, the increase of the putative gene associated with linalool production was not observed . Tetraploid accessions showed no significant changes in gene expression, corroborating the stability observed in the essential oil composition. The data support that tetraploids showed higher tolerance under stress conditions. These results highlight the impact of saline stress on essential oil composition and gene expression in L. alba, emphasizing how different genome sizes can influence stress responses and metabolic adaptations.

Acetylcholine acts on antioxidant activity and lipid peroxidation in Maize (Zea mays) plants under heat and water stress

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Maize (Zea mays) is a C4 photosynthetic metabolism plant and thus has greater water use efficiency, however, it can be directly affected by abiotic stresses, such as heat and drought stress, causing excessive synthesis of reactive species of oxygen (ROS), responsible for causing oxidative stress, damaging lipids, proteins and destroying cellular components. To protect against ROS and stress, plants increase the activity of antioxidant and bioregulatory enzymes, such as Acetylcholine (ACh), produced in small quantities act on germination, growth, development, cellular metabolism, and mitigating the effects of stress. Therefore, the objective of the work was to analyze the potential physiological and biochemical effects of the application of Acetylcholine in maize plants under heat and drought stress. The experiment was carried out with a double factorial design, normal conditions (temperature 31.9 ºC/19.9 ºC max./min and irrigated) and stress (38 ºC/28 ºC day/night and suspension of irrigation) x 3 modes of application (0 mmol L-1 (C); seed (TS) and foliar (F) treatments were both treated with 1 mmol L-1 of ACh, analyzes of antioxidant enzymes (SOD, CAT and APX) and lipid peroxidation were carried out (MDA). Data were submitted for analysis of variance and means compared by Turkey's test ($p<0,05$). SOD decreased the activity in both condition and treatment compared to control. CAT showed an increase in enzymatic activity in both conditions and treatment. The APX enzyme increased by 155.28% in F in normal conditions, however, it decreased by 46.3% compared to the control treatment. The MDA in the TS decreased by 24.40% in normal conditions and plants with TS and F decreased the content MDA by 23.88% and 30.94%, respectively, compared to C. As a result, the use of Acetylcholine alleviated the adverse effects proved to heat and drought stress.

Acetylcholine as a Biological Membrane Protector in Soybeans Subjected to Thermal and Water Stress

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Soybean ([Glycine max (L.) Merr]) is a valuable crop in Brazil due to its high protein and oil content. However, prolonged droughts combined with rising temperatures cause harmful damage to the morphological and physiological development of plants, compromising their productivity. One way to increase plant tolerance to abiotic stress is through the application of bioregulators, including acetylcholine (ACh). ACh has been studied for its potential to mitigate negative effects of abiotic stress by improving plant metabolism and growth. For five days, plants were exposed to 38/28°C (day/night) and irrigated with 30% of field capacity. On the fifth day of stress and on the recovery day (6th day), a sample was collected from each treatment for analysis of POD, SOD, APX, H2O2, O2-, and MDA. The experiment was conducted in a completely randomized design, with a 2 x 2 factorial arrangement (absence and presence of stress and ACh - 2mM), with 4 treatments and 9 replications. Initially, ACh did not show a beneficial effect on the activity of the antioxidant enzymes POD, SOD, and APX, and resulted in high levels of H2O2 and O2-, but increased MDA activity, suggesting minor damage to cell membranes. However, after 24 hours, recovery occurred, and ACh showed a positive effect, increasing antioxidant enzyme activity and reducing ROS concentrations, while maintaining reduced MDA activity. The application of acetylcholine contributes to the maintenance of biological membranes both during and after stress, causing lipid peroxidation (MDA).

ACTION OF DOPAMINE ON SOYBEAN (GLYCINE MAX) SEEDLINGS SUBJECTED TO OSMOTIC STRESS

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Water is essential for plant growth and its scarcity can cause serious damage. Climate change affects the water cycle and damages seed germination processes. Dopamine is a catecholamine that interacts with other molecules, improving the response to abiotic stresses. Its interaction with hormones promotes better seedling growth and development. The aim of this study was to evaluate the performance of exogenous dopamine as a stress mitigator due to osmotic deficit. The experiment was conducted in a completely randomized design, double factorial (condition without stress and stressful condition) x seven doses respectively: distilled water; 0.01; 0.05; 0.1; 0.5; 1 and 2 mMol of dopamine, The germination test consisted of 50 seeds per repetition, with 4 repetitions for each treatment, totaling 200 seeds, mannitol ($C_6H_{14}O_6$) was used to impose the stress. The germination test was carried out according to the Seed Analysis Rules (RAS). % germination, germination speed index (GVI) and biomass were analyzed. The results indicate that although % germination was not significantly affected by osmotic stress, GVI decreased in stressed seedlings, but treatment with dopamine, regardless of dose, improved GVI. Osmotic stress caused a reduction in the aerial part, regardless of the treatment, however, the dopamine treatments provided greater fresh mass of the aerial part when compared to the control. Root length was affected by osmotic stress, but the application of dopamine resulted in greater root length in stressed seedlings compared to the control treatment. The 0.05mMol treatment increased the root fresh weight of stressed seedlings. It can be concluded that the application of dopamine to stressed and unstressed seedlings leads to better growth and development.

Aluminum (Al) and zinc do not enhance seed germination of Vochysia tucanorum, an Al-accumulation species

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Aluminum (Al) is found in acidic soils (pH < 5) in its toxic form (Al^{3+}), causing inhibition of root growth in sensitive species. Aluminum-accumulating species, however, show high Al concentration in their leaves, not exhibiting toxicity symptoms. When cultivated without Al, these plants show low leaf hydration and gas exchange rates, root necrosis and leaf shedding. Proper plant development, including seed germination, requires the activity of auxins, such as indole-3-acetic acid (IAA), which are zinc (Zn)-dependent for their biosynthesis. We germinated seeds of Vochysia tucanorum (Vochysiaceae), an Al-accumulating species, under water (control), 250 µM Al + 0 µM Zn, 0 µM Al + 0,91 µM Zn, and 0 µM Al + 1,82 µM Zn to test whether Zn could replace the Al during germination of this Al-dependent species. The Al concentration measured before germination revealed seeds exceeding 20,000 mg Al kg-1. The percentage of germination was similar between all treatments. The same response pattern was observed for germination time and rate. The significantly high Al concentration found in the seeds did not allow testing the hypothesis that Zn could replace Al during germination. As V. tucanorum is an Al-dependent species, the question raised here should be tested in plants under total absence of Al, which involves seedlings that have 'consumed' the Al from seeds.

ALUMINUM ACCUMULATION IN THE GENUS MICONIA: A PHYLOGENETIC PERSPECTIVE FROM THE ATLANTIC RAINFOREST

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Aluminum (Al) accumulation is notably prevalent among tropical woody species from Melastomataceae, Rubiaceae, Symplocaceae, and Vochysiaceae. The neotropical genus Miconia (Melastomataceae) is widespread in both the Cerrado, often referred to as the 'Brazilian savanna', and in tropical humid forests across South America. In the Cerrado, Miconia species thrive on acidic soils (pH < 5.0) with high Al saturation (m% > 70%), accumulating between 5,500 and 8,600 mg Al kg-1 dry leaf. Given the high frequency of this genus in the Atlantic rainforest, we investigated whether Al accumulation could be revealed by Miconia species within this ecosystem. We collected Miconia species along an elevation gradient across four experimental sites in the Atlantic rainforest. Leaf Al concentration, along with soil fertility parameters, including pH and m%, were measured. Additionally, phylogenetic analysis was conducted to determine whether Al accumulation is primarily influenced by m% or is species-dependent. We identified 27 Al-accumulating Miconia species, with no non-accumulating ones, on distrophic soils with m% exceeding 70%. However, m% did not correlate with Al accumulation in leaves. Notably, M. willdenowii, M. brunnea, and M. flammea accumulated Al at levels ten- to 20-fold lower than the remaining 24 species. Phylogenetic analysis suggests that these species may have lost the ability to accumulate Al above 1,500 mg kg-1. Overall, Miconia species in the Atlantic rainforest show leaf Al concentrations 20-fold higher than those in the Cerrado, with accumulation patterns influenced more by phylogeny than by m%. These results suggest the existence of Al non-accumulating Miconia species within the Atlantic rainforest.

Aluminum-induced root growth in Camellia sinensis is mediated by indole-acetic acid

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Aluminum (Al) is toxic to most plants, but some species accumulate Al in their leaves without exhibiting toxicity symptoms. In some of these species, Al seems to cause beneficial effects to plant growth, including root development, though the reasons behind this are still debated in the literature. Auxins, like indole-acetic acid (IAA), known to regulate root growth, have not been explored in relation to Al beneficial effects. Thus, we asked whether root IAA concentration correlates with Al-induced root growth in Camellia sinensis, an Al-dependent and -accumulating species. For this, plants of this species were cultivated under increasing Al concentrations (0, 500, 1000, and 2000 μM) in nutrient solution for 90 days. The concentrations of IAA, biometric data, organ biomass, root surface area, and relative leaf water content (RWC) were measured over time. Plants exposed to 500 μM Al exhibited the highest root growth compared to those subjected to higher Al concentrations, while plants grown without Al showed leaf shedding and inhibited root growth. Elevated root IAA levels were observed in plants exposed to 500 μM Al from day 60 onwards, which coincided with enhanced root growth. Thus, the increased root growth observed at 500 μM Al was likely due to optimal root IAA concentration. Enhanced root growth resulted in a larger root surface area, which in turn improved RWC from day 30. This demonstrates that the improved root growth of C. sinensis induced by Al is mediated by IAA, ultimately leading to better shoot growth supported by adequate water status in the plant.

ANALYSIS OF THE PHYSIOLOGICAL EFFECT OF IRON STRESS IN SUGAR CANE

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Sugarcane (Saccharum spp.) is a globally significant crop, with Brazil leading in production, particularly for sugar and bioenergy. However, soil contamination by trace metals like iron (Fe) presents a growing challenge to agricultural expansion. Iron toxicity disrupts photosynthesis, increases reactive oxygen species, causes oxidative damage, and reduces levels of chlorophyll, protein, and starch, ultimately hindering crop growth and productivity. This study aimed to evaluate the physiological impacts of Fe stress on various sugarcane genotypes to identify cultivars with enhanced tolerance to Fe toxicity. Sixty-day-old seedlings were grown in hydroponic system during 10 days under two conditions: (i) nutrient solution and (ii) nutrient solution supplemented with 231 µM $FeCl_3$. On the 10th day, non-photochemical quenching (NPQt), effective quantum yield of photosystem II (ΦPSII), non-photochemical quantum yield of photosystem II (ΦNO), quantum yield due to non-photochemical quenching (ΦNPQ), linear electron transport rate (qL), and SPAD index were measured using the MultispeQ device (v 2.0). Additionally, pigment indices (anthocyanins, flavonoids, chlorophyll) and nitrogen balance were assessed using the MPM-100. Data were analyzed via analysis of variance and Tukey's test ($p < 0.05$) to determine significant differences among genotypes. RB108519 exhibited the highest tolerance, characterized by elevated ΦNPQ, ΦNO, and chlorophyll levels. This genotype also demonstrated a high NPQt, indicating an enhanced capacity to mitigate photosynthetic damage by dissipating excess energy as heat, thereby preventing oxidative stress. On the other hand, RB867515 was the most sensitive, with lower qL, ΦPSII, and ΦNPQ values, indicating less efficient photosynthesis. Additionally, RB867515 showed high ΦNO and flavonoid levels, suggesting Fe stress-induced impairment of photosynthetic capacity and activation of an antioxidant response. The nitrogen balance indicated the potential of RB108519 to produce high biomass under stress, whereas RB867515 was adversely affected. These findings support the selection of sugarcane cultivars with improved Fe tolerance, contributing to more resilient agricultural systems.

Anatomical and ultrastructural alterations confers tolerance to drought stress in cowpea genotypes

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The drought impairs several essential reactions in plant metabolism, which might lead to yield loss. Tolerance is the characteristic of adapting to stressful conditions, which may change among individuals in the same species. The current study aimed to evaluate two cowpea genotypes: BRS Tumucumaque (sensitive to water deficit) and BRS Marataoã (tolerant to water deficit), under two soil water retention curve (SWRC) levels, 40 and 80%. The soil was kept at 80% SWRC for 20 days after sowing, and the water restriction regime started. Roots and leaves samples were collected at 48 DAE and prepared for anatomical and structural analysis. The evaluated leaf parameters were: adaxial epidermis, palisade parenchyma, spongy parenchyma, abaxial epidermis, cuticle, cell wall thickness, and starch accumulation. The following parameters were evaluated in roots: secondary xylem and secondary phloem thickness, ray parenchyma cell diameter, and starch accumulation. The tolerant genotype presented more organized spongy parenchyma, thicker palisade parenchyma, adaxial epidermis, and total leaf compared to the sensitive genotype. The sensitive genotype showed thicker spongy parenchyma and cell wall under water deficit; in addition, the abaxial and adaxial leave sides changed under drought. A thicker cuticle was observed under water deficit in both genotypes, but no difference was observed between genotypes. More starch granules were observed under 40% SWRC in both genotypes, mainly in the tolerant one. The transmission electron microscopy showed that the tolerant genotype presented higher thylakoid volume than the sensitive one, under 40% SWRC. In roots was observed higher vase element diameter in the sensitive genotype under 40% SWRC, which was not observed in the tolerant genotype.

Anatomical Changes in Crotalaria spp. in Response to aluminum

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Brazilian soils are predominantly rich in aluminum, which becomes mobile at pH < 5, affecting sensitive plants. However, some species have developed mechanisms to tolerate aluminum. This study aims to evaluate the integrity of plant tissues in soil with available aluminum. The soil used was Oxisol, and the experimental design was a randomized block in a factorial scheme (2x3): soil factor (aluminum availability; correction with dolomitic limestone - $MgCO_3$) and species factor (C. juncea, C. spectabilis, C. ochroleuca), cultivated for 43, 53, and 53 days, respectively, with five replicates, totaling 30 experimental samples. For anatomical analysis, fully expanded leaves and main roots were collected, fixed in FAA 70% for 48 hours, and stored in 70% alcohol. The samples were dehydrated in alcohol at different concentrations (70%, 80%, 90%, 99.5%) and embedded in hydroxyethyl methacrylate. Each treatment repetition produced a historesin block, from which three slides were made, with 5-10 µm thick sections using a rotary microtome. The slides were stained with toluidine blue and analyzed using digital photomicrographs, with a Zeiss Primo Star microscope equipped with an AxioCam ERC5S camera. In the root tissue, the primary xylem thickness increased in C. juncea when cultivated in aluminum-contaminated soil, with a 38% increase compared to limed soil. The leaf tissue showed no anatomical changes in soil with aluminum. The Crotalaria species cultivated in aluminum-contaminated soil maintained the integrity of their leaf tissues. However, in C. juncea, aluminum accumulation in the roots led to changes in root anatomy, affecting the primary xylem and vessel elements, impairing water absorption and gas exchange.

APPLICATION OF 5-AMINOLEVULINIC ACID IN YOUNG PLANTS OF PALHETEIRA SUBJECTED TO DIFFERENT DOSES OF CADMIUM

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The objective of this work was to evaluate the biometric, photosynthetic and antioxidant parameters of Clitoria fairchildiana R.A Howard when subjected to application of 5-ALA and cadmium. The experiment was conducted in a greenhouse, where seedlings were produced. After three months, they were transplanted into 3kg pots. The plants received application of 5-ALA, weekly for 5 weeks, totaling 5 applications. Three days of acclimatization, cadmium dosages were applied once, through 3 doses of CdCl2.H2O: 0, 15 and 30 mg/L-1. Around 300 mL of CdCl2.H2O were applied to each vessel. After applying the dosages, the seedlings were watered every day. After 3 days of acclimatization after the last application of 5-ALA, doses of CdCl2.H2O were applied. The experimental design was randomized blocks, with 3 treatments of Cd and 3 treatments of 5-ALA. The data were subjected to analysis of variance, and the differences between treatments were confirmed using the Tukey test ($p<0.05$). The biometric variables and pigments showed changes upon application of 5-ALA and little variation in their levels under the doses of cadmium. For the antioxidant system, the activity of the enzymes G-POD, APX, SOD, CAT and MDA suffered fluctuations in their levels due to the application of 5-ALA and Cd, varying depending on the concentration of the metal and the part of the plant. Although the statistical difference was not evidenced by severe stress, in which no major differences were observed in the variables found, resulting in a mild situation in which the plant did not need to produce greater amounts of ROS. 5-ALA could be a possible attenuator of C. fairchildiana under doses of cadmium. It is important to carry out further analyzes to elucidate the physiological and antioxidant behavior of the species in relation to contact with cadmium and 5-ALA and the interaction between these factors.

Application of CropEvo Biostimulant Reduces the Impacts of Low Light Availability on Irrigated Rice Crops

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Rice is one of the most widely cultivated cereals globally. In Brazil, the state of Rio Grande do Sul accounts for approximately 70% of the production. However, prolonged precipitation reduces solar radiation availability, potentially impacting crop productivity. Thus, this study aims to evaluate the performance of rice plants under light restriction during the reproductive stage, associated with the application of the biostimulant CropEvo®. The experiment was conducted in the field at the experimental area of the Federal University of Pelotas (UFPel), using the irrigated rice cultivar IRGA 424 RI. The biostimulant was applied at R0 and R2 stages (250 mL ha-1) via foliar spraying, resulting in the following treatments: T1: Control; T2: Light stress (stages R0 to R4); T3: Light stress (stages R0 to R4) + CropEvo®; T4: Light stress (stages R5 to R8); and T5: Light stress (stages R5 to R8) + CropEvo®. Light stress was induced by using shade nets over the plants (5.0 m^2 per plot), reducing light intensity by 35%. For treatments T2 and T3, the shade nets were kept over the plants from stages R0 to R4, and for treatments T4 and T5, from stages R5 to R8. Chlorophyll index was assessed at stages R3 and R6, and at the end of the cycle, spikelet sterility and productivity were measured. The chlorophyll index at stage R3 was higher in plants treated with the biostimulant, while at stage R6, treatments with light restriction showed higher values compared to the control. Spikelet sterility was higher during the second period of light stress (R5/R8), although to a lesser extent in the treatment with the biostimulant application. For productivity, comparing light stress treatments without the biostimulant, there was a reduction of 1.6 tons ha-1 in the first period (R0/R4) and 0.5 tons ha-1 in the second period (R5/R8).

Assessing the Impact of Chromium on Native Species in the Revegetation of Mining Tailings

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Mining is essential for industrialization, providing necessary resources. However, it increases the presence of persistent heavy metals in the environment, accumulating in aquatic and terrestrial ecosystems. Among heavy metals, chromium (Cr), despite being vital for humans in small quantities, possess significant health risks when present in high concentrations. In this context, phytotechnologies are eco-friendly and cost-effective approaches to the management of heavy metals contamined sites. The use of native plants capable of accumulating biomass without causing oxidative damage is essential for the effectiveness of this technique. The study was conducted at the Federal University of Viçosa, Florestal Campus, and investigated the efficacy of three plant species in the phytoremediation of mining tailings. Ten-liter pots with mixtures of tailings and water were used. The plant species Pistia stratiotes, Polygunum hydropiperoides, and Setaria parviflora were exposed to five chromium concentrations (0; 0.05; 1; 5; and 10 mg L-1). The experimental design was a randomized block design with a 5x3 factorial arrangement and five repetitions. Measurements of malondialdehyde (MDA) and calculations of the relative growth rate were evaluated. The results were analyzed using ANOVA and Tukey's test. P. hydropiperoides showed a consistent relative growth rate up to 5 mg L-1 of Cr, with a slight increase at 10 mg L-1. P. stratiotes, on the other hand, maintained stable growth regardless of Cr concentration. Notably, S. parviflora exhibited twice the relative growth rate at 10 mg L-1of Cr and had the lowest concentration of MDA, suggesting lower lipid peroxidation and, consequently, greater resistance to Cr. Comparatively, the other two species showed an increase in MDA, indicating higher oxidative stress with increasing Cr levels. S. parviflora significantly outperformed in Cr tolerance. In conclusion, the study highlights the use of S. parviflora for tailing dams revegetation, due to its superior growth capacity and lower MDA concentration.

Association of Ascophyllum nodosum Seaweed Extract with Mg in Alleviating Water Stress in Soybean Plants

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Water deficiency at different levels can trigger various physiological and metabolic responses in plants, primarily reducing the productivity of major crops. To mitigate the adverse effects of water deficiency (WD), the use of a seaweed extract (EA)-based biostimulant supplemented with magnesium was evaluated. The experiment was conducted using a randomized complete block design (RCBD) in a 2x3 factorial scheme, with four replications. A dose of 300 mL of seaweed extract (A. nodosum) with or without magnesium supplementation was applied, simulating two water conditions: field capacity (FC; 6 to 10 kPa) and moderate water deficiency (MWD; 30 to 40 kPa), with three foliar application times (30, 45, and 60 days after emergence, DAE). Leaf temperature was monitored daily using an IR thermal camera (FLIR).A decrease in leaf temperature of 0.37°C and 0.83°C was observed for the A+Mg and A treatments, respectively, compared to the S/A treatment under FC. Similarly, under WD, leaf temperature decreased by 0.94°C and 1.01°C for the A+Mg and A treatments, respectively, compared to the S/A treatment. Hydrogen peroxide (H2O2) was accumulated in all treatments, with higher levels in plants under WD. However, plants treated with EA showed lower expression of hydrogen peroxide. Control plants, particularly those not receiving extract application (in both water conditions), had higher deposition of hydrogen peroxide radicals.

Therefore, using seaweed extract supplemented with magnesium effectively reduced the negative effects of WD on soybean plants (Glycine max L.).

Benefits of mycorrhizal symbiosis in Stryphnodendron adstringens and Cratylia argentea under high manganese concentration

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Arbuscular mycorrhizas (AM) are symbiotic associations between fungi from the Glomeromycota phylum and plant roots, which are crucial for plant development, particularly in nutrient-poor and stressful soils. These associations enhance nutrient absorption, such as phosphorus and nitrogen, facilitating plant adaptation to challenging environments like acidic soils rich in heavy metals, including manganese (Mn). While Mn is an essential micronutrient for plants, involved in processes such as photosynthesis, it can become phytotoxic at high concentrations, particularly in acidic soils, impeding plant growth by causing chlorosis, necrosis, and interfering with the absorption of nutrients like iron and phosphorus. Our study evaluated the effect of mycorrhizas on two native leguminous species from the Cerrado, Stryphnodendron adstringens and Cratylia argentea, grown in soil with elevated Mn concentrations (100 and 600 mg/kg). Seeds were sown directly into pots containing Mn, with one group being mycorrhizal and another non-mycorrhizal. All pots were inoculated with rhizobia. The plants were cultivated in a greenhouse for seven months. The results indicated that mycorrhizas had a positive impact on plant development, especially in C. argentea, where nodules formed only in mycorrhizal plants. In contrast, S. adstringens did not form nodules, but the presence of mycorrhizas improved plant growth. Additionally, a positive correlation was observed between mycorrhizas and shoot biomass in both species, and a negative correlation between Mn presence and certain growth parameters, suggesting that high Mn concentrations negatively affect development. However, the mycorrhizal symbiosis proved beneficial, mitigating the toxic effects of Mn.

BIOACTIVITY OF Lithothamnium sp. EXTRACTS IN HYDROPONIC ARUGULA CULTIVATION

Janyne Soares Braga Pires, Welligton Castrillon Grélla, Adriano Alves Fernandes, Basílio Cerri Neto, Sara Dousseau Arantes

Arugula is a plant sensitive to abiotic stresses, which can affect its productivity in warmer seasons and regions. Elevated temperatures impact production by limiting plant growth due to reduced oxygen availability in the roots. To mitigate the stress experienced by the crop, the use of biostimulants can become an effective strategy. Lithothamnium sp. is a marine alga used as a biostimulant to enhance plant physiological performance and induce tolerance to environmental stresses. This alga provides nutrients, amino acids, and phytohormones that stimulate plant growth and development. The objective of the study was to evaluate the bioactivity of a commercial product composed of extracts from this marine alga in the development of arugula in a hydroponic system. The experiment was conducted in a randomized block design with 5 treatments and 5 replications, containing 18 plants per plot. The doses used were (0-control; 0.75; 1.5; 2.25; and 3.0gL-1). Gas exchange was evaluated in the most developed leaves using an infrared gas analyzer, IRGA 6400 LI-COR (Lincoln, NE, USA). The data were subjected to analysis of variance, regression analysis, and qualitative means comparison using Tukey's test, both considering a 5% probability of error. The results indicate that the application of Lithothamnium sp. doses improved the evaluated physiological parameters. An increase in the photosynthetic rate was observed with increasing doses, reaching a maximum point at 1.9gL-1. After this point, however, the values decreased, suggesting the existence of an optimal dose. Stomatal conductance and transpiration rate also responded to the doses, with both parameters reaching a maximum point at 2.0gL-1. Higher doses may lead to a decrease in these parameters, suggesting possible metabolic inhibition or stress under high concentration conditions. The results indicate that the use of biostimulants can be a viable strategy to optimize hydroponic arugula cultivation and a sustainable alternative to conventional fertilizers.

BIOCHAR OF AÇAÍ ON THE PHYSIOLOGICAL RESPONSES OF BRAZILIAN MAHOGANY IN SOIL CONTAMINATED WITH COPPER

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The objective of this study was to evaluate the potential of açaí biochar to mitigate copper toxicity in Brazilian mahogany plants. The experimental design used was a randomized block design (RBD), with five blocks, in a 4x3 factorial scheme. This scheme corresponded to the control (no copper addition) and three doses of copper (200, 400, and 600 mg of Cu per kg of soil) in combination with three levels of biochar (0%, 5%, and 10%), totaling sixty experimental units. The results showed that applying 5% biochar in soils contaminated with up to 200 mg of Cu per kg maintained gas exchange processes, including photosynthesis, stomatal conductance, transpiration, intercellular CO2 concentration, and the internal/external carbon ratio. Additionally, there was an improvement in water use efficiency, even under abiotic stress conditions. This study suggests that açaí biochar can be an effective alternative to improve and sustain the physiological responses of Brazilian mahogany plants exposed to different copper concentrations in the soil, helping to mitigate toxic effects.

CAN LEAF PIGMENTS BE INDICATORS OF EUCALYPTUS DEFENSE AGAINST LEPTOCYBE INVASA?

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The eucalyptus gall wasp, Leptocybe invasa Fisher & La Salle (Hymenoptera: Eulophidae), originally from Australia, induces gall formation on stem apices, petioles, and leaf blades of susceptible eucalyptus genotypes. These galls impair plant growth and, in highly susceptible genotypes, can entail death. Given the lack of effective control measures against this pest and considering that the most susceptible genotypes generally exhibit greater tolerance to drought, early diagnostic tools are essential to support the development of breeding programs. In this study, we hypothesized that leaf pigments could be used as indicators of Eucalyptus defense against L. invasa in the first few hours and the first few days after infestation. The hybrids Eucalyptus tereticornis Sm (susceptible) and Eucalyptus camaldulensis Dehnh (resistant) to L. invasa were used. The treatments consisted of control susceptible Eucalyptus, infested susceptible Eucalyptus, control resistant Eucalyptus and infested resistant Eucalyptus. The leaf pigments chlorophyll a, chlorophyll b, carotenoids, and anthocyanins were measured. Plants infested by L. invasa showed a reduction in production of chlorophyll a and b within the first 15 hours after infestation. Resistant plants responded to the attack by reducing the production of all pigments in the same period. After four days of infestation, L. invasa induced the production of chlorophyll a and carotenoids, along with a reduction in chlorophyll b. In response, resistant plants reduced the production of all pigments. We conclude that the leaf pigments carotenoids and anthocyanins are indicators of Eucalyptus defense against L. invasa in the first 15 hours after infestation, while chlorophyll a, carotenoids, and anthocyanins after four days. Additionally, we determined that the most suitable period for evaluating leaf pigments as indicators of Eucalyptus defense against L. invasa is four days after infestation

Characterization of the Trehalose-6-phosphate pathway transcriptional profile along sugarcane development

Arthur Vanni Lopes

Sugarcane has a high bioenergetic potential due to sucrose accumulation in its culms. In response to carbon metabolism, various sugar signals are generated in the source and sink organs throughout plant development. Among these signaling molecules, trehalose- 6-phosphate (Tre6P) stands out as a critical regulator of sucrose levels. The overexpression of the Escherichia coli genes trehalose-6-phosphate synthase (TPS) and trehalose-6-phosphate phosphatase (TPP) in sugarcane resulted in a reduction and increase in sucrose levels in transgenic plants, respectively, demonstrating that manipulating Tre6P metabolism has the potential to modify sugar accumulation. This project aims to determine the differences in expression among TPS, TPP, and trehalase (TRE) in sugarcane and explore new strategies that may aid in sucrose accumulation. We retrieved query sequences for TPS, TPP, and TRE from the literature, specifically from Arabidopsis thaliana, Zea mays, and Oryza sativa, and subsequently identified homologous sequences in sugarcane. Domain analyses revealed that class I and class II TPS possess glycosyltransferase family 20 and trehalose phosphatase domains. Meanwhile, TPP has trehalose phosphatase domains, and TRE has trehalase domains. Phylogenetic trees were constructed, and expression profiles of the targets were analyzed throughout sugarcane development (1, 3, 6, and 12 months) using RT-qPCR. Among TPS I and II, expression levels in culms followed a similar pattern, with higher expression in the later months, whereas leaves showed differentiation between them. TPP exhibited increased expression in the 12th month in the culm and the early months in the leaves. TRE showed high expression levels in the culm compared to leaves along sugarcane development. These results showed that the expression levels of TPS class I and TPP in culms could indicate a regulation in sucrose accumulation along sugarcane development. These data has a potential to explore strategies that could impact the sugarcane productivity in the future.

Combination of partial root-zone drying and kaolin film in Coffea canephora for thermal comfort and water savings.

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Drought duration, intensity and frequency, worsened by climate changes, are demanding intelligent combination of new technologies. The combination of partial root drying (PRD) and the foliar application of processed kaolin particle film (KF) at 5% of the spray volume were investigated in Coffea canephora. Four irrigation levels were applied twice per week (when necessary): conventional - compensating for 100% of the crop's daily evapotranspiration (ETc), always irrigating one single plant side; PRD100, PRD70 and PRD30 where the water amounts completed ETc up to 100%, 70% or 30%, respectively, were applied by weekly alternation on the two irrigated plant sides. C. canephora leaf responses, as leaf temperature (Tleaf), crop water stress index (CWSI) and net leaf CO2 assimilation rate (Anet, μmol CO_2 $m^{-2}s^{-1}$) were measured at midday during the summer and winter of 2022. Plants protected with KF reduced the Tleaf by 2.5 °C during the winter and 2.4 °C during the summer when compared to those without kaolin protection (GL). No differences in Tleaf were observed among the irrigation levels. The CWSI in GL was 30% and 20% higher than in KF plants during winter and summer, respectively. No differences were observed in CWSI among the irrigation levels in winter. In summer, CWSI of PRD70 was by 30% higher in GL and 41% higher in KF than in conventional irrigation. KF application increased Anet in winter by 38%, 47%, 54% and 52%, in conventional, PRD100, PRD70 and PRD30 irrigation levels, respectively, with no difference among four irrigation levels. KF application reduced Tleaf and CWSI, and increased Anet during winter, dry period occurring in the region of investigation. It must be highlighted that the reduction in water supply with PRD did not affect Anet, indicating the possibility of water amount reduction, as one recommendation for future coffee management.

CORRELATION ANALYSIS BETWEEN SOYBEAN MODULES DEMONSTRATE ATTENTION DURING STRESS STIMULI

Gustavo Maia Souza, Douglas Antônio Posso, Thiago Francisco Carvalho Oliveira, João Gabriel Moreira Souza, Lyana Pinto, Ana Carolina Costa Araujo

Cognition is a process that enables organisms to perceive and interact with the surrounding world. Attention is one of the key subprocesses supporting cognition and can be defined as a disproportionate investment of physical or mental energy by an organism, tissue, or cell into a particular activity or the reception of a specific stimulus or set of stimuli. Although plants are cognitive beings, they do not possess a central organ, such a brain, making the understanding of plant attention a challenge for scientific research. In this study, we hypothesized that, in response to a stimulus, plant modules can synchronize their electrical activity, indicating a process of attention. Thus, our objective is to study plant attention utilizing the plant electrome to observe synchronization on plant electrical activity. To investigate this hypothesis, synchronized measurements were taken from four modules of soybean plants: stem, first trefoil, second trefoil, and third trefoil. Measurements were taken before and after applying wounding and burning stimuli to the second trefoil. We obtained characteristic profiles for each measured series, including potential difference, frequency, complexity, and chaoticity analysis. Utilizing Time Dispersion Analysis of Features, we visualized the average behavior of all plants in relation to each calculated characteristic. With these results, a correlation test was conducted between all plant modules before and after the stress. Before stress, the modules did not show significant correlation, with the highest Pearson correlation value at 0.1, indicating that no substantial correlation existed between the modules before stress. After stress, the analysis revealed a substantial increase in correlation, peaking at 0.8 between the stem and the second trefoil, and 0.7 between the first and second trefoil. Our analysis demonstrated that wounding and burning stimuli induced synchronization between plant modules, suggesting a likely state of attention in plants.

Could seed priming induce tolerance at salt stress in Rapanea ferruginea?

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Seed priming is a technique used to increase uniformity of germination and tolerance to stresses, thus improving the development of seedlings in the field. Hydropriming is a type of seed priming, that uses water in a controlled manner during imbibition. It is an economical, simple, and ecological technique that may increase tolerance to abiotic stresses in plants, such as Rapanea ferruginea (Ruiz & Pav.) Mez, a native plant from the Atlantic Forest. The salt stress induces photosynthesis reduction, reactive oxygen species increase, reduced nutrient uptake, and impairment of plant growth. We aimed to evaluate whether hydropriming reduces the effects of salt stress on R. ferruginea plants. The seeds were subjected to hydropriming and the young plants were posteriorly irrigated with 100 mM sodium chloride (NaCl). We evaluated photosynthesis, superoxide dismutase activity, and the histochemical localization of superoxide anion, hydrogen peroxide, and lipid peroxidation in R. ferruginea plants. A two-way analysis of variance was performed considering two seed treatments (unpriming and hydropriming) at two NaCl concentrations (0 and 100 mM), and each treatment had four replicates. NaCl reduced the photosynthesis of R. ferruginea plants by about 30%, independent, of seed treatment. Histochemical localization demonstrated that hydrogen peroxide accumulated was not influenced in plants subjected to salt stress. However, superoxide anion was incremented in plants from non-primed seeds, and lipid peroxidation increased by NaCl. Superoxide dismutase activity was reduced by about 80% by salt stress in plants from non-primed seeds. In plants from hydropriming seeds, there was a reduction of about 60%, independent of NaCl. Therefore, hydropriming does not mitigate salt stress damage in R. ferruginea plants.

Cultivars of Coffea canephora developed to amazon southwest cultivated under different soil water tensions

Núbia Pinto Bravin, Marcio de Oliveira Martins

Amazon Southwest is at the Brazilian north region, with a high potential to produce coffee grain. In despite of a high pluviometric index, there is a well-defined period of the year with water scarcity that irrigation is quite necessary. Hence, coffee cultivars which are tolerant to drought are essential to produce with no significant increase at the costs. Thus, this work aims test three cultivars produced to this particular region under water deficit levels. Plantlets were vegetatively produced from 5 cm stakes, which were maintained at nursery with high humidity by 120 days. After this, the plants were transferred to 8 L pots containing commercial substrate and sand (1:1, v/v) and transported to a greenhouse. Factorial scheme was 3 x 4, with three cultivars (BRS1216, BRS2314 and BRS 3210) and four water treatment (80%, 40%, 20% and 10% of water capacity), with five replicates. The experimental period was 35 days. All cultivars were affected by water treatments. Photosynthesis was reduced at 20% and 10% water treatment but BRS2314 kept carbon assimilation at 40% of water capacity. Stomatal conductance was reduced while the water stress was higher, reflecting at the leaf transpiration. Intercellular concentration of CO2 was well related to CO2 assimilation, reducing at 40% at BRS2314 plants but increasing at higher water stress levels. Effective quantum efficiency was reduced in all cultivars at more stressed treatments but BRS2314 kept at moderate stress level (40% of water capacity). Potential quantum efficiency was the same for all cultivars, reducing levels at more stressed plants. Relative water content (RWC) and electrolyte leakage (EL) showed no differences among cultivars with reduction only at 20% and 10% of water capacity. In conclusion, these cultivars showed similar responses to water deficit but BRS2314 plants look promising when the cultivation occurs at moderate stress.

DIFFERENT ECOLOGICAL AND NUTRITIONAL STRATEGIES IN SHRUB AND HERBACEOUS PLANT SPECIES FROM THE CAMPOS RUPESTRES

Débora Sousa, Camilla Oliveira Rios, Daniel Negreiros, Eduardo Gusmão Pereira, Igor Rodrigues de Assis

The quartzitic and ferruginous Campos Rupestres (CR) are characterized by soils with low nutritional content. The study evaluated the ecological and nutritional strategies of shrub and herbaceous plants from CR in the Serra da Calçada. Quartzite soils showed lower nutrient content compared to ferruginous soils. Phosphorus (P) and nitrogen (N) concentrations were low in both soil types, with values of 4.74 and 4.80 mg dm^3 for P, and 0.14 and 0.09 dag kg^{-1} for N in ferruginous and quartzitic CR, respectively. Plants from ferruginous CR had higher nutrient concentrations in roots and leaves compared to those from quartzitic CR, except for potassium, which was higher in plants on quartzite. In shrub plants, nitrogen, manganese, and calcium concentrations were higher. The roots of shrub plants in ferruginous soils had higher levels of N and P. The CSR analysis revealed that all species studied were highly stress-tolerant and poorly competitive, but varied in their morphophysiological plasticity. Plants in ferruginous soils had higher concentrations of carbohydrates in the leaves, indicating greater photosynthetic capacity and higher chlorophyll a content. In contrast, the high concentration of sugars in the roots of plants in both soil types suggests a conservative energy storage strategy, with roots functioning as stable reservoirs during stress. Despite no significant differences in NO_3^- concentration, shrub plants in quartzitic CR developed adaptive mechanisms to maximize NH_4^+ absorption. The study provided valuable insights for the conservation and management of CR ecosystems. It also deepened the understanding of plant adaptations to extreme environments, crucial for biodiversity preservation and the development of sustainable practices in natural resource management.

DIURNAL PATTERNS OF GAS EXCHANGE AND STARCH ACCUMULATION IN SUGARCANE LEAVES UNDER LIGHT DEPRIVATION

Gabriel Marques Leal, Bruno Viana Navarro, Hellen Oliveira de Oliveira, Marcos Silveira Buckeridge

Mature sugarcane leaves are characterized as source organs, capable of producing photosynthates beyond their physiological needs, thereby coordinating the availability of carbohydrates throughout the sink tissues over the light/dark cycle. During the light period, part of the carbon assimilated in the leaves through photosynthesis is stored as transitory starch to maintain growth. Photosynthesis controls the balance between the leaf's acquisition and storage of carbon and its growth usage. We investigated the variation in leaf gas exchange and starch accumulation during the diurnal cycle in sugarcane leaves exposed to light deprivation at different day periods. Our results showed that, during the daily variation, leaf +1 of sugarcane plants reached the peak of carbon assimilation and stomatal conductance four hours after dawn (ZT4), even though the available light was greater at ZT8. This indicates that factors other than light were regulating the photosynthetic rate. Also, light deprivation throughout the day inhibited carbon assimilation and starch accumulation, while stomatal conductance and transpiration rates decreased. When plants were exposed to light deprivation until ZT4, a decrease in photosynthesis was observed during the following period of the day. This reduction suggests that the abrupt transition between the absence of light and high light intensity compromised the carbon assimilation capacity. Simultaneously, these plants exhibited greater starch accumulation at the end of the day, while light deprivation between ZT4 and ZT8 repressed starch accumulation. Our findings indicate that light deprivation during different day conditions altered carbon partitioning over the 24-hour cycle. These results enhance our understanding of how sugar sensing and signaling modulate carbon assimilation and distribution through plant organs. This knowledge can help develop strategies to understand fundamental aspects of sugarcane physiology related to carbohydrate production.

DOES HYDROPRIMING PROVIDE HEAT TOLERANCE IN Canavalia rosea SEEDS?

Geovane da Silva Dias, Ana Maria Oliveira Ferreira, Josyelem Tiburtino Leite Chaves, Javier Kaynan Trindade, Elisa Monteze Bicalho

Temperature is an environmental factor influencing seed germination, mainly regarding climate emergency scenarios, in which temperature increases, rainfall, and heat waves will be more frequent and intense. Canavalia rosea (Sw.) DC. is an important seashore environment species, where sand temperatures can exceed 50ºC in summer. It was investigated whether hydropriming (HP) in C. rosea seeds promotes tolerance to heat stress. C. rosea seeds were exposed to 25, 33, and 60 ºC after or not being primed. There was evaluated the germination percentage, germination speed index (GSI), viability, proline content and H_2O_2, lipid peroxidation (MDA), and histolocalization of the superoxide anion (O_2 •−). The seeds not subjected to HP had an average germination percentage of 92%, while those subjected to HP had 66.33% ($p<0.01$). However, germination decreased with increasing temperature when the seeds were hydroprimed, with average values of 84.5 (25ºC), 81.5 (33ºC), and 71.5% (60ºC). GSI there was a significant difference only for the HP treatment ($p<0.001$), with mean values of 8.03 (control) and 5.06. HP60 (HP + 60°C temperature) had lower viability than the other treatments, with unprimed seeds averaging 92.66% viability compared to 68.33% for HP and intense red coloring. The same treatment showed the least intense staining in the embryonic axis for histolocalization of O_2 •−. The passage through the HP at 33ºC induced higher concentrations of MDA, H_2O_2, and proline in the seed tissue, with mean values of 96.178, 2.685, and 7.027 nmol-1 g, respectively ($p<0.01$). HP proved to be more damaging to germination than temperature. The seeds withstood high temperatures and the priming treatment did not favor germination. This suggests that these plants have a natural thermotolerance mechanism that is not enhanced by the priming.

DOES MYCORRHIZATION ALTER THE PHYSIOLOGICAL RESPONSES OF Lippia alba UNDER WATER DEFICIT CONDITIONS?

Luiz Palhares Neto, Leonardo Silva-Santos, Natália Corte-Real, Cláudia Ulisses

The ability of plants to tolerate environmental stresses can be modulated by symbiotic interactions with soil microorganisms, such as arbuscular mycorrhizal fungi (AMF). Water deficit and association with AMF can modulate the secondary metabolism of plants, as evidenced in species of medicinal interest, emphasizing the importance of studies aimed at understanding these aspects in plant physiology. One of the most studied and widely used medicinal species is Lippia alba, belonging to the Verbenaceae family and is endemic to Brazil. Its leaves possess antibacterial, antifungal, anti-inflammatory, and larvicidal properties due to the presence of essential oils in glandular trichomes. The objective of this study was to evaluate the influence of arbuscular mycorrhizal fungi (AMF) on pattern of nutrient absorption, gas exchange, and growth in Lippia alba plants subjected to different water treatments. Cuttings of L. alba were planted in sterile soils containing or not containing AMF spores. Sixty days after planting, the plants were subjected to two water regimes: hydrated and water deficit (WD) for 60 d. Growth evaluations, gas exchanges, photosynthetic pigments and nutrientes contente were carried out. WD reduced the production of root biomass, water use efficiency, root/leaf biomass ratio, specific leaf area, leaf phosphorus content, total chlorophyll, chlorophyll a, chlorophyll b, carotenoids, and increased leaf temperature. In contrast, the association of AMF in plants under the WD regime promoted an increase in root biomass, specific leaf area and leaf relative water content, total chlorophyll, chlorophyll a, chlorophyll b, and carotenoids. We conclude that WD promotes morphophysiological changes in plants of L. alba, however, the association with mycorrhizal fungi contributes to the species' tolerance.

Does the use of the biostimulant CropEvo reduce the impacts caused by thermal stress on soybean crops?

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High temperatures can interfere with the physiological responses and productive potential of agricultural crops. The use of inputs with biostimulant activity for plants has been increasingly sought by producers and is the subject of various research studies. The objective of this study was to evaluate the performance of soybean plants in response to thermal stress and the potential to reduce the effects of stress through the use of the biostimulant CropEvo®. The experiment was conducted in the field, in the experimental area of the Federal University of Pelotas (UFPel), with the soybean cultivar Nidera NS 6601 IPRO. The stress was induced by installing small greenhouses covering the plants in an area of 4.5 m² during two periods of the reproductive stage: R1 to R4 and R5.1 to R8, with four repetitions per treatment. The biostimulant application occurred at stages V3 and R1 (250 mL ha^{-1}) via foliar spraying, composing the following treatments: T1: Control; T2: Control + CropEvo®; T3: Thermal stress (R1 to R4); T4: Thermal stress + CropEvo® (R1 to R4); T5: Thermal stress (R5.1 to R8); and T6: Thermal stress + CropEvo® (R5.1 to R8). The chlorophyll index was evaluated at stages R3 and R6, and after harvest, the thousand-grain weight (TGW), yield, and protein content were measured. Thermal stress resulted in a reduction in the chlorophyll index, thousand-grain weight, and plant yield. However, in the treatments with the application of the biostimulant, even under thermal stress, these parameters showed significantly higher values. The greatest difference was observed in yield, with an increase of 10% for plants under thermal stress associated with CropEvo during the first stress period and 17% higher for the second period. The protein content in the grains did not show a significant difference.

EFFECT OF BROWN ALGAE EXTRACT ON STOMATAL CONDUCTANCE AND WATER POTENTIAL OF CITRUS UNDER WATER DEFICIT

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There are several reports in the literature on the effect of brown algae extracts (Ascophyllum nodosum L.) in agriculture, ranging from increased productivity to the induction of tolerance to biotic and abiotic stresses. This study aimed to investigate the impact of brown algae extract (YaraVita BIOTRAC™) on stomatal conductance (gs) and water potential (ψw) of citrus seedlings subjected to water deficit. The experiment was conducted in a greenhouse, in a completely randomized design (CRD) in a factorial scheme, with four doses of the extract (0,0; 0,5; 1,0; 1,5 L 200 L^{-1}) on 'Ponkan' mandarin seedlings grafted on 'Swingle' citrumelo, subjected to two water regimes: full irrigation (FC) and 10 days under water deficit (60% FC, WD). The WD treatments were reassessed after 10 days of rehydration (RH). The gs was evaluated with a digital porometer and the minimum and maximum ψw with a Scholander pressure bomb. The 1.0 L BIOTRAC dose resulted in the highest gs, confirmed by Tukey's test, during WD. In RH, the dose was also significant, fitting a second-order model (adjusted R^2 = 0,87) with the highest gs at 1,5 L. For ψw, in WD, there were significant differences between water regimes and doses by the Kruskal-Wallis test, but Dunn's test did not confirm these differences. Graphical analysis suggested a decreasing linear trend in ψw MAX and a hyperbolic behavior in ψw MIN, with the lowest response at 0,5 L and the highest at 1,0 L. In RH, Kruskal-Wallis found no significant dose effect on ψw, but graphical analysis shows a higher response at 1,0 L for both. The extract demonstrated effectiveness in increasing gs of citrus seedlings, both in WD and RH, indicating that the extract can enhance the plants' ability to maintain transpiration and gas exchange under water stress.

EFFECT OF CADMIUM ON THE GERMINATION OF HANDROANTHUS SERRATIFOLIUS (VHAL) S. O. GROSE SEEDS

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Contamination by metals such as cadmium, mainly from agricultural and industrial activities, poses a global challenge. Synthetic phosphate fertilizers are significant sources of cadmium, which causes soil and groundwater contamination. This study aimed to evaluate the germination and seedling emergence of Handroanthus serratifolius subjected to different cadmium concentrations. The seeds were exposed to nine cadmium concentrations (0, 3, 8, 20, 40, 60, 80, 100, and 200 mg/L) using cadmium sulfate ($CdSO_4$) as the source. The experiment was conducted in Gerbox-type containers, where the seeds were placed between papers moistened only once with the cadmium solutions and the assay was conducted for 45 days. The highest cadmium concentration (200 mg/L) resulted in a germination rate of only 3%. However, concentrations between 3 and 100 mg/L showed no significant impact on germination compared to the control, suggesting that H. serratifolius seeds possess tolerance to cadmium at low to intermediate levels. On the other hand, the seedling emergence percentage began to decline at 8 mg/L, with an average reduction of 38.9%, and this effect was more pronounced at concentrations of 20 to 100 mg/L, where the reduction reached around 65% compared to the control. At the concentration of 200 mg/L, no seedlings formed. It was concluded that while H. serratifolius seed germination is not significantly affected by cadmium concentrations up to 100 mg/L, seedling formation is drastically reduced starting at 8 mg/L, being completely inhibited at 200 mg/L. These results indicate that cadmium affects the seedling emergence phase more than the initial germination, suggesting differential tolerance in the early stages of plant development.

EFFECT OF MANGANESE ON THE GROWTH AND METABOLISM OF TOMATO PLATS WITH LOW ETHYLENE PERCEPTION

Tatiane Santos Correia, Dinorah Moraes de Souza Marçal, Eduarda Santos de Andrade, Beatriz Costa de Oliveira Queiroz de Souza, Vitor de Laia Nascimento

Manganese (Mn) is an essential micronutrient for plants, high doses have toxic effects, while its deficiency reduces productivity and deteriorates culture, its absorption is regulated by ethylene, a phytohormone that acts in responses to nutritional stress, Tomato plants (Solanum lycopersicum L. cv. Micro-Tom) mutants for ethylene signaling are more tolerant to nutritional stress. Therefore, the objective of this work was to evaluate the influence of Mn on plant growth and metabolism under conditions of changes in ethylene perception. Wild type (WT) tomato plants and their hormonal mutant Never ripe (Nr) were germinated in a growth chamber, afterwards the seedlings were transferred to pots containing sand and Hoagland's nutrient solution, with treatments: absence, excess, and ideal doses of Mn. The height, root length and number of leaves were evaluated. The plants were dried in an oven with forced air circulation and weighed on a scale to quantify biomass. Leaf area data were quantified using ImageJ software. Gas exchange and chlorophyll fluorescence were measured with MINI-PAM portable fluorometer. Compounds from the metabolism of carbohydrates, nitrogen, phenols and pigments were quantified. There were no responses to Mn treatment in the parameters of height, biomass, specific leaf area, gas exchange, chlorophyll fluorescence and Total Soluble Sugars (TTS), reducing sugar, starch, protein, amino acid, phenolic compounds, chlorophyll a and b and carotenoids contents. However, Nr plants in excess of Mn showed a 41% decrease in root length and a 74% decrease in sucrose content. WT plants in the absence and excess of Mn showed a 27% reduction in leaf number, but only the absence of Mn showed a 45% reduction in leaf area. Although the genotypes showed low interaction between nutritional treatments, it was found that the WT genotype showed a greater response to the absence of Mn and the Nr genotype to excess Mn.

Effect of phenolics from pyroligneous acid on the activity of antioxidant enzymes in Pennisetum glaucum (millet) leaves

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A sustainable increase in agricultural production is essential to meet the growing global demand for food. Although urea is widely used as an N source, approximately 50% to 70% of the applied nitrogen is lost due to volatilization caused by the action of extracellular soil ureases. The use of urease inhibitors in association with urea is a strategy to decrease such nitrogen losses. Hydroquinone (HQ) and methylhydroquinone (MHQ) present in pyroligneous acid were determined to be urease inhibitors. This work evaluated the extent of the addition of HQ, MHQ or N-(butyl)thiophosphoric triamide (NBPT; reference of urease inhibitor) in urea-treated soil on the activity of antioxidant enzymes in millet leaves. The superoxide dismutase (SOD) activity was not affected by the presence of urease inhibitors at 0.06% in urea-treated soil. MHQ or NBPT (0.06%) treatment increased catalase activity by 2.4-fold, which contributed to the decrease in H2O2 amounts. Higher concentrations of the urease inhibitor (0.5 and 1.0%) decreased SOD activity in leaves and therefore the formation of H2O2. MHQ (0.5 and 1.0%) decreased CAT activity similarly to the observed for the treatment of soil with 1.0% NBPT. All millet plants showed normal growth, with no leaf chlorosis or any other visible disorders by the time of leaf harvest. Overall, these results suggest that the effect of HQ or MHQ on the activity of SOD and CAT in millet leaves does not impair the overall antioxidant response of the plants in the first 50 days of growth under greenhouse conditions. Both HQ and MHQ are lead substances for investigation in the field as potential additive in urea fertilizers to improve their efficiency, without impairing the plant response to oxidative stress.

EFFECT OF SALINITY ON GAS EXCHANGE IN MICRO-TOM TOMATO

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Salinity is one of the main factors limiting plant growth and productivity, directly affecting critical physiological processes such as photosynthesis and transpiration. However, there are reports that certain substances, including jasmonic acid (JA), can mitigate the damaging effects of salinity. Considering that tomato plants are sensitive to salt stress and that Micro-Tom has been used as a model plant material, the objective of this research was to evaluate the extent to which exogenous application of JA could contribute to mitigating the effects of salinity on gas exchange in these plants. As a first result, it was found that NaCl concentrations equal to or greater than 100 mmol per liter of growing substrate are deleterious to Micro-Tom, regardless of whether the plants are treated with JA. On the other hand, the effect of JA (100 μM methyl jasmonate) in mitigating salinity was not confirmed. Although the plants that did not receive JA showed a significant reduction in gas exchange variables (stomatal conductance, photosynthetic rate, and transpiration rate) when grown in saline substrate (50 mmol NaCl per liter of growing substrate) compared to those grown in non-saline substrate, the plants under saline treatment showed statistically similar values for these same variables, regardless of whether they were treated with JA. Thus, the evaluation of JA as a potential agent to mitigate salinity in Micro-Tom remains open, and we suggest exploring other concentrations and methods of application (in this case, JA was applied by spraying until runoff).

Effect of silicon nanoparticles on the mitigation of cadmium toxicity in lettuce (Lactuca sativa L.)

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Cadmium (Cd) is an extremely toxic heavy metal, known for causing severe damage to plant metabolism. At elevated levels, Cd interferes with organelle function, inhibits essential metabolic pathways, and impairs the photosynthetic process, leading to the excessive generation of reactive oxygen species (ROS). This oxidative stress can cause significant damage to proteins, lipids, and nucleic acids, negatively impacting plant growth and survival. Consuming lettuce contaminated with Cd poses a substantial risk to human health, including carcinogenic potential. This study aimed to investigate the ability of silicon in nanoparticle form (SiNP) to mitigate the toxic effects of Cd in lettuce plants (Lactuca sativa L.). The plants were grown hydroponically and exposed to 50 µM of Cd and 2 mM of SiNP for six days. Analyses were conducted to measure the absorption and distribution of Cd and Si in the roots and leaves, as well as to evaluate biochemical parameters, including lipid peroxidation (MDA), hydrogen peroxide concentration (H2O2), and the activity of antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and peroxidase (POX). The results showed that SiNP reduced Cd concentration in the roots while facilitating its translocation to the leaves. While the presence of SiNP helped to reduce Cd toxicity by limiting its absorption in the roots, no significant changes were observed in ROS production or enzymatic activity in the leaves. This suggests that the amount of SiNP applied may not have been sufficient to fully activate the plant's antioxidant defense mechanisms. These findings are relevant to agriculture, as they highlight the potential of SiNP as a tool to reduce Cd contamination, thereby improving food safety and protecting public health.

Effect of stress intensity on the survival of eucalyptus seedlings

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Eucalyptus is Brazil's most cultivated exotic tree, due to its critical role in the cellulose industry. Given the increasing frequency of droughts, identifying clones with enhanced drought tolerance is essential. We examined the physiological responses of two commercial eucalyptus clones to varying evaporative demand. After 30 days of acclimation in a greenhouse, seedlings of two clones of Eucalyptus grandis x E. urophylla (Clones A and B) were transferred to a BOD chamber with 20°C and 80% relative humidity (RH), simulating fluctuations on atmospheric demand. The average evapotranspiration was set at 2.5 mm/day. Daily measurements included assimilation rate (A), stomatal conductance (gs), intercellular CO_2 (Ci), and transpiration rate (E), and seedlings were classified as normal, wilted, or senescent. Our results indicated clone B initially exhibited a higher A and gs than clone A; however, both declined to nearly zero by the end of the experiment. E for clone B decreased more than for clone A, reaching 11% and 15% of initial values, respectively. Ci remained relatively stable, with increases observed just before senescence in both clones. Clone B achieved a peak A (16.99 µmol m^{-2} s^{-1}) on day 13, while clone A reached 8.97 on the same day. Both clones began wilting around day 13. Although both clones senesced at similar rates, clone A wilted for no more than one day before senescing, whereas clone B remained wilted for up to three days. Clone A exhibited negative A values on day 21, followed by clone B on the next day. As the plants aged, gas exchange parameters (A, gs, and E) approached zero, while Ci remained elevated, suggesting biochemical limitations to photosynthesis. Clone A wilted later, indicating better tolerance to water deficit, but clone B demonstrated greater resilience, surviving longer in a wilted state and showing superior defense against oxidative stress.

EFFECT OF ZINC SUPPLY ON CITRUS PLANT PHYSIOLOGY

Rodrigo Marcelli Boaretto, Gustavo Trevizan Devite, Dirceu Mattos Jr, Gabriel Antonio Bortoloti

Citrus farming stands out as one of the main sectors for fruit production and exportation of Brazil. The search for strategies to increase fruit productivity and quality has been a constant in the sector. Zinc is an element present in protein synthesis and a cofactor in the production of antioxidant enzymes. However, its performance can be influenced by the form of fertilizer applied in the production system, whether through soil or foliar application, making the analysis of chlorophyll content and enzymatic responses to oxidative stress experienced by orange trees relevant. This project aimed to analyze the response of orange trees to the application of zinc in different forms: incorporated into the soil before planting in a single dose, as a topdressing after planting, and via foliar application in installments over one year of plant development. The experiment was conducted in a greenhouse using 80-liter pots for the development of Citrus sinensis (L.) Obseck cv. Pêra orange trees. The treatments were divided into (1) Control, without zinc; (2) Zinc before planting; (3) Zinc as topdressing; (4) Zinc before planting and as topdressing; (5) Foliar zinc; (6) Zinc before planting and foliar. With a total of 5 repetitions of each treatment, the leaves were subjected to analyses of water potential, SPAD index for indirect measurement of chlorophyll content, catalase activity, and lipid peroxidation. The treatments with zinc as topdressing and planting together with foliar application had lower catalase activity, demonstrating that plants subjected to these treatments had lower efficiency of the antioxidant system. The treatment with zinc applied only as topdressing also showed lower water potential in the plants. The same treatment showed a lower amount of chlorophyll, as demonstrated by the SPAD index, and lower lipid peroxidation activity.

Effects of a resistance inducer on increasing yield and mitigating water stress in soybean plants.

Gustavo Ramos Olivera

Climate change has caused prolonged periods of water deficit, which significantly contributes to the reduction of soybean crop productivity. To mitigate the effects of water stress, resistance inducers activate various defense mechanisms in plants. Therefore, the aim of this study was to evaluate the technical feasibility of applying SAFE (Prime Agro) to increase production and improve resistance to water deficit in soybean crops. The experiment was conducted using a randomized block design (RBD) in a 2x2 factorial scheme. The scheme considered two irrigation conditions—irrigated and water deficit (20% of field capacity)—and two SAFE application conditions—with application (1.2 L/ha) and without application, in four replicates. The following were analyzed: Net CO2 assimilation, stomatal conductance, effective quantum yield of PSII, total leaf area, shoot and root dry matter and grain weight. SAFE application had no impact on net CO_2 assimilation under water deficit conditions. However, under irrigation conditions, soybean plants showed an increase in net CO2 assimilation. Only water deficit reduced stomatal conductance. Soybean plants that did not receive SAFE and were under water deficit showed a reduction in the effective quantum yield of PSII. There was no interaction between SAFE application and irrigation treatments regarding leaf area, which was positively influenced by SAFE application in irrigated plants. Neither SAFE nor water deficit affected shoot dry matter. However, an increase in root dry matter was observed under water deficit conditions. Grain weight was lower in plants under water deficit, with no influence from SAFE application. Physiological variables and leaf area were positively impacted by SAFE application, although these effects were not sufficient to alter production parameters.

EFFECTS OF COPPER EXPOSURE ON SEED GERMINATION AND SEEDLING FORMATION OF HANDROANTHUS SERRATIFOLIUS (VAHL) S. GROSE

Iago Lima Magalhaes, Ludyanne da Silva Sousa, Leticia Cristine Nascimento da Silva, Nayra Quetlen Avinte Viera, Eliandra de Freitas Sia, Marcos Diones Ferreira Santana, Túlio Silva Lara, Ruy Bessa Lopes

Copper occurs naturally in soil and its presence is essential for plants. However, industrial and agricultural activities increase its concentration in the environment and make it potentially toxic, which can be harmful to seed germination and/or seedling development. The objective of this study was to evaluate the effect of different copper concentrations on the germination percentage (GP) and percentage of seedlings formed (PSF) of Handroanthus serratifolius (Vahl) S. Grose. The seeds were collected in western Pará, subjected to asepsis, divided into eight treatments with four replicates of 25 seeds each and sown in a Gerbox type box, between Germitex paper, moistened with copper sulfate ($CuSO_4$) solution at concentrations of 0, 200, 400, 600, 800, 1000, 1200 and 1400 mg/L, only when setting up the experiment. For 45 days, the germination percentage and seedling formation were evaluated, and the data were submitted to the Tukey test at 5% significance. When compared to the control, copper concentrations of 200 and 400 mg/L did not influence the GP, while at 600 and 800 mg/L, only 20.5% germinated, with the lowest GP being observed for concentrations of 1000, 1200 and 1400 mg/L (6%, 3% and 13% respectively). In the seedlings formed, the concentration of 200 mg/L decreased the PSF by 54.2% compared to the control, and at concentrations above 600 mg/L, this variable reached 1.4% on average, approximately 95.2% of the seeds did not produce seedlings. Copper concentrations up to 400 mg/L did not significantly affect the germination of H. serratifolius seeds; however, from 600 mg/L onwards, in addition to germination, seedling formation is also significantly impacted, reaching complete inhibition at concentrations from 1000 mg/L onwards and influencing plant development.

EFFECTS OF Eichhornia crassipes (MART.) SOLMS ON PHOTOSYNTHESIS AND ANATOMY OF BELL PEPPER (Capsicum annuum L.)

Andre Santos Amorim, Igor Barros Ziviani, Ivoney Gontijo, Lívia Batista das Neves, Júlia Felipe Miranda, Ana Caroline Pariz Rocha, Andreia Barcelos Passos Lima Gontijo, Antelmo Ralph Falqueto

The use of aquatic macrophytes as fertilizers has become a promising alternative in conventional agriculture fertilization practices. The high concentration of nutrients in macrophytes promotes rapid growth and higher productivity of crops, reducing the use of agrochemicals. In this study, we utilized an organic fertilizer based on the macrophyte Eichhornia crassipes (Mart.) Solms (EC) to evaluate the vegetative development of bell peppers (Capsicum annuum L.) in comparison with conventional fertilization. The plants were grown in pots, and the experiment was conducted in a completely randomized design with 5 treatments and 10 replications: Control (soil with no correction), soil containing 40g, 100g, and 150g EC, and NPK. Compared to the control, treatments with 40g, 100g, and 150g EC increased chlorophyll index (IC) a by 18%, 21%, and 25%, respectively. The treatment with 150g EC increased IC b by 61% and 72% compared to NPK and the control, respectively. The differences between treatments were reinforced by the positive correlation between photosynthetic performance parameters [photosynthetic performance index (PIABS), quantum yield of photochemistry (φP0), and quantum yield for electron transport (φE0)] and IC. 100g EC increased the stem xylem thickness (SXT), while 40g EC increased the thickness adaxial epidermis thickness (AET). Higher IC a contributed to enhanced photosynthetic performance and maintenance of energy conservation capacity in the photosynthetic system. Also, increased SCT provides a steady flow of water and nutrients, resulting in greater cellular turgor. In conclusion, the soil fertilization based on EC can maintain or improve the physiological performance of bell pepper crops. The application of 100g EC showed to be more efficient, resulting in larger conductive vessels (>SXT) which increases the water status of plants.

Effects of salt stress on photosynthetic and growth parameters in jatobá seedlings

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The jatobá (Hymenaea courbaril L.) can be used in the production of resins, varnishes, glue, incense, and homemade medicines. Additionally, it has low nutritional and water requirements in natural environments, making it suitable for use in programs aimed at the restoration of degraded natural areas. The objective of this research was to evaluate the effects of saline stress on the initial growth and photosynthetic parameters in jatobá seedlings. The experimental design was a randomized block design, with a control group (0 mM) and two levels of NaCl (20 and 40 mM), and 16 repetitions. Biometric aspects were evaluated: height, stem diameter, number of leaves, and fresh biomass shoot, root, and total; and physiological variables: Fv/Fm ratio, the photosynthetic index (PI), and greenness intensity (SPAD index). The treatments did not have a negative effect on height and stem diameter on 1st ($F=2.31$; $p=0.118$), 8th ($F=1.18$; $p=0.32$), and 14th ($F=0.97$; $p=0.39$) day. However, the average number of leaves was significantly affected in the 40 mM treatment on 14th day ($F=3.38$; $*p<0.05$), when compared to the control (40 mM = 9.47 leaves vs. 0 mM = 11.71 leaves). No negative effect was observed on the biomass shoot and roots. The quantum yield of PSII did not show a significant change under the 20 mM concentration. A reduction in the variable to maximum chlorophyll fluorescence ratio of PSII was observed only on 13th and 14th day ($F=17.25$, $p<0.001$) at the 40 mM saline concentration ($F=5.97$, $p<0.001$). The saline stress treatments did not significantly influence the PI and greenness intensity parameters until the 6th day ($p>0.05$). The results suggest that jatobá is a species that tolerates saline stress up to concentrations of 40 mM NaCl, and could be an alternative for reforestation in areas degraded by salinity.

ELIMINATING Al3+ THROUGH THE BARK: THE STRATEGY OF Al3+ NON-ACCUMULATING SPECIES FROM THE CERRADO

Marina Pedroso de Freitas Caetano, Luá Taibo Timpone, Gustavo Habermann

Aluminum (Al) is toxic to most plants, inhibiting root growth in sensitive species. However, the Brazilian savanna (Cerrado) thrives on acidic soils (pH < 5.0) with high Al saturation (m% > 70%). These conditions may influence the Cerrado wood vegetation, which is categorized into two groups: Al-accumulating and non-accumulating species. Al-accumulating species accumulates Al in their leaves without showing toxicity symptoms, whereas non-accumulating species do not, and their tolerance mechanisms remain unclear. Previous studies on Miconia albicans (Melastomataceae), an Al-accumulating species, revealed higher Al concentration in the bark compared to the leaves, suggesting that Al elimination through bark may be a strategy used by non-accumulators in the Cerrado. We measured Al concentration in mature leaves and trunk bark of five adult individuals of Annona coriaceae, Xylopia aromatica (Annonaceae), Caryocar brasiliensis (Cariocariaceae), Erytroxylum suberosum (Erytroxylaceae), Pouteria torta (Sapotaceae), and Schefflera vinosa (Araliaceae), all non-Al accumulating trees and shrubs. These specimens were randomly selected from cerrado sensu stricto remnants in Itirapina and Mogi Guaçu, São Paulo, Brazil. Soil samples (20-30 cm depth) were collected close to the plants. Both sites exhibited low cation exchange capacity (CEC), m% above 80%, and low nutrient availability, classifying these soils as dystrophic. Erythroxylum suberosum and A. coriaceae showed a 12-fold and 3.4-fold higher Al concentration in their bark compared to their leaves, respectively, while the other species showed similar concentrations between leaves and bark. The discovery of two non-Al-accumulating woody species with a higher Al concentration in their bark than in their leaves suggests that some species in this group may use this strategy to eliminate excess Al absorbed from the soil. Understanding the mechanisms of tolerance and possible elimination of this metal is crucial for comprehending the ecology of this group within the Cerrado vegetation.

ENCAPSULATED NITRIC OXIDE DONORS ENHANCE GERMINATION OF COMMON BEAN UNDER WATER DEFICIT

Caio Vinícius Menele Severino, Maria Vitória Pereira Dainezi, Fernando Nakahara Antiloto, Neidiquele Maria Silveira

New practices are necessary to improve germination and seedling establishment, especially in rainfed areas where drought may occur shortly after sowing. The combination of nitric oxide (NO) donors with nanomaterials is a promising approach for agriculture. We tested the hypothesis that pre-treatment of common bean seeds with encapsulated NO donors, such as S-nitrosoglutathione (GSNO) or S-nitroso-N-acetylcysteine (SNAC), improves germination and initial seedling growth under water deficit conditions (WD). Bean seeds (cv. IAC2051) were soaked in GSNO or SNAC solutions at 100 µM, while seeds in the control and water deficit treatments were soaked in water. After soaking, the seeds were sown in trays to evaluate germination and initial growth parameters. The control treatment received constant irrigation, while the other treatments (WD, WD + GSNO and WD + SNAC) were watered only twice: on the 1st day and the 8th day. Overall, our data show that pre-treatment of seeds with encapsulated GSNO and SNAC increased germinability by 12.5% and 5%, respectively, compared to water deficit. GSNO and SNAC showed germination speed index 5 and 2 times higher, respectively, than water deficit. However, this positive effect was not observed in the initial growth of bean seedlings under low water availability, as there was no significant difference in shoot and root dry mass and relative water content between treatments under water deficit.

Encapsulated nitric oxide in environmental restoration: limited effect on drought tolerance in Hymenaea courbaril seedlings

Maria Vitória Pereira Dainezi, Brenda Mistral de Oliveira Carvalho, Caio V. Menele Severino, Fernando Nakahara Antiloto

Forest restoration aims to recover degraded areas but faces challenges due to high seedling mortality, exacerbated by frequent droughts caused by climate change. Nitric oxide (NO) has emerged as a signaling molecule that enhances plant growth and tolerance to water deficit. Additionally, nanotechnology provides an innovative approach to optimize the delivery and controlled release of NO. This study aimed to investigate the effect of foliar application of S-nitrosoglutathione (GSNO), an encapsulated NO donor, on promoting vigor in Hymenaea courbaril L. seedlings under water deficit. H. courbaril is a key species in forest restoration programs. Plants were divided into three groups: well-hydrated control, plants subjected to water deficit that received water spraying (WD), and plants under water deficit sprayed with encapsulated GSNO at a concentration of 100 µM (WD + GSNO). Three sprayings were conducted throughout the experiment. Overall, the foliar application of encapsulated GSNO was not effective in mitigating the effects of water deficit on the evaluated parameters, including gas exchange, chlorophyll content, and dry mass of leaves and roots. Future experiments should test different concentrations of NO donors, explore other NO donors, and extend the evaluation period.

EXCESS MANGANESE DOES NOT AFFECT EARLY GROWTH OF Stryphnodendron adstringens BUT REDUCES NODULATION IN Mimosa bimucronata

Julia Thomaz, Giuliano Stoppa Baviera, Edgar Oliveira Vicente, Sarah Caroline Ribeiro de Souza

Manganese (Mn) is an essential micronutrient for plant metabolism, participating in the water oxidation catalysis in Photosystem II, acting as an enzymatic cofactor (e.g., Mn-superoxide dismutase), and aiding in the synthesis of chlorophyll and secondary metabolites. However, at elevated soil concentrations, it induces oxidative stress, competes with important cations like Ca^{2+} and Fe^{2+}, leading to chlorosis and leaf necrosis.

The bioavailability of Mn occurs in its reduced form, Mn^{2+}, and increases when soil pH falls below 5.5. Some plants adopt strategies such as accumulation, isolation, and elimination of excess Mn, as well as forming symbiotic associations with arbuscular mycorrhizal fungi to decrease the mineral's availability in the roots.

With the increasing acidification of soils and consequently the rise in Mn bioavailability, this study aimed to evaluate the development of tree species such as Stryphnodendron adstringens (barbatimão), native to the fields and open formations of the Cerrado, and Mimosa bimucronata (maricá), from coastal plains of the Atlantic Forest, to understand the tolerance of these species in acidic soils with available Mn^{2+} and the effects of mycorrhizal associations under these conditions. We tested Mn concentrations of 0, 30, 60, and 120 mg/kg.

Overall, the growth parameters of S. adstringens were not significantly affected by the Mn concentrations applied. In contrast, M. bimucronata exhibited reduced nodulation at Mn doses of 60 and 120 mg/kg, although a Mn concentration of 30 mg/kg promoted its growth. Mycorrhization levels were high in S. adstringens across all Mn doses, while excess Mn appeared to specifically enhance mycorrhization in M. bimucronata. These findings suggest that excess Mn does not impair the growth of S. adstringens, identifying it as the most Mn-tolerant species among those studied. Furthermore, the observed mycorrhizal associations indicate a beneficial effect in mitigating Mn toxicity in these plants.

EXOGENOUS CYSTEINE APPLICATION CHANGES SOLUBLE SOLIDS CONTENT AND DECREASES MASS LOSS IN GREEN BELL PEPPERS

Ellen Rayssa Oliveira, Ana Paula Preczenhak, Marcos Fabian Sanabria Franco, Ariel Sharon de Araújo Nogueira Marcelino, Liliane Marques de Sousa, Ricardo Alfredo Kluge

The application of amino acids can reduce quality losses during the postharvest of minimally processed products. The objective was to examine the effects of exogenous cysteine application on the postharvest quality parameters of minimally processed green bell peppers. For minimal processing, the bell peppers were cut into 2 cm transverse slices and sanitized. Then, the slices were immersed in solutions with increasing cysteine concentrations (0, 4, 8, and 16 mM) for 5 minutes. The bell peppers were stored at 5°C and 95% relative humidity. Analyses were conducted at 0, 6, 24, 48, 72, and 120 hours after cutting. Soluble solids content, color, and mass loss were analyzed. The experimental design was completely randomized in a 4 × 6 factorial analysis. The results were analyzed by ANOVA, and means were compared using Tukey's test with a 5% probability. It was observed that the application of 16 mM cysteine significantly reduced the mass loss at all evaluation times. On the other hand, the control treatment and the application of 4 mM cysteine resulted in higher mass losses. Cysteine helps maintain the integrity of plant cell membranes by reducing energy expenditure during stress conditions. Therefore, when provided at an appropriate dose (4 mM), the fruits preserve their height soluble solids content compared to the control treatment. However, when the dose is higher, combined with the physical damage caused by minimal processing, greater oxidative stress is generated, resulting in the consumption of soluble solids as substrates for respiration. The results showed that postharvest treatment with exogenous cysteine did not affect color parameters, including chroma and hue angle, in minimally processed green bell pepper. The application of cysteine effectively reduced mass loss in minimally processed green bell peppers without affecting color parameters. Furthermore, the application of 4 mM cysteine maintains a high soluble solids content.

EXOGENOUS HISTAMINE ON MAIZE SEEDS [ZEA MAYS L.] UNDER HIGH TEMPERATURES

Adriana, Gabriel Cesar Monteiro, Bruno Felipe Picoli de Oliveira, Helida Regina Sala, Daniele Silva Sukert, Ana Claudia Pacheco, Bruna Oliveira Reinheimer Spolaor

Maize [Zea mays L.] is a cereal cultivated worldwide that has great economic importance. Due to the substantial increase in global temperature, this crop is directly affected in its productive potential. However, an application of a biomolecule such as Histamine (H) is able to act to mitigate the effects of stress. Histamine acts on germination, reproduction, growth, development and also on biochemistry metabolism, protecting against the effects of heat stress. This study aimed to evaluate the effects of exogenous Histamine in maize seeds under to high temperatures. The experiment was carried out in a completely randomized design with a double factorial scheme, 2 conditions (constant temperature and high temperature) x 7 application (0, 100, 1000, 2000, 5000, 10000 e 50000 μM). The results were subjected to an analysis of variance (ANOVA, $p<0.05$) and the means were compared using the Scott-Knott test. Activity of antioxidant enzymes, superoxide dismutase, catalase and peroxidase (SOD, CAT and POD); oxidative radicals, hydrogen peroxide (H_2O_2), malondialdehyde (MDA), superoxide radical (O_2^-), and growth parameters (root and shoot lengths, fresh mass, dry mass) were evaluated. Our results demonstrate that exogenous Histamine incresead CAT e POD only at H2000 and decresead MDA (at 1000, 2000, 5000, and 10000) and H_2O_2 (at 100, 1000, 2000, and 10000) under heat stress. Application of histamine resulted in a decrease in the biomass of shoots and roots only at dose 5000. Histamine is efficient in promoting physiological, biochemical and morphological mechanisms in the face of disturbing abiotic. Thus, promoting mechanisms of plant tolerance to abiotic stresses, such as high temperatures.

Exogenous salicylic acid on antioxidant defense and metabolic regulation in cotton cultivars under drought

Renato Oliveira de Sousa, Jeane Ferreira de Jesus, Manderson Silva Nunes, Isabella Gomes Sousa, Stelamaris de Oliveira Paula Marinho, Karolayne Ribeiro Caetano, Rafael de Souza Miranda

Environmental stresses have posed significant challenges to agricultural production, altering plant growth and productivity by disrupting metabolic processes and redox homeostasis. This study aimed to investigate the role of exogenous salicylic acid (SA) in modulating the metabolic profile and activating antioxidant defense responses to water deficit in drought-contrasting cotton cultivars. The trials were conducted in a greenhouse using a randomized block design with a 2 × 2 × 2 factorial scheme, comprising two SA treatments (negative control with distilled water and SA at 1500 μM), two cultivars (FM 970 - tolerant and FM 911 - sensitive), and two water regimes (well-watered control [NC] and drought). Drought treatments were imposed for 20 days. Drought significantly decreased the dry mass of cotton plants, regardless of SA treatment or cultivar. Lipid peroxidation was significantly increased by drought compared to the NC, a response observed only in FM 911 plants. Under well-watered conditions, ascorbate peroxidase (APX) and superoxide dismutase (SOD) activity were decreased by SA treatment in both cultivars. Drought-stressed plants showed increased guaiacol peroxidase (GPX) activity, a response intensified by SA treatment in FM 911 plants. Metabolic analysis revealed distinct profiles among the cultivars, forming different groups under drought conditions. FM 970 plants showed a strong correlation with cellobiose and malic acid under NC conditions, and with tryptophan under drought. In contrast, FM 911 plants showed positive correlations with sugars (maltose, glucose, fructose) under drought, but negative correlations under NC conditions. Under drought, SA resulted in clustering among the cultivars, with FM 970 correlating positively with sorbose, palatinose, and succinic acid, while FM 911 correlated with ribose, malonic acid, and trehalose, which may play roles in osmotic adjustment and cell integrity. In conclusion, SA triggers protective responses in the drought-sensitive FM 911 cultivar, including pathways related to the antioxidant system and osmotic adjustment.

EXPLORING SPATIAL DIVERSITY IN SALT PRIMING RESPONSES ACROSS DIFFERENT RICE LEAVES

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Plants are composed of repeated structural and functional units, called modules, which develop during ontogenetic growth. These modules have their own life cycles and can respond independently to environmental conditions on time scales shorter than those of the entire plant. Environmental responses occur at the module level, influencing the phenotypic plasticity of plants. However, the recognition of the modular nature of plasticity and its relationship with time and space remains limited. This study aims to determine the memory effect induced by salt priming (halopriming), focusing on the spatial diversity of responses in leaves of different ages (younger, intermediate and older leaves) and the apical and basal halves of each leaf, as well as different analytical scales. Seeds of the rice cultivar Nipponbare (Oryza sativa spp. japonica) were subjected to priming with 0 and 60 mM NaCl for 12 hours. At the V5 stage (five fully expanded leaves), a group of plants was exposed to salt stress with 150 mM NaCl, resulting in four treatments: P0V0 (no priming and no salt at V5); P0V1 (no priming, 150 mM NaCl at V5); P1V0 (priming with 60 mM NaCl, no salt at V5); P1V1 (priming with 60 mM NaCl, 150 mM NaCl at V5). After seven days, leaf porometry was performed, along with analyses of relative water content, electrolyte leakage, and biochemical parameters (amino acids, sucrose, total soluble sugars, lipid peroxidation, and hydrogen peroxide). PCA (Principal Component Analysis) distinguished the P1V1 and P0V1 treatments from the control, while P1V0 showed partial overlap. This suggests that priming did not induce a clear stress memory in this cultivar. Regarding spatial variability, the apical portions of the leaves segregated from the basal portions, highlighting the heterogeneity of responses and the need for an integrated approach.

EXPLORING THE GROWTH-DEFENSE TRADE-OFF IN TOMATO PLANTS SUBJECTED TO VARYING LEVELS OF MECHANICAL DAMAGE

Beatriz Correa Araújo, Marcelo Lattarulo Campos

Plants must balance growth and defense do survive environmental stressors, a challenge that is particularly relevant in economically important crops like tomatoes (Solanum lycopersicum), which are vulnerable to pests. This study investigated the impact of mechanical wounding on growth and defense responses in the Micro-Tom (MT) tomato cultivar. Using 25-day-old plants, a wounding protocol was applied with groups subjected to 1x, 3x, 5x or 10x lesions, alongside a control group. Growth parameters such as shoot length and time to first flowering were measured, and defense responses were assessed through trichome density analysis and planned herbivory tests using Spodoptera frugiperda larvae. The results showed a significant, stepwise reduction in plant growth with increasing lesion frequency, where even a single lesion was sufficient to suppress growth. Interestingly, trichome density, a key indicator of defense activation, displayed a non-linear response. Glandular trichomes, which are crucial for deterring herbivores, increased notably in plants subjected to 3x and 10x wounds. This suggests a complex regulatory mechanism driving trichome formation, likely as a defense strategy. Although the herbivory test with Spodoptera frugiperda is pending, it is expected to further elucidade the relationship between mechanical stress and plant resistance to insect pests. The study highlights the intricate balance between groth and defense in tomatoes, demonstrating that even minimal damage can trigger defensive responses, potentially at the expense of growth and reproductive success. These findings contribute to a deeper understanding of the growth-defense dilemma in plants and have important implications for agriculture, particularly in developing strategies to enhance crop resilience while managing the trade-offs between growth and defense.

EXPLORING THE IMPACTS OF ARSENIC STRESS ON CELL CYCLE REGULATION IN *Arabidopsis thaliana*

Bruno Brayan Zanotti Pimentel, José Pires de Araújo Neto, Daniel Gomes Coelho, Joao Antonio Siqueira, Adriano Nunes-Nesi, Wagner Luiz Araújo

Phytoremediation is a technique used for the decontaminate environments polluted by contaminants such as arsenic (As). However, identifying plants that can thrive under these harsh conditions remains a significant challenge. Here, we aimed to understand the effects of As on the growth of Arabidopsis thaliana. We cultivated mutant lines of CDK (cdkb1), SOG1 (sog1-101), and E2F (e2fb-1), all within the same wild-type background (Col-0), under optimal conditions (without As [0]) and under As ([200 µM]).

The fresh shoot mass was similar among the genotypes in absence of As (As[0]) and was similarly reduced by As. Fresh root mass varied slightly among the genotypes; but under As exposure, root biomass was reduced across all genotypes. In the absence of As, few variations were observed, although sog1 exhibited a higher total biomass. In the presence of As[200 µM], all genotypes exhibited drastic reductions in total biomass. The proline concentration was similar among genotypes in the As[0] condition, but it increased in the presence of As, with sog1 showing the most significant rise. In As[0] condition, Col-0, cdkb1, and e2fb1 did not exhibit superoxide staining in either aerial or root parts, unlike sog1. Under As stress, all genotypes displayed superoxide activity in root tips and leaves, with sog1 being the least affected in the roots.

Peroxidase activity was minimal in the aerial parts under both As conditions. In contrast, in the roots, only Col-0 did not show staining in As[0] condition. Under As stress, all genotypes displayed staying by peroxidase activity. For chlorophyll a and b, differences were noted when these pigments were analysed separately, but the chlorophyll a/b ratio did not differ significantly. Carotenoids levels were unaffected under As[0], but were reduced under As stress, as noted in cdkb1 and e2fb1.

EXPLORING THE INTERPLAY BETWEEN THIOREDOXIN REDUCTASES AND GLUTATHIONE PATHWAYS IN ALUMINUM STRESS RESPONSE

Marcelle Ferreira Silva, Thiago Batalha Wakin de Araújo, Paula da Fonseca Pereira, Elias Feitosa Araújo, Markus Schwarzländer, Adriano Nunes Nesi, Wagner L. Araújo

Toxicity triggered by aluminum (Al), mainly Al3+, is a critical factor that limits agricultural production in acidic soils (pH < 5.0). Its main symptom is root growth inhibition. Being a highly reactive element, Al can alter the energetic state, disturbing cellular redox homeostasis, altering membrane potential, therefore affecting cellular metabolism. To prevent or mitigate the effects of these toxicity plants display two mechanisms. These include tolerance mechanisms – which are based on the internal sequestration and detoxification of Al, and exclusion mechanisms – which prevent the entry of toxic Al species into the root tip. Both strategies involve the presence of organic acids (OA), that come from mitochondrial processes to complex Al. In this context, mitochondrial metabolism is crucial to support cellular processes mitigating Al stress; therefore, maintaining mitochondrial redox homeostasis is essential in responses to Al stress. To understand how and in which extent the mitochondrial redox system is related to Al mitigation we used Arabidopsis thaliana mutants for NADP-dependent TRX reductase A and B double mutant (ntra/b) and the GLUTATHIONE REDUCTASE 1 (gr1-1). Our data demonstrate that the ntra/b mutant displayed a “tolerant” behavior, being less affected by the Al stress in root growth, which could be associated with a better function of glutathione (GSH) redox system, overlapping the lack of NTR in these genotypes. Thus, in agreement, the gr1-1 displayed a more sensitive phenotype. Collectively, our data led us to propose that the redox status of the glutathione redox system is essential to deal with toxicity caused by aluminum and in the lack of the NTR system, the reductant power of NADPH can be exclusively used by GR for the GSH redox system, leading to a better Al mitigation.

Exploring the role of the 2-oxoglutarate dehydrogenase E1 subunit in Arabidopsis metabolism during osmotic stress

Lauanda Cristiny Rufino, Valéria Freitas Lima, Jonas Rafael Vargas, Márcia Jussara da Silva Gomes, Adriano Nunes-Nesi

The tricarboxylic acid (TCA) cycle enzyme 2-oxoglutarate dehydrogenase (2-OGDH) converts 2-oxoglutarate (2-OG) into succinyl-CoA, releasing CO2 and generating NADH. 2-OGDH has an essential role in plant metabolism, being both a limiting step in mitochondrial respiration as well as a key player in carbon–nitrogen interactions. Here, we investigated the role of the E1 subunit isoforms of 2-OGDH in Arabidopsis thaliana under polyethylene glycol (PEG)-induced osmotic stress and subsequent recovery. Mutant lines e1-ogdh1.2, e1-ogdh2.2, and e1-ogdh1.2::2.2 were grown in a hydroponic system and subjected to 48 hours of osmotic stress followed by 96 hours of recovery. Interestingly, the lack of the E1 subunit affected rosette leaf area, intensifying osmotic stress symptoms in the mutant plants, especially in roots. Metabolite profiling in shoots was relatively unaffected among the genotypes during stress. However, in roots, significant metabolic changes were observed, particularly in TCA cycle intermediates during both osmotic stress and recovery. After 48 hours of stress, GABA levels were elevated in the double mutant, while succinate levels were reduced in the e1-ogdh1.2 and double mutants. During recovery, glutamate levels remained elevated, especially in the double mutant and e1-ogdh2.2. Notably, the double mutant exhibited the highest GABA levels after 24 hours of recovery, while WT plants had the lowest. These results suggest that alternative pathways, such as the GABA shunt, might compensate when the TCA cycle is compromised. Additionally, the double mutant roots showed reduced proline degradation during the first 24 hours of recovery, suggesting that the absence of the E1 subunit hinders proline degradation early in the recovery phase. These findings suggest that the E1 subunits of 2-OGDH play a critical role in the stress response, particularly during early recovery, and their absence renders plants more sensitive to stress, underscoring the importance of the TCA cycle during challenging conditions.

FIELD EXPERIMENTS AND FLUX BALANCE ANALYSIS REVEAL THE EFFECTS OF DROUGHT ON SOYBEAN METABOLISM

João Vitor Vieira Barros, Ana Luísa Kruschewsky da Paz, Felipe Mateus Souza Serrão, Christina Cleo Vinson Williams, Maria Lucrécia Gerosa Ramos, Walter Quadros Ribeiro Júnior, Thomas Christopher Rhys Williams

Soybean (Glycine max (L.) Merr) is especially sensitive to drought stress during reproductive development, which results in shortening of the growth cycle, reduced numbers of pods and seeds and accelerated senescence. These alterations are associated with metabolic changes throughout the plant that are either directly caused by stress or represent part of the strategy used to survive. Breeding programs directed at increasing tolerance to drought are therefore necessary and may involve engineering of soybean metabolism. In order to avoid slow and unreliable trial and error approaches greater understanding of plant metabolic phenotypes obtained through both field and in silico experimentation is required. Here, we therefore evaluated the effects of different levels of irrigation in the field using a modified line source sprinkler system. Plants were harvested at three time points during reproductive growth and different organs subject to biochemical analysis. Data on the composition and growth of leaves and stems under different irrigation regimes were then used to constrain a genome scale model of soybean. In the stems, concentrations of starch, glucose and raffinose increased with decreased irrigation, whilst in leaves concentrations of starch and raffinose increased. We did not observe any changes in fatty acid abundance in either of these organs, whilst nitrogen concentrations decreased. Increased sugar concentrations suggest an osmotic adjustment response, whilst reductions in nitrogen point to more rapid senescence and potentially decreased nitrogenase activity. Flux balance analysis indicated that drought led to metabolic alterations in both organs. However, the number of active reactions and relative distribution of flux through different pathways changed little under different levels of stress pointing to a degree of metabolic robustness.

First evidence of plant-plant communication through electrome analysis.

Douglas Antônio Posso, Thiago Francisco de Carvalho Oliveira, Helena Chaves Tasca, Gabriela Niemeyer Reissig, Ana Carolina Costa Araújo, Gustavo Maia Souza

In plant communication, volatile organic compounds (VOCs) are released by an emitter plant, carrying a message that induces a response in the receiver plant. The perception of VOCs is supposed to occur at the membrane level through specific sensors that likely trigger electrical signaling. The electrome represents the electrical dimension of plants, coupling electrical signals with biological information. Thus, this study aimed to detect the effects of plant communication through electrome changes in a receiver plant. Soybean plants at stage V4 were placed in paired acrylic boxes connected by a controlled airflow system (emitter → receiver) and subjected to three treatments: (i) soybean plants alone, without VOC influence from emitter plants; (ii) soybean plants exposed to VOCs from wounded soybean plants; and (iii) soybean plants exposed to VOCs from wounded tomato plants. The electrome of receiver plants was gathered approximately one hour before and two hours after wounding, using a custom sensor developed by LACEV at two sampling points: channel 1 (C1) on the stem near the soil, and channel 2 (C2) near the leaves. The results suggest that receiver plants detected VOC stimuli from emitter plants, as indicated by changes in their Approximate Entropy (ApEn), reflecting variations in the dynamic behavior of the receiver plants' electrophysiology based on the treatment. Specifically, post-intervention ApEn showed less dispersion in electrophysiological complexity, 0.04, after perceiving VOC signals from wounded soybean plants, compared to signals from wounded tomato plants (0.06) or no VOC exposure (0.1). This suggests a probable recognition of same-species VOCs as a warning signal. These results open a new trend in communication experiments and further hypotheses as electrophysiological results can be real-time accessed and analyzed throughout a wide range of experiments.

Foliar boron supplementation enhances soybean resilience to water deficit through anatomical and physiological changes

Rafaela Andrade von Bentzeen, Orivaldo Benedito da Silva, Elbert Hernando Pinzón- Sandoval, Evaristo Mauro de Castro, Paulo Eduardo Ribeiro Marchiori

Drought poses a significant challenge to crop productivity. This study investigated the potential of boron, a micronutrient known to improve plant tolerance to various abiotic stresses, to alleviate the effects of water deficit on soybeans (Glycine max L.) plants. Our objective was to evaluate the effects of foliar boron (B) supplementation on the anatomical and physiological characteristics of soybean plants in water deficit. Conducted in a greenhouse with a 2 x 2 factorial design (B doses and water conditions) and five replications, the experiment used doses of 0 and 300 mg of L-1 B, applied via foliar spray, under well-irrigated conditions (80% FC) and water deficit (60% FC). Treatments were applied 40 days after planting (DAP). Assessments were carried out at maximum stress and following rehydration. Supplementation with B improved the net CO2 assimilation rate by 39.7% during rehydration in water-deficit plants. At maximum stress, application of B increased the thickness of the adaxial and abaxial epidermis by 13.8 and 17.4 µm, respectively, compared to controls. Collenchyma area increased by 13.48%, while the diameter of the metaxylem decreased by 39.38%, and the number of xylem vessels increased by 52.87% under water deficit with application of B. During rehydration, the area of the sclerenchyma increased by 46.95%, metaxylem was reduced by 25.66%, and the number of xylem vessels increased by 46.37% with application of B compared to controls. In conclusion, 300 mg of B L-1 foliar application induced anatomical changes that enhanced gas exchange in soybean plants under water shortage, suggesting the potential benefit of boron application to mitigate drought stress.

Foliar boron supplementation improves soybean response to water deficit

Paulo Henrique Frois Correa Barros, Cecilia Baldoino Ferreira, Carlos Henrique Milagres Ribeiro, Adriano Teodoro Bruzi, Paulo Eduardo Ribeiro Marchiori

In Brazil, the average soybean (Glycine max (L) Merr) production is approximately 3600 kg/ha, although its potential can exceed 6000 kg/ha. One of the primary limitations to achieving this potential is water scarcity in agricultural production systems. Therefore, optimizing soybean crop management to mitigate periods of water deficit is essential for improving yields. This study aimed to evaluate the effects of foliar application of boron in soybeans, with the objective of reducing the impacts of water stresss. The experiment was conducted in a greenhouse at the Plant Physiology Sector, Department of Biology (DBI), Federal University of Lavras (UFLA) using a randomized block design with three replications. Two plants per pot, sown with the cultivar UFLA6301RR, were subjected to water deficit from the phenological stages of V3 to R4. Two sources of boron, boric acid and boron-MEA, were applied at the Vn and R1 stages, and compared to a control group. Proline and hydrogen peroxide were quantified in Vn and R1, alongside the production yield measurements. Analysis of variance was performed, and significant differences were further examined using Tukey test at 5% significance level. The results showed that proline at Vn and R1, hydrogen peroxide at Vn and yield were significantly affected, while hydrogen peroxide at R1 was not. Foliar boron application improved the cultivar's performance under water deficit, with boric acid increasing proline production and reducing water stress overall. The highest yields were observed in treatments with boric acid and boron-MEA at R1. Thus, foliar boron application enhances soybean resilience to water deficit, improving both yield and biochemical characteristics responses.

FOLIAR FERTILIZER IMPROVES THE GROWTH AND PRODUCTIVITY OF SOYBEANS EXPOSED TO HIGH IRRADIANCE

João Subtil da Silva Neto, Emily Carolina Duarte Santos, Luciana Minervina de Freitas Moura, Alan Carlos da Costa, Caroline Müller, Laine Garcia Ferreira, Ketlyn Santos Sousa, Adinan Alves da Silva, Igor Eli da Silva

High irradiance can affect plant productivity. This study investigated the effect of nutrient formulations on the growth and productivity of soybean plants exposed to different irradiance levels. The experiment was conducted under controlled conditions in a growth chamber. Soybean plants at developmental stage R1 were treated with a foliar fertilizer consisting of magnesium and manganese sulfate, copper, iron, ammonium polyphosphate, and an adjuvant (Agriultra sill®), as well as with the same solution at a 1.5-fold higher concentration. In parallel, a control treatment was carried out with water only. The plants were then exposed to three irradiance levels (300, 1200, and 2800 μmol m–2 s–1) over a period of 13 days, when plant height, number of leaves, stem diameter, and distances between nodes were evaluated. At the end of the plant cycle, the number of pods, the number of grains, and the weight of the grains were evaluated. Plants under 300 μmol m–2 s–1 showed a greater height and greater distances between nodes due to etiolation caused by the search for light at low irradiance. The number of leaves and the diameter of the stem were not affected by irradiance or the application of foliar fertilizer. At 2800 μmol m–2 s–1, the most concentrated formulation increased the height and distance between nodes and also increased the number and weight of grains compared to the control. In contrast, the less concentrated formulation reduced the number of pods and grains at high irradiance and performed better than the control at 300 μmol m–2 s–1. Nutrients such as Mg, Cu, and Mn were important for stabilizing the photosynthetic apparatus and favored growth and productivity. In general, the more concentrated fertilizer mitigated the effects of high irradiance and improved the productivity of the soybean plants.

FOLIAR GLYCINE BETAINE APPLICATION MITIGATES HEAT STRESS IN COTTON PLANTS

José Eduardo Pires Cardoso de Oliveira, Pedro Henrique Mondin Codognoto, Nandhara Angélica Carvalho Mendes, André Rodrigues dos Reis

Glycine betaine (GB) is a quaternary ammonium compound that plays a significant role in enhancing plant tolerance to various environmental stresses, particularly heat stress. As global temperatures rise due to climate change, understanding and employing strategies to mitigate heat stress in crops is crucial for maintaining agricultural productivity. Glycine betaine acts as an osmoprotectant, enhancing plants to manage osmotic balance, cellular integrity, and overall physiological processes under stress conditions. Heat stress can lead to the overproduction of reactive oxygen species, which can cause oxidative damage to lipids, proteins, and nucleic acids. Heat stress can cause critical physiological changes in plants, including increased respiration rates, protein denaturation, and disruption of cellular membranes, leading to impaired metabolic activities and reduced growth. GB enhances the antioxidant capacity of plants, promoting the activity of antioxidant enzymes such as superoxide dismutase, ascorbate peroxidase and catalase. By reducing oxidative stress, GB peroxidation of cellular membrane protecting plant cells from damage. In this study, cotton plants variety TMG 51 was sprayed with four different doses of GB using Gran7 Glyfort (0, 0.2, 0.3, and 0.5 L ha-1) as commercial product under controlled temperature at 38ºC for 72h. Results indicated that all treatments significantly differed from control, with reductions in H_2O_2 concentration by 63%, increases in APX activity by 60%, and protein concentration by 118% in response to 0.5 L ha-1. Foliar application of GB effectively enhanced enzymatic activity controlling lipid peroxidation in leaf cell tissues, acting as ROS scavenging in plant tissues and a notable increase in total proteins. These findings suggest that foliar GB application can be a good strategy to mitigate heat stress in cotton plants under field conditions.

FOLIAR MAGNESIUM FERTILIZATION MITIGATES HIGH TEMPERATURE IN COFFEA ARABICA

Nandhara Angélica Carvalho Mendes, Pedro Henrique Mondin Codognoto, José Eduardo Pires Cardoso de Oliveira, André Rodrigues dos Reis

Coffee is the second most consumed beverage worldwide, second only to water, and its demand is steadily increasing in the market. However, to meet this demand, cultivation techniques must overcome the adversities that affect plant development, with coffee particularly affected by Magnesium (Mg) deficiency. Mg deficiency leads to the generation of ROS such as superoxide radical (O2.-), hydrogen peroxide (H2O2), hydroxyl radical (OH.), and singlet oxygen (1O2) under higher temperatures.

The objective of this study was to evaluate of Mg doses on the antioxidant metabolism of coffee Arabica seedlings (cv. Mundo Novo) under higher temperatures.

The experiment was conducted on laboratory of biology of Faculty of science and Engineering, located in the city of Tupã-SP, Brazil. The experimental design was completely randomized, with treatments arranged in a 2 x 2 factorial scheme, consisting of two magnesium doses (15 and 450 mM of MgO) and with two temperature (25 and 35ºC). The following parameters were evaluated: MDA (Heath and Packer, 1968), H2O2 (Alexieva et al., 2001), SOD (Giannopolitis and Ries, 1977), APX (Moldes et al., 2008), CAT (Azevedo et al., 1998) and total protein (Bradfort, 1976).

The application of 450 mM of MgO at 25ºC and 35ºC resulted in reductions of 27% and 64% (MDA), 22% and 36%, respectively. For SOD, CAT and total protein, there was an increase of activity by 39-57%, 13-14% and 39 e 53%, respectively, under 450 mM MgO application and both temperatures.

Foliar fertilization with Mg plays a role in mitigating stress caused by high temperatures by alleviating the formation of reactive oxygen species (MDA and H2O2) and increasing the activity of antioxidant metabolism enzymes.

Foliar physiological and anatomical characteristics of sweet potato genotypes under water deficit conditions

Evaristo Mauro de Castro, Orivaldo Benedito da Silva, Yohanna Vassura, Bruno Henrique Feitosa, Paulo Eduardo Ribeiro Marchiori

Sweet potato [Ipomoea batatas (L.) Lam.] is a tuberous root vegetable rich in bioactive compounds and benefits human health. Physiological and anatomical characteristics contribute to the selection of drought-tolerant materials. Therefore, this study aimed to evaluate the morphophysiological characteristics of four sweet potato genotypes under different water conditions. The study was carried out in a 4×4 factorial scheme (genotypes×water conditions) in a completely randomized design, with four replicates and one plant per pot, totaling 32 plants. The genotypes used were 1440, 1192, 1058, and 1153, with field capacity water conditions and a 30% field capacity water deficit. Evaluation of the rate of assimilation of CO2 (An-µmol CO2 m-2 s-1) and anatomical analyses occurred 60 days after planting (40 days of moderate water deficit). Anatomical sections were obtained following plant anatomy protocols. The rate of assimilation of CO2 of the sweet potato genotypes was affected by water deficit, with a reduction of 43.47, 44.35, 51.24, and 67.46% for genotypes 1440, 1192, 1058, and 1153, respectively, in relation to the control. Water deficit promoted an increase in leaf thickness of genotypes 1440 and 1058 (196.63 and 248.40 µm) in relation to the control (227.38 and 270.55 µm). There was a reduction in the thickness of the palisade parenchyma in the photosynthesizing tissues of 1192 (72.87 µm) compared to the control (87.37 µm). Thickness (108.47, 135.13, and 97.30 µm) and field capacity (71.72, 112.84, and 79.51 µm) increased in the spongy parenchyma of genotypes 1440, 1058, and 1153. The water deficit promoted anatomical modifications and alterations in the functioning of the genotypes. These results may contribute to the genetic improvement of sweet potatoes.

Foliar spraying of salicylic acid and methionine to promote tolerance to thermal stress

Milena Teles de Oliveira, Josyelem Tiburtino Leite Chaves, Liliana Andrea Ramírez Franco, Ana Cláudia Alves Teixeira, Elisa Monteze Bicalho

Thermal stress caused by temperature elevation can interfere in photosynthesis, metabolism, cell and structure of plants. Greater levels of tolerance to abiotic stress can be provided by the application of several molecules, including salicylic acid and methionine, signaling molecules linked to antioxidant metabolism and defense mechanisms. Therefore, this work aimed to investigate the effects of foliar spraying of salicylic acid and methionine on young plants leaves of a native species of the Atlantic Forest, Rapanea ferruginea (Ruiz & Pav.) Mez subjected to thermal stress. The young plants received spraying with deionized water (controlled spraying), salicylic acid and methionine at concentrations of 1.0mM/L and 1g/L, respectively. After spraying, the plants were subjected to temperatures of 40 and 25ºC, corresponding to stress and thermal control, respectively, in a factorial arrangement. After 48 hours, photosynthetic parameters were evaluated, quantification of superoxide dismutase activity (SOD) and hydrogen peroxide (H2O2), in addition to the histochemical location of H2O2 and superoxide anion. The results indicate that all treatments subjected to thermal stress suffered a reduction in photosynthesis and the spraying of salicylic acid and methionine enhanced the decreasing in photosynthesis rate in the stressful condition, with the treatment with methionine being the one with the lowest photosynthetic rate. The SOD activity in plants under stress was also reduced in treatments that received salicylic acid and methionine spraying. Levels of H2O2 were high in all spray treatments under stress, with the highest rates being influenced by methionine spraying. The histochemical localization results showed a lower presence of superoxide anion in stressed treatments, different from H2O2, which was more evident in plants under stress. Therefore, the results indicate that in this experiment, foliar spraying of salicylic acid and methionine on young leaves of Rapanea ferruginea did not promote tolerance to thermal stress.

FOOD SUSTAINABILITY IN DROUGHT STRESS CONDITIONS: PHASEOLUS A PLANT MODEL

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Food sustainability is one of the fundamental axes in the United Nations agenda. To maintain food sustainability in the present context of climate change is a huge challenge, since human population is constantly increasing and predicted to reach 10 billion people for the year 2050 and drought events are becoming more common in many agricultural areas in the world. Particularly, Chile has experienced a mega drought period and occupies place 15 in the list of most affected countries by climate change.

Phaseolus vulgaris is the main legume for human consumption worldwide. As a low environmental impact source of protein (16-33% of protein content) and beneficial health compounds, its consumption is being promoted worldwide. However, it is a crop with high sensitivity to drought. Therefore, it is a big challenge to maintain yield reducing the required water input, increasing water use efficiency.

Our team seeks to highlight the value of Chilean common bean germplasm and improve drought tolerance via two main strategies: reducing water loss by transpiration by modifying stomatal pore index (SPI) and improving plant performance by root inoculation with beneficial bacteria consortia. For SPI modification, MYB60 transcription factor has been identified and characterized for common bean and an in vitro regeneration protocol has been stablished for its genetic edition. Also a polyploidy induction protocol has been stablished and plants with modified ploidy have been generated. In the case of bacteria inoculation, a consortium of 10 bacteria strains from Antarctic soils and hydrothermal vents have been characterized for future inoculation and evaluation in greenhouse assays. Parallelly, nutritional characterization and proximate analysis of Chilean common bean landraces has been done to compare with modified seeds. Current results will be presented.

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Gamma-Aminobutyric Acid (GABA) as a Potential Mitigator of Thermal and Light Stress in Solanum lycopersicum

Júlia de Carvalho Costa, Kellen Kauanne Pimenta de Oliveira, Raphael Ricon de Oliveira, Lillian Magalhães Azevedo, Antonio Chalfun Junior

Greenhouse gas emissions have increased considerably in recent decades, causing a rise in the average global temperature and severe impacts on plant growth and development. Understanding how plants respond and adapt to thermal variations is fundamental for cultivar improvement and ensuring food production. This study aimed to investigate the role of gamma-aminobutyric acid (GABA) as a potential mitigator of thermal and light stress effects in agronomically important plants. Tomato seeds (Solanum lycopersicum cv. Micro-Tom) were grown under controlled conditions at a temperature of 25°C with a photoperiod of 16/8h (light/dark). Plants with fully developed leaves were exposed to two different treatments, one with the exogenous application of GABA and the other with the application of water (control). After application, the plants were subjected to high thermal stress of 35°C with a 22-hour light photoperiod, reducing the period of darkness to evaluate their responses to the "Speed Breeding" method. Phenotypic evaluations were conducted weekly after leaf expansion, aiming to assess plant development from the vegetative to the reproductive stage. Additionally, at the end of the experiment, the plants were weighed to evaluate their fresh mass, considering the following parameters: total weight, fresh mass, and the size of the shoot and roots. According to the results of this study, gamma-aminobutyric acid (GABA) promoted an increase in root mass for adaptation to thermal stress environments. On the other hand, there was a decrease in the size of the shoot. There was an earlier maturation in GABA-treated plants, but this did not reflect in the final fruit quantity, which was higher in control plants. However, the control group plants showed significant deformities and fruit darkening, while the GABA-treated plants maintained their integrity. This study suggests that GABA plays a role in reducing the effects of thermal and light stress in Solanum lycopersicum.

GAS EXCHANGE AND CHLOROPHYLL FLUORESCENCE IN PHYSIOLOGICAL MONITORING OF Myroxylon peruiferum GROWING ON ORE TAILINGS

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The use of leguminous trees in strategies for the recovery of degraded areas aims to improve soil fertility and physical structure, especially in environments such as those impacted by the Fundão dam collapse in Minas Gerais, Brazil. In the present study, M. peruiferum L.f. plants were evaluated under different proportions of iron ore tailings and fertile substrates. After cultivation, the treatment containing pure iron ore tailings negatively affected plant development, decreasing the height, stem diameter, number and thickness of leaflets. The photosynthetic rate, Rubisco carboxylation efficiency and ETR were reduced after 21 months of cultivation on pure tailings but recovered after 29 months of treatment. Several parameters associated with chlorophyll a fluorescence and the OJIP curve were negatively affected by the presence of iron ore tailings in the cultivation substrates. Cultivation on pure tailings also reduced the Chl a/Chl b ratio and resulted in increased anthocyanin levels in the plants. On the other hand, starch levels were not affected by the treatments, whereas total soluble carbohydrate levels were greater in the plants maintained on the pure tailings. The results of the present study indicate that although M. peruiferum plants develop even on pure iron ore tailings, mixing this residue with increasing proportions of fertile substrates may contribute to faster and more vigorous establishment of plants of this species in areas impacted by the Fundão dam collapse. Analyses of gas exchange and, mainly, chlorophyll a fluorescence have proven to be powerful tools for assessing the toxic effects of iron ore tailings on the photosynthetic metabolism and growth of plants of this species.

GAS EXCHANGE AND PRODUCTION OF SOYBEAN PLANTS EXPOSED TO SOIL WATERLOGGING AND LIGHT RESTRICTION

André Silas Lima Silva, Roberto Cecatto Júnior, Vandeir Francisco Guimarães, Michele Aline Anklan, Andrieli Sherman

Exposure to waterlogged soil and low light incidence in the soybean plant canopy causes damage to growth and yield. The study aimed to investigate gas exchange, foliar nutrient content, growth, and yield of soybean plants exposed to waterlogged soil and light restriction conditions during the vegetative and reproductive phases. The experiment comprised the following treatments: plants without stress, plants under light restriction (LR), plants in waterlogged soil (WS) and plants in waterlogged soil + light restriction (WS+LR). Two experiments were conducted. The first imposed treatments simultaneously at the beginning of the V5 phenological stage, and the second at flowering (R1). For imposing light restriction (LR), a shading net with 80% retention capacity was used. In WS treatments, the soil was maintained above field capacity. Gas exchange and relative chlorophyll content were evaluated at five and ten days of exposure to stress conditions (DES). Biometric evaluations and foliar nutrient content measurements were carried out at 14 DES. At the end of the crop cycle, yield components and total yield were determined. Plants in WS under full sun exhibited chlorotic leaves, lower nitrogen, phosphorus and potassium contents, lower dry mass accumulation, and lower assimilation rate of CO_2 (A). Plants subjected WS and LR, either individually or in combination, showed reduced A, stomatal conductance, and transpiration at five and ten DES, leading to reduced dry mass accumulation, pod number, and yield. Thus, the WS and LR conditions, either combined or isolated, for a period of 14 days from the V5 or R1 phenological stages, negatively affect A, which is correlated with reduced dry mass accumulation and decline in grain production yield of soybean plants.

GAS EXCHANGE IN Virola surinamensis SUBMITTED TO CADMIUM DOSES AND BIOCHAR PROPORTIONS IN THE SOIL

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The objective of this work was to evaluate the mitigating effect of açaí as biochar on the physiological responses of Virola surinamensis plants in soil contaminated by cadmium (Cd). A randomized block design was used in a 4x3 factorial scheme, with four replications, with different doses of Cd (0, 10, 20, and 30 mg L-1) and proportions of biochar (0%, 5%, and 10%), totaling 48 experimental units. The physiological variables (photosynthesis, stomatal conductance, transpiration, intercellular CO2 concentration and internal/external carbon) were subject to analysis of variance using the F test, and when significant, the Tukey test was applied at a 5% probability level. In plants with 10 and 20 mg L-1 of Cd, the presence of 5% biochar mitigated the effect of the metal, increasing photosynthesis. Plants with 30 mg L-1 of Cd, when exposed to 5% biochar, were able to maintain their photosynthesis. As for transpiration, plants treated with 20 mg L-1 of Cd and 5% biochar showed an increase in transpiration, while when exposed to 10% biochar there was a reduction, where the higher proportion of soils may have had a toxic effect on the plants. For intercellular CO2, in the condition of soils contaminated with 10 mg L-1 of Cd, the proportions of biochar managed to increase the concentrations of the carbon rate. In the presence of metal, the 10% biochar ratio showed better results in the internal/external carbon ratio than the 5%. The 5% proportion of biochar attenuated the toxic effect of Cd on photosynthesis and transpiration in Virola surinamensis plants, regardless of the different doses of Cd.

GERMINATING UNDER STRESS: ALUMINUM MODULATES MORPHOANATOMY AND METABOLISM IN SOYBEAN ROOT TIPS

AMANDA TAVARES DA SILVA, BRUNO GUILHERME GONÇALVES, GISELE GOMES PARNAÍBA LOPES, CLEBERSON RIBEIRO

Aluminum (Al) can induce physiological and morphological changes in plants, especially in germination and emergence, compromising crop development. This work aimed to evaluate the performance of two soybean cultivars with differential tolerance to Al, 50I52RSF IPRO (tolerant) and NA5909 RG (sensitive), after exposure to this metal. The seeds were germinated in gerboxes, using Germitest® paper, under the conditions of absence (0 mM) and presence (1.5 mM) of Al. On the third day, the seedlings were collected to analysis of the germination rate, growth index, vigor and total length of the seedlings, total length, volume and diameter of the roots. In the root tips, the concentration and location (confocal microscopy) of Al were determined, as well as the quantification of oxidative stress markers (O2-•, H2O2 and MDA), the activity of antioxidant enzymes (SOD, CAT, POX, APX, GPX, GR and DHAR) and compounds related to primary metabolism. The presence of Al reduced the growth, vigor and length of roots of the sensitive cultivar, due to the greater accumulation of Al in the root apices of this cultivar's seedlings. In the tolerant cultivar, there was greater formation of border cells, which resulted in the death of these cells after Al accumulation. These cells act on the front line, protecting the meristematic center of the root tips from direct contact with Al, which contributes to mitigating the stress induced by this metal. In addition, micromorphological damage was not observed in the root tips of both cultivars; however, oxidative stress increased in the sensitive cultivar exposed to Al, culminating in increased lipid peroxidation and cell death. Thus, the results confirm the greater tolerance of cultivar 50I52RSF IPRO to Al, which is attributed to lower Al accumulation, less oxidative stress and a greater number of border cells.

Halopriming of rice seeds improves plant performance when exposed to salinity during vegetative growth

Chrislaine Yonara Schoenhals Ritter, Fernando Alay, Jaqueline da Silva dos Santos, Marcelo Nogueira do Amaral, Eugenia Jacira Bolacel Braga

Oryza sativa L. is sensitive to salinity, particularly during the development and reproduction stages. However, it can develop complex signalling and gene regulation mechanisms, including the ability to "remember" previous exposures through processes such as acclimation and priming. Halopriming, a conditioning method using low doses of salt, activates stress tolerance mechanisms, and modified plant response to a future stress exposure. Aiming to better understand this mechanism, the present study evaluate whether halopriming in cv. BRS A704 could generate beneficial responses in plants subjected to salt stress during the vegetative stage. For this, BRS A704 were immersed in different concentrations of NaCl (0, 30, 60, 90, and 120 mM) for 12 hours (halopriming). Afterward, seeds were rinsed, dried, and restored to their original weight before placed in paper rolls for subsequent evaluation. Seedlings were transferred to hydroponic, where, at the 5 expanded leaves, they were subjected to 0 or 150 mM NaCl. The experiment followed a 5x2 factorial design, totalling ten treatments. The principal component analysis (PCA) demonstrated a clear distribution of plant responses when exposed to 0 mM and 150 mM NaCl during the vegetative stage. Plants treated with halopriming at 30 mM and 60 mM NaCl and subjected to salt stress at 5 expanded leaves exhibited similar growth to non-stressed plants, suggesting a positive effect of these concentrations. Shoot length, fresh mass, Na^+/K^+ ratio, stomatal conductance, and Na^+ in shoot contributed to this performance. On the other hand, halopriming concentrations of 90 mM and 120 mM NaCl resulted in reduced growth after the stress at 5 expanded leaves, indicating that higher doses of NaCl impair seedling development by inducing excessive osmotic and ionic stress. Therefore, halopriming with low NaCl concentrations can enhance the performance of rice plants by accelerating and optimizing the cultivar's tolerance response to adverse environmental conditions.

Hydrogel increases water demand and changes the thermal regulation of cotton plants under water deficit

Gabriela Soares da Silva, Maria Valnice de Souza Silveira, Guilherme de Sousa Araújo, Renan Medeiros Torres, Antonio de Sousa Silva, Gonçalves Albino Dauala, Rafael de Souza Miranda

Reduced precipitation and increased temperatures have promoted water scarcity in several agricultural regions, making research on plant water requirements crucial to preserving crop production potential. This study aimed to investigate the role of hydrogel in water consumption, thermal regulation, and photosynthetic pigments in cotton plants under water deficit conditions. The experiment was conducted in a greenhouse using the FM 970 cultivar in a randomized block design, with a 2 × 2 factorial arrangement comprising two water regimes [control at 90% of field capacity (FC) and water deficit at 50% FC] and two hydrogel levels (no hydrogel and 1.0 g per pot). Plants were grown in plastic pots containing 11 kg of soil, with daily irrigation based on soil moisture levels. The average relative humidity was 50 ± 10%, with maximum, mean, and minimum temperatures of 43.0 °C, 35.8 °C, and 28.7 °C, respectively. In hydrogel absence, an average daily water amount of 0.560 L and 0.273 L was provided to control and stressed plants, respectively, totaling 15.64 L and 7.94 L throughout the experiment. In contrast, plants grown with hydrogel exhibited higher water demand, with daily averages of 0.571 L for well-watered plants and 0.290 L for stressed plants, totaling 15.98 L and 8.41 L, respectively. The high-water consumption induced by hydrogel was likely due to its role in leaf cooling, as water deficit conditions significantly increased leaf temperature, particularly in hydrogel-treated plants. At the analyzed time points (7, 14 and 21 days), stressed plants showed a significant increase in chlorophyll b compared to well-watered plants, while chlorophyll a increased only at 14 and 21 days of water deficit, regardless of hydrogel treatment. In conclusion, the data show that hydrogel increases water demand and alters the thermal regulation of cotton plants under water limitation, but does not affect photosynthetic pigments.

IDENTIFICATION OF GENES FOR NIGHTTIME HEAT TOLERANCE

Cristian Daniel Asmat Ortega, Cristiane Paula Gomes Calixto, Colleen J. Doherty, Carlos Takeshi Hotta

Plants are vital for global food supply but with the increasing frequency of heat waves due to climate change, plant heat stress has become a significant threat to food security. Heat stress can cause substantial damage, leading to reduced growth and productivity. Plants respond to environmental stresses by regulating gene expression. This regulation can be modulated at specific times of the day via the circadian clock in a process called gating. To identify time-of-day-specific genes responding under exposure to heat, we performed a gene co-expression analysis (WGCNA) from Arabidopsis thaliana grown under control (22 ºC) and heat (37 °C) conditions at different times of the day. We identified 18 co-expression modules from 23,083 genes. Among them, 100 genes displayed higher expression levels at night, a time of day that is little studied. Further gene ontology analysis revealed that these genes were significantly enriched in categories such as response to heat, protein folding, endoplasmic reticulum stress, and response to reactive oxygen species. Our results provide potential targets for improving plant thermotolerance and helping the development of resilient crops.

IDENTIFYING LEAF TRAITS RELATED TO WATER DEFICIT RESISTANCE IN HYMENAEA STIGNOCARPA MART. EX-HAYNE

Adler Salomon, Francisco de Almeida Lobo, Ana Paula de Souza Caetano, Momade Juma Aliasse, Jaçanan Eloisa de Freitas Milani

The Brazilian’s Cerrado is characterized by two contrasting seasonal periods: the dry and the rainy seasons. Although native species are supposedly adapted to it, due to the las 10 years of increase water deficit, some native species has suffered and die. Hymenaea stigonocarpa (jatoba is its common name) is one of the resilient species that remained unharmed by water stress. For this reason, this research was developed with the objective of providing information about the attributes related to the species' performance in the face of water deficit. If was found that jatoba’s leaves are amphistomatic, with a uniseriate epidermis covered with trichomes and a thick layer of cuticle. Most pavement cells on the adaxial surface are mucilaginous. The mesophyll is dorsiventral with glandular cavities and consists of two to three layers of palisade parenchyma. Phenolic compounds accumulate in the epidermis and mesophyll cells. The observed xeromorphism, reflects an adaptation to the water-deficient conditions of the Brazilian’s Cerrado. Leaf respiration rates decrease with temperatures above 40°C, reaching a reduction in 50% of its maximum value at 55,4°C (T50). Beyond 60°C, respiration rates approach zero, resulting in a complete inhibition of respiratory processes. Leaf osmotic potential at full turgor (Ψπ100) and at incipient plasmolysis (Ψπ0) were -0.64 MPa and -1.83 MPa, respectively, indicating a strong ability to maintain turgor pressure across a wide range of water potentials. The relative water content at incipient plasmolysis (RWC0) was about 73.1%, and for a plant resistant to water deficit RWC0 is often above 70%. Volumetric elastic modulus (□) was 1.09 MPa, indicating elastic cell walls that shrink water loss preventing cells to lose turgor, which can be advantageous in maintaining cell integrity during drought.

IMPACT OF ANTHOCYANIN CONTENT ON DROUGHT TOLERANCE IN TOMATO (SOLANUM LYCOPERSICUM L.)

Gabrielli Marques, Phelipe Henrique Costa de Miranda, Agustin Zsögön, Karla Gasparini

Drought is one of the main threats to the future of world's agriculture. Thus, enhancing the ability of crops to thrive and produce with limited water availability is crucial. Anthocyanins are flavonoids responsible for red, blue and purple colors found in many plants. Given their role in osmoregulation, antioxidant activity and reactive oxygen species (ROS) scavenging, anthocyanins have emerged as potential players in alleviating drought stress. In this study, we investigated the physiological effects of anthocyanins on drought stress by examining tomato (cv. Micro-Tom, MT) genotypes with accumulation (ANT1), reduction (a) and no anthocyanin (aa). Sixty days after germination, plants were subjected to drought stress by suspending irrigation for nine days. After this period, relative water content (RWC) and gas exchange were assessed. All genotypes showed similar RWC under control conditions. Under drought stress ANT1 had the highest RWC. Regarding gas exchange. Green plants (MT, a and aa) showed better photosynthetic performance compared to the cyanic ANT1 plants in control conditions. However, no difference was observed in stomatal conductance (gs), and transpiration (E). The intercellular CO2 concentration (Ci) was higher in MT and ANT1 compared to a and aa under control conditions. Under drought stress, ANT1 plants showed the highest values of A and gs and no significant difference was observed in E and Ci. Our results demonstrated that anthocyanin accumulation can optimize water relations and ensure better photosynthetic performance under stress conditions. Genetic manipulation of anthocyanin content in the future could enhance plant productivity under various abiotic stress conditions.

IMPACT OF MELATONIN AND NICKEL APPLICATION ON SOYBEAN PLANT PIGMENTS UNDER WATER DEFICIT STRESS CONDITIONS

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Soybean (Glycine max L.) is a commodity of great economic relevance in the global agricultural scenario, especially due to its widespread use in human and animal feed, in addition to its importance in the production of biofuels. However, soybean crops are highly sensitive to water stress, which can seriously compromise their yield and quality. Faced with this challenge, the use of plant bioregulators such as melatonin (MEL) emerges as a promising strategy to mitigate the adverse effects of water stress, since MEL plays a fundamental role in the regulation of physiological and biochemical mechanisms in plants, including the activation of antioxidant defenses and growth regulation.In addition, nickel (Ni) is an essential micronutrient that, although required in small quantities, plays vital roles in plant metabolism, such as the activation of enzymes involved in nitrogen metabolism and general plant development. Therefore, the objective of this study was to evaluate the combined effects of melatonin and nickel application on photosynthetic pigments and secondary compounds in soybean plants under water stress conditions.The experiment was conducted in a completely randomized design, using a 2x4 factorial scheme, with two water regimes (constant irrigation and water suspension) and four treatments (distilled water, MEL, Ni and MEL+Ni application), totaling four replicates per treatment. MEL and Ni were applied both via seed treatment (10 μM MEL and 45 mg Ni kg-1) and by foliar application at the V4 stage (100 μM MEL and 20 g ha-1 Ni). To quantify the effects of the treatments, instantaneous pigment measurements were performed using the Multi-Pigment-Meter MPM-100, ADC. The data obtained were statistically analyzed using analysis of variance (ANOVA), and the means were compared using the Tukey test ($p<0.05$).

Impact of root-shoot translocation on the efficiency of the glutathione inhibitor Buthionine sulfoximine in Pistia stratiotes: solution and opportunities in plant stress studies

Vinícius Melo da Silva, Victor Issamu Uesugi, Ana Júlia Carvalho Defeo, Guilherme Jordan Souza Veras, Esneider ROJAS VARGAS, Juraci Alves de Oliveira

Glutathione (GSH) is a multifunctional peptide in plants with a variety of studies in plant stress. Many studies use the depletion of GSH biosynthesis through inhibitors as an approach. The most widely used inhibitor for this purpose is Buthionine sulfoximine (BSO), a potent inhibitor of GSH synthesis, generally applied via nutrient solution or directly in the soil. We report here that this approach, widely used in several studies, is curiously ineffective for the aquatic macrophyte Pistia stratiotes. Our initial results, using increasing doses of BSO (0, 25, 50, 100, and 200 µM) in a nutrient solution, indicate an 80% depletion of GSH in the roots but less than 2% in the leaves. We hypothesize that, in this species, BSO does not reach the leaf tissues due to translocation problems. To test this hypothesis, the efficiency of BSO with foliar application was evaluated. First, to overcome the natural hydrophobicity of P. stratiotes leaves, we tested the impact of foliar application of a 0.1% Triton-x100 surfactant solution on gas exchange, pigment (chlorophyll and carotenoid) and antioxidant enzyme levels (Superoxide dismutase, Catalase, Peroxidases, and Ascorbate peroxidase). Our results indicated that none of these variables differed from treatment without Triton-x100 application during the first 48 hours. Next, we performed a test with BSO (200 µM) applied directly to the leaves and in the nutrient solution and compared it with a control treatment for 48 hours. Our results indicate that BSO when applied directly to the leaves, reduces GSH levels by 80% and suggests that the efficiency of the inhibitor is affected by translocation in this species. These findings are relevant for studies that intend to use BSO in P. stratiotes and offer an approach to overcome the use of this and other effectors in this plant.

IMPACT OF WATER DEFICIT ON PIGMENTS AND CHLOROPHYLL FLUORESCENCE IN SWEET POTATO GENOTYPES

Elisa Patrícia Ramos de Melo, João Lucas Pires Leal, Dario Sousa da Silva, Bruna Oliveira Reinheimer Spolaor, Adriana Lima Moro, Ana Cláudia Pacheco Santos, Edgard Henrique Costa Silva

Water deficiency impacts physiological processes in sweet potato, compromising the yield and quality of tuberous roots.The aim of this study was to evaluate how water deficit impacts the pigment content and chlorophyll fluorescence of sweet potato genotypes. The experiment was conducted in a greenhouse in a completely randomized design with four replications in a 20x2 factorial scheme. Twenty sweet potato genotypes and two water depth (20 and 100% of pot capacity) were evaluated. The planting of standardized slips was carried out in pots (12L) filled with soil and sand (2:1). The pots were irrigated for five weeks. After this period, irrigation management was initiated according to the 20% and 100% treatments. The differentiation of water depth remained for four weeks. Evaluations were performed at 5, 10, 15, 20, 25, and 30 days after irrigation was withdrawn. The chlorophyll and flavonoid content were measured in the leaves using a multi-pigment meter. Chlorophyll fluorescence was obtained using a fluorescence measurement kit. The means were compared by the Scott-Knott test at 5% probability. The results indicate that, although chlorophyll content was not significantly affected by water stress, flavonoid production increased in some genotypes under stress conditions. Chlorophyll fluorescence was more sensitive to water deficit, with a reduction in maximum fluorescence and quantum yield of photosystem II (Fv.Fm). The electron transport rate was also lower in plants subjected to water deficit. The response to water deficit varies between genotypes. The identification of drought-tolerant genotypes is essential for the development of cultivars adapted to water deficit.

Impacts of hydrogel on growth and physiological responses of cotton plants under water restriction

Guilherme de Sousa Araújo, Maria Valnice de Souza Silveira, Gabriela Soares da Silva, Renan Medeiros Torres, Antonio de Sousa Silva, Rafael de Souza Miranda

Water deficit is a growing concern that induces physiological and biochemical imbalances in plants, such as stomatal closure, reduced photosynthesis and oxidative damage. As a mitigation strategy, hydrogel polymers have been proposed to alleviate the harmful effects of drought on agricultural production. This study aimed to evaluate the impacts of hydrogel on morphology, growth, gas exchange and photosynthetic pigments of cotton plants subjected to drought conditions. The experiment was conducted in a greenhouse using the FM 911 GLTP cultivar in a completely randomized design, following a 4 × 2 factorial scheme. The factors included four hydrogel doses (0, 0.5, 1.0 and 1.5 g of dry hydrogel per pot of 11 dm-3 of soil) and two water regimes [a well-irrigated control at 90% field capacity (FC) and drought at 50%]. Under well-irrigated conditions, plants treated with 1.0 g of hydrogel exhibited a higher total number of leaves, as well as greater shoot, root and total dry mass compared to those without hydrogel. Conversely, cotton plants growing in well-irrigated soils with hydrogel had lower levels of chlorophyll a, chlorophyll b, total chlorophyll, and carotenoids compared to those without hydrogel. Drought conditions significantly reduced leaf number, stem diameter, plant height, dry mass accumulation, and photosynthetic pigment levels compared to the well-irrigated treatment, regardless of hydrogel application. However, under drought stress, plants treated with 0.5 g of hydrogel showed higher dry mass than those grown without hydrogel. The superior performance of hydrogel-treated stressed plants was associated with the maintenance of net photosynthesis, stomatal conductance and transpiration, which were similar to the values observed in well-irrigated plants. In conclusion, hydrogel enhances morphological traits and dry mass accumulation under well-irrigated conditions, and mitigates the negative effects of drought on gas exchange in the FM 911 cotton cultivar.

Influence of arbuscular mycorrhizal fungi on the growth and leaf anatomy of Joannesia princeps Vell. (Euphorbiaceae)

Esneider Rojas Vargas, Victor Issamu Uesugi, Luzimar Campos da Silva

Heavy metal contamination caused by the collapse of the Fundão dam (Samarco) in Mariana (MG, Brazil), has become a global concern. Joannesia princeps Vell. (Euphorbiaceae) is an endemic plant found in areas affected by Fundão tailings, where a gradual increase in copper (Cu^{2+}) has been reported. However, the accumulation of this element in native species from Mariana has not been investigated. Phytostabilization of toxic ions through native plants inoculated with arbuscular mycorrhizal fungi (AMF) is a useful strategy to facilitate metal accumulation in plant roots. In this context, J. princeps has potential for phytostabilizing soils degraded by Fundão mining waste. This study aimed to evaluate the influence of AMF on Cu^{2+} accumulation in the belowground and aboveground parts of J. princeps in a greenhouse experiment. Growth, gas exchange, calcium (Ca) content, pigments, and morphoanatomical changes were measured in plants with and without AMF inoculation, exposed to different $CuSO_4$ treatments (0, 2, 4, and 8 mM). AMF presence significantly enhanced Cu^{2+} accumulation in roots (58%), alleviating the impact of toxic $CuSO_4$ concentrations on root growth (49%), photosynthesis (70%), and stomatal conductance (64%) compared to plants without inoculum. Plants without AMF showed lower Ca acquisition, reduced photosynthesis (399%) and stomatal conductance (392%) at 8 mM of $CuSO_4$. In the leaf anatomy of plants without inoculum, greater thickening of palisade parenchyma cell walls and callose deposition were observed at highest concentration. In lacunar parenchyma, reduced intercellular spaces and pectic warts, considered biomarkers of abiotic stress, were noted. It is suggested that AMF inoculation in J. princeps promotes the phytostabilization of high Cu^{2+} concentrations, reduces stomatal closure, and improves photosynthesis, with no apparent damage to leaf anatomy. Therefore, J. princeps has high potential for restoring soils impacted by Fundão tailings in Mariana.

INFLUENCE OF BIOFERTILIZERS ON ENZYMATIC ACTIVITY IN COMMON BEAN

Elialdo A Souza, Fabricio Porto, Miriam Resende, Vitória Luiz, Welisson Rocha, Douglas César Marques, Giovana Ferreira, Guilherme Leite, Matheus Santos

The application of biofertilizers in common bean cultivation stands out as a promising practice, capable of significantly contributing to agricultural sustainability. This study aimed to evaluate the influence of applying seaweed extract and a complex of amino acids and nutrients on bean cultivation by analyzing lipid peroxidation (LP), the activity of the enzymes peroxidase (POD), superoxide dismutase (SOD), catalase (CAT), average chlorophyll content initially and 7 days after application, thousand-grain weight (TGW), and productivity (sc.ha-1). The experiment was conducted at the Satis Experimental Field, located in Araxá, MG, situated at 19°33'03.4"S 46°52'34.7"W, during the 24/25 crop season. A Completely Randomized Design was carried out, consisting of a control, application of a compound with amino acids and nutrients (AA) via foliar spray during the Vn stage, application of a product based on seaweed extract (SE), Kappaphycus alvarezzi, Durvillaea potatorum, Ascophyllum nodosum, in seed treatment, and via foliar spray at the R1 and R3 stages. The data were subjected to the Scott-Knott test. Seven days after the treatments were applied, chlorophyll levels were higher with AA application via foliar spray at the Vn stage, as well as with SE treatment, both in seed treatment and via foliar spray at the R1 and R3 stages, compared to the control. Lipid peroxidation (LP) and peroxidase enzyme (POD) activity showed higher averages when AA was applied via foliar spray during the Vn stage. Catalase (CAT) showed higher averages when SE was applied in seed treatment and via foliar spray during the R1 and R3 stages. On the other hand, the variables thousand-grain weight and productivity did not show significant variations under the experimental conditions, although, in absolute terms, the averages were higher. The results obtained in this experiment highlight the need for further studies to better understand the role of bioactivating substances in bean physiology.

Influence of CropEvoem Biostimulant on Response to Light Restriction in Soybean Crops

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oybean has a significant impact on global food security. Its adaptability and nutritional benefits have established it as a key product in various markets, contributing to both human consumption and animal feed. Climate projections indicate increasingly intense phenomena, where prolonged periods of precipitation lead to reduced availability of solar radiation. Seeking alternative management strategies, the present study aimed to evaluate soybean productivity in response to the application of the bio-stimulant CropEvo® to mitigate the impacts of low light availability. The experiment was conducted in the field with the cultivar Nidera NS 6601 IPRO. The bio-stimulant CropEvo® was applied at the V3 and R1 stages (250 mL ha -1) via foliar spraying. The treatments consisted of: T1: Control; T2: Control + CropEvo; T3: Light stress during stages R1-R4; T4: Light stress + CropEvo® during stages R1-R4; T5: Light stress during stages R5.1-R8; and T6: Light stress + CropEvo® during stages R5.1-R8. Light stress was induced using shading nets that reduced light by 35%. For treatments T3 and T4, the shade coverings were maintained over the plants during stages R1 to R4, and for treatments T5 and T6, they were maintained during stages R5.1 to R8. Chlorophyll index and thermal images were evaluated at stages R3 and R6, while the weight of a thousand grains (PMG) and productivity were assessed after harvest. In response to the bio-stimulant application, there was a reduction in leaf temperature and an increase in the chlorophyll index for both evaluated periods compared to the control treatment. The light restriction resulted in reduced PMG and productivity; however, in response to the bio-stimulant, there was a significant increase in these same variables in treatments T2, T4, and T6, indicating the positive effect of CropEvo® against light stress.

Influence of exogenous silicon supply on leaf gas exchange parameters and water relations in citrus under drought-induced stress

Kelly Nascimento Silva, José Lavres Jr

Silicon (Si) is classified as a beneficial element for plant growth and development since, when absorbed, it deposits in different structures, acting in morphological, physiological, and biochemical processes that may confer greater tolerance to crops against biotic and abiotic stresses, including drought-induced stress. Therefore, the objective of this research was to study the effects of Si supplies and the application methods in Citrus plants subjected to drought. The study was carried out in a greenhouse conditions located at the Department of Soil Science, Luiz de Queiroz College of Agriculture, USP, in Piracicaba, SP. Two-year-old seedlings of ‘Pera’ sweet orange (Citrus sinensis (L.) Osbeck) grafted on the 'Sunki Tropical' rootstock were arranged in a completely randomized block design with 4 replications in a 2 x 2 x 4 factorial scheme, resulting as the combination of to two water regimes: 80% (well-watered) or 40% (water-stressed) at field capacity; two forms of Si application, foliar or soil, and four Si concentrations (0, 60, 80, or 100 mg L-1). After 4 months, at the end of experiment, leaf water potential and leaf gas exchange parameters [CO2 assimilation, leaf transpiration, and leaf water use efficiency (CO2 assimilation/transpiration)] were evaluated. Plants treated with 80 mg L^{-1} of Si exhibited less negative leaf water potential values under drought conditions, indicating a better water status adjustment, regardless of the Si application method. Similarly, Si-treated plants to Si concentration of 100 mg L^{-1} showed 52 % higher leaf water use efficiency (WUE) than control plants. However, no significant effects of Si application rates as well as the Si application forms were found on CO_2 assimilation rate and leaf transpiration parameters. Therefore, by improving leaf water potential and WUE, Si can mitigate the adverse effects of drought conditions, making it an effective solution to deal with abiotic stress in Citrus.

INFLUENCE OF LIGHT AVAILABILITY ON LEAF TRAITS AND THERMOTOLERANCE OF FOUR TROPICAL TREE SPECIES

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Human activities have profoundly altered the Earth's surface through deforestation, pollution, and resource overexploitation, leading to climate change and extreme climate events that favors only certain species. To mitigate these effects forest restoration efforts as such as reintroduction of native species through enrichment plantings are needed. We investigated the response of leaf traits and thermotolerance of seedlings of four tropical tree species used in forest enrichment plantations to varying light gradients, under both nursery and field conditions. The species used in our study were Aspidosperma pyricollum, Cytharexylum myrianthum, Goniorrhachis marginata and Handroanthus chrysotrichus. We measured and estimated the relative distance plasticity index (RDPI) of leaf mass per area (LMA), leaf thickness (LT), chlorophyll index, leaf anatomy, and leaf thermotolerance parameters, which were based on 50% critical loss of maximum quantum yield of photosystem II with increasing temperature (Fv/Fm) (T50 and TCrit). Leaf thermotolerance has been shown to have a positive relationship with increased shade, which was observed in the nursery and field experiments, suggesting the effectiveness of forest enrichment in mitigating the impacts heat extreme events on the leaf physiology of tropical tree seedlings. Despite the low plasticity to light availability of leaf thermotolerance compared to other leaf traits it remains a valuable tool for assessing species' heat stress limits and could help in tropical tree species conservation efforts under climate threats.

INFLUENCE OF POST-HARVEST TREATMENTS ON RIPENING AND CHANGES IN BIOGENIC AMINES IN BANANAS

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Bananas are rich in minerals and bioactive compounds such as vitamins, phytosterols, polyamines, phenolic compounds, and carotenoids, which have high nutritional value. However, their post-harvest shelf life is limited due to their climacteric nature. This study aimed to evaluate changes in the chemical properties of bananas after harvest, treated with putrescine, ethylene, and an ethylene inhibitor (1-MCP). For this purpose, fruits were subjected to different treatments (Control, Ethylene, 1-MCP, Putrescine, Putrescine + 1-MCP, Putrescine + Ethylene) and stored at 16 ºC for 20 days. The levels of soluble solids (SS), acidity, pH, and the content of biogenic amines such as 5-hydroxytryptophan (5-HTP), tryptophan (TRP), tryptamine (TRY), putrescine (PUT), cadaverine (CAD), histamine (HIS), hydroxy serotonin (5-HTP(S2)), tyramine (TYR), spermine (SMD), dopamine (DA), and spermidine (SPM) were analyzed in the fruits. The results indicate that untreated bananas and those treated with ethylene showed more homogeneous ripening, with increased SS levels. The combination of putrescine and ethylene resulted in higher concentrations of TRP, PUT, SMD, and SPM, while isolated putrescine increased HIS and TYR levels. Treatments with 1-MCP increased DA concentration, with higher CAD levels when combined with putrescine. Untreated bananas had higher levels of 5-HTP(S2) compared to treated ones, and there was no impact of treatments on fruit pH. Amines such as putrescine play a fundamental role in mitigating oxidative stress. Exogenous putrescine treatment may be promising for preserving the bioactive properties and shelf life of bananas by delaying the action of ethylene and accumulating biogenic amines typical of oxidative stress defense in fruits. In summary, the post-harvest treatments studied influenced banana ripening and affected the accumulation or degradation of biogenic amines in the fruit.

Influence of seaweed extract-based fertilizers on photosynthetic processes in corn crop under water deficit conditions

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The effects of climate change are becoming increasingly evident, negatively impacting the plant metabolism of various plants, causing stress. Therefore, the search for alternatives to mitigate these disturbances is necessary, and fertilizers based on seaweed extracts are a new pathway for stress reduction and increased productivity in plants. This study aims to evaluate the effects of increasing doses of YaraAmplix Biotrac (BIO) on photosynthetic processes under water stress conditions in maize (Zea mays L). The experiment was conducted in the greenhouse at the Plant Physiology Sector of the Department of Biology at the Universidade Federal de Lavras (UFLA). The experimental design used was completely randomized in a factorial scheme (2X4) with four replications, with the first factor being the water conditions: 100% (CC) and 60% of water demand (WD), and the second factor being the increasing doses of YaraAmplix Biotrac: 0; 0.5; 1.0; and 1.5 L/ha applied to the B27828WV hybrid. Stomatal conductance (gs), leaf net photosynthesis (A), efficiency ratio of photosystems (PV/PM), predawn (WPA) and midday (WPM) water potential, and chlorophyll A and B (CLA and CLB) were evaluated. The use of BIO positively influenced the variables of gs, A, PV/PM, WPA, and WPM, allowing an increase in gas exchange processes regardless of the water condition. Regarding WPA, there was a tendency for improved water recovery with increasing BIO dose under WD condition, and for WPM, the optimal dose was 0.5 L under CC condition. The fertilizer did not influence the levels of CLA and CLB, which were reduced under WD conditions. Therefore, we can conclude that the use of YaraAmplix Biotrac positively favored the crop in alleviating water deficit conditions.

Initial tolerance responses in seedlings of herbaceus cotton cultivars (Gossypium hirsutum L.) in soil contaminated with boron

Maycon Anderson de Araujo, Roberta Possas de Souza, Andressa Aparecida Rodrigues de Melo, Aline Redondo Martins, Liliane Santos de Camargos

As a micronutrient, boron (B) is required in small amounts in plant metabolism for growth, development and reproduction. In excess, B can cause late emergence, decreased stem height and poorly developed root system. Germination is a process that is controlled by several endogenous and exogenous factors to the seed, such as hormonal balance, water balance, vigor and light. The process is a complex interaction between genetic factors, environmental conditions and signaling within the seed. The present study sought to evaluate the initial development potential of herbaceous cotton (Gossypium hirsutum L.r. latifolium Hutch) under high concentrations of B, analyzing its initial tolerance and the partitioning of nitrogen compounds and sugars. The experiment was conducted in a completely randomized design, using two cultivars of herbaceous cotton (Gossypium hirsutum L.) and four different concentrations (0.5 (control), 30, 60 and 120 mg dm^3 $soil^1$), in a double factorial scheme (Cultivar x B Concentration). Each replicate consisted of 50 seeds, with four replicates per treatment. At the end of the experiment, a nutritional analysis was performed on the shoot and root parts, and it was found that the two cultivars 1 and 2, in the last treatment, presented 25.6 and 19.5 mg B kg DW (dry weight) in the shoot, respectively. The emergence speed index (EVI), length and dry mass production of the shoot and roots were evaluated, and the photosynthetic pigments, total protein and amino acids, phenolic compounds and starch were quantified. Cultivar 2, despite showing signs of stress, showed changes in the partitioning of compounds that could potentially have helped in its maintenance in soil with excess B, such as an increase in starch in the roots and an increase in nitrogen compounds in its leaves and cotyledons.

IODINE IN MITIGATING WATER DEFICIT STRESS IN TOMATOES

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Water deficit stress poses a challenge to cultivated plants caused amid climate change. This study focuses on mitigating water deficit stress in tomato (Solanum lycopersicum) known for its sensitivity to such condition. Emerging studies show the potential benefit of iodine in enhance plant tolerance ability to abiotic stress. Here, we investigated the efficacy of various iodine sources when combined with urea in alleviating water deficit stress in tomato (Solanum lycopersicum cv Micro-Tom WT). A randomized 3x2 factorial design was employed with two water conditions (irrigated and deficit) and three top dressing conditions (urea, urea+potassium iodide (KI), urea+potassium iodate (KIO3)), and replicated six times. Irrigation restriction was imposed at anthesis and carried out gradually over nine days. Biometric and physiological parameters were analyzed at maximum stress and five days post-rehydration. Iodine supplementation increased root dry mass, with plants treated with KIO3 showing a 37.0% increase under field capacity conditions. When subjected to water restriction, this increase compared to the control was 36.5% with KI and 34.4% with KIO3. When subjected to water restriction, this increase compared to the control was 36.5% with KI and 34.4% with KIO3. Despite a slight reduction in the Fv/Fm ratio at maximum stress, no damage to the photosynthetic apparatus was observed in plants subjected to water deficit, since on rehydration the values remained statistically the same as in the control. The iodine-treated plants showed a lower water potential in plants subjected to water deficit on the morning before maximum stress, indicating better maintenance of hydration. The recovery of stomatal conductance observed five days after rehydration was limited to plants treated with KIO3. This shows the potential benefit of iodine in mitigating water deficit stress in tomato plants.

Iron(II) sulfate affects Albizia lebbeck seed germination and alters the proteomic, hormonal, and polyamine profiles

Jociel Nascimento de Noronha, Tadeu dos Reis de Oliveira, Mateus Santana Rodrigues, Renan Carrari-Santos, Vanildo Silveira, Claudete Santa-Catarina

Albizia lebbeck is a fast-growing pioneer species and is considered a promising option for the recovery of areas contaminated by toxic metals. We evaluated the influence of iron(II) sulfate (FeSO4) on the germination and growth of A. lebbeck seedlings. Disinfected seeds were incubated with different concentrations (0, 2, 4, 8, 16, 24 or 32 mM) of FeSO4, pH 5.5. Germination, seedling growth, proteomic profiles, and endogenous contents of hormones, PAs, and photosynthetic pigments were assessed in 12-day-old seedlings. The highest concentrations of FeSO4 (16, 24 and 32 mM) negatively affected germination and seedling growth. Proteomic analysis from seedlings treated with 0, 4, or 24 mM FeSO4 allowed the identification of 368 proteins. A similar proteomic profile was observed in seedlings grown with 4 mM compared with those grown without FeSO4, indicating that 4 mM FeSO4 did not cause phytotoxic effects. Seedlings grown with 24 mM increased the accumulation of stress-related proteins, such as glutathione peroxidase and glutathione S-transferase compared to those without FeSO4. A decrease in accumulation of acyl-coenzyme A oxidase 4 peroxisomal, 3-hydroxyacyl-CoA dehydrogenase, malate dehydrogenase, malate synthase, isocitrate lyase, and chlorophyll-binding proteins suggests a link between changes in these proteins and the inhibition of seedling growth under stress. This inhibition resulted in a lower content of photosynthetic pigments and indole-3-acetic acid, abscisic acid, jasmonic acid, and salicylic acid, but increased the ACC contents, the precursor of ethylene. The endogenous content of putrescine was lower at 4 mM than at 24 mM, whereas the contents of spermine and total free PAs were greater in seedlings at 24 mM. Therefore, despite the phytotoxic effect of high FeSO4 concentrations, the results indicate the potential use of this species in the recovery of areas contaminated by Fe, as it was able to tolerate concentrations up to 8 mM.

Is photosynthetic machinery efficiency pivotal for performance of semiarid-typical cotton cultivars under drought?

Maria Valnice de Souza Silveira, Renato Oliveira de Sousa, Teonis Batista da Silva, Jeane Ferreira de Jesus, Manderson Nunes da Silva, Rafael de Souza Miranda

Water restriction impairs numerous physiological and biochemical processes in plants across all stages of development. Thus, characterizing resilient cultivars is crucial for preventing losses in agricultural production. This study aimed to identify drought-resistant cotton cultivars and determine physiological indicators for drought acclimation in semi-arid regions. The experiment was conducted in greenhouse using a completely randomized design (CRD) in a 6 × 2 factorial scheme, with six cultivars (FM 985 GLTP, FM 978 GLTP RM, FM 974 GL, FM 970 GLTP RM, FM 912 GLTP RM, FM 911 GLTP) and two water regimes: a well-irrigated control at 100% field capacity (FC), and water deficit treatment at 60% FC. Plants were harvested 20 days after drought exposure. Drought stress significantly increased membrane damage in all cotton cultivars compared to the well-irrigated control, but the damage was less severe in FM 970 and FM 974 plants. The elevated membrane damage in drought-stressed plants was correlated with lower dry mass accumulation in all cultivars. Under drought conditions, FM 978 and FM 985 plants showed higher total dry mass than the other cultivars; however, the highest relative drought tolerance indexes were observed in FM 970 and FM 985 plants. Interestingly, drought had little to no effect on gas exchange parameters (net photosynthesis, stomatal conductance, and transpiration) and photosynthetic pigments (chlorophyll a, chlorophyll b, total chlorophyll, and carotenoids), at least during the evaluated time-point. The data highlight the strong performance of semiarid-typical cultivars under drought. In conclusion, the drought tolerance of cotton plants is not linked to photosynthesis-associated physiological regulations. The FM 970 and FM 985 plants are the most promising cultivars for cultivation under water-restricted conditions.

LEAF THERMOTOLERANCE OF NATIVE AND EXOTIC GRASSES IN THE FERRUGINOUS CAMPO RUPESTRE

Isabela Rezende Tonhi, Camilla Oliveira Rios, Eduardo Gusmão Pereira

The increase in global temperature with climate change, as a result of human actions, has significant impacts on biodiversity. The campo rupestre ecosystem, which is home to notable species endemics, faces other challenges such as the presence of exotic species. Therefore, this study seeks to evaluate the thermotolerance response of native and exotic grass species in the ferruginous campo rupestre. The hypothesis evaluated is that the exotic species, with C4 metabolism, will have a better thermotolerant response and a greater competitive success with climate changes. The experiment was carried out in an area of ferruginous campo rupestre at Serra da Calçada, located in the Espinhaço Range, in Minas Gerais, Brazil. Ten individuals of each species were collected in the field, the native - capim flechinha (Echinolaena inflexa) with C3 metabolism and the invasive - capim gordura (Melinis minutiflora) with C4 metabolism. The thermotolerance analysis was performed by exposing leaf discs to temperatures of 35°C to 59°C with subsequent measurement of the maximum quantum yield of photosystem II (Fv/Fm). In this way, the critical temperatures resulting from the 15% (T15) and 50% (T50) decrease of the Fv/Fm value were defined. The native C3 species presented higher T15 and T50 values when compared to the invasive C4 species. The smaller drop in Fv/Fm values of E. inflexa with the increase in temperature was associated with a higher leaf proline concentration. Therefore, given the scenario of increasing temperature, the greater thermotolerance of the native species may result in greater success in competition than the invasive species, reinforcing the importance of permanent conservation areas.

MAPPING SALT-RESISTANT COTTON CULTIVARS USING GROWTH AND PHYSIOLOGICAL INDICATORS

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Cotton (Gossypium hirsutum L.) crop is widely explored in semiarid regions, and the plants exhibit different performance when exposed to stressful environments. The tolerance to salt stress may vary according to salt level, genotype, phenological stage, and duration of stress exposure. Thus, searching salt-tolerant cultivars is essential to cultivate cotton crop in areas affected by salinity. The present study aimed to investigate the impacts of salinity on irrigation water in growth and physiological indicators of cotton plants. The experiment was conducted in a greenhouse using a randomized block design (RBD) in a 6 × 5 factorial scheme, consisting of six semiarid-adapted cotton cultivars (FM 911 GLTP, FM 912 GLTP RM, FM 970 GLTP RM, FM 974 GL, FM 978 GLTP RM, and FM 985 GLTP) and five salinity levels (0, 4.0, 8.0, 12, and 16 dS/m). The plant growth, gas exchange, photosynthetic pigments, leaf temperature and membrane damage were investigated thirty three days after imposition to salt stress. A cluster analysis and principal component analysis were performed to find the relationship between treatments and analyzed variables. In general, salt stress severely decreased the plant growth, net photosynthesis, stomatal conductance and transpiration; while promoted increase in leaf temperature, and contents of chlorophyll (Chl) a, Chl b and Chl total, especially at high electrical conductivity (from 8.0 to 16 dS/m).The salt-induced alterations were more evident in FM 911 plants, characterized as the most salinity sensitivity. In contrast, FM 970 were found to be tolerant to salinity, with the highest performance even under severe salt stress. Our findings reveal that all studied cultivars display elevated performance under electrical conductivities of 0 and 4.0 dS/m. The data suggest promisor cotton cultivars to growing in areas affected by salinity, emerging as alternative to cultivate in salt environments.

Mechanisms of Aluminum Tolerance in Solanum lycocarpum: Implications for Crop Domestication

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The expansion of land use for agricultural cultivation is constrained by soil properties, especially in tropical and subtropical regions where acidic soils (pH < 5.0) are predominant. Aluminum (Al) is the most abundant metallic element in Earth's crust and poses a major constraint in acidic soils where it can form toxic compounds for plants, particularly as Al^{3+}, which can lead to rhizotoxicity and affect growth and development. This study aimed to elucidate the mechanisms underlying Al tolerance observed in Solanum lycocarpum, a species commonly found in poor, highly acidic, and Al-saturated soils. The results indicated that the addition of Al did not inhibit S. lycocarpum growth, as evidenced by the phenotypic similarity between treated and control plants. Additionally, biometric, photosynthetic, and photochemical parameters were not adversely affected by Al, suggesting the presence of robust tolerance mechanisms in S. lycocarpum. Regarding anatomical characteristics, no significant changes were observed in the leaves of plants exposed to Al, although the root apex exhibited some degree of disorganization in the root cap region. Interestingly, histochemical studies revealed that Al present in the roots accumulated, at least partially, in the nuclei of meristematic cells. A greater accumulation of soluble sugars and proline was also observed in the roots of plants subjected to Al stress, suggesting that adjustment of primary metabolism is an important mechanism for enhanced Al tolerance. In terms of organic acid levels, a reduction in malate and fumarate concentrations was observed in the leaves in the presence of Al, which may be attributed to increased Al complexation for compartmentalization in structures like vacuoles and trichomes. Collectively, our findings suggest that S. lycocarpum exhibits significant Al tolerance, possibly due to a combination of exclusion mechanisms and internal tolerance strategies, making it an excellent model species for the de novo domestication of new Al-sensitive crops.

METHYL JASMONATE REDUCES WATER DEFICIT AND ALUMINUM TOXICITY STRESS IN VACCINIUM CORYMBOSUM THROUGH ABA SIGNALING

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Water deficit (WD) and aluminum (Al) toxicity are significant stressors, increasing due to climate change. This combined effect impacts the productivity of plants, making Vaccinium corymbosum (highbush blueberry) particularly vulnerable. Recent findings suggest that foliar methyl jasmonate (MeJA) application could mitigate the detrimental effects of stresses. The study aimed to study the ABA and MeJA relationship on V. corymbosum plants subjected to combined WD and Al stress (WD+Al) with MeJA application. Star and Legacy cultivars were subjected to seven treatments: (1) control (80% field capacity, low Al saturation), (2) WD (50% field capacity), (3) Al toxicity (85% Al saturation), (4) WD+Al combination (50% field capacity, 85% Al saturation), (5) Al+MeJA, (6) WD+MeJA, (7) WD+Al+MeJA during 21 days. Water potential (Ψw), relative growth rate (RGR), relative water content (RWC), aluminum (Al) concentration, net photosynthesis (Pn), stomatal conductance (gs), proline concentration, and abscisic acid (ABA) were measured. The Ψw and RGR significantly improved by MeJA application, reaching 4-times higher than WD and Al alone treatments in Legacy. RWC decreased in Legacy under WD+Al stress, but MeJA treatment recovered values to the control. WD+Al+MeJA treatment reduced Al concentration up to 2-fold compared to WD+Al in Legacy. Pn and gs decreased 2-fold under WD+Al stress, recovering to control levels with MeJA. The decrease in gs in WD+Al plants correlated with increased ABA levels in both cultivars, especially in Star. In Legacy, proline significantly increased under WD+Al treatment compared to the control, correlating with elevated ABA level. The results indicated that MeJA mitigates WD+Al stress via ABA signaling in highbush blueberries, suggesting its potential use in agriculture.

MICROBIAL CONSORTIUM WITH RHIZOBIUM, AZOSPIRILLUM BALDANIORUM AND TRICHODERMA ASPERELLOIDES IMPROVES GROWTH, PHOTOSYNTHETIC PIGMENTS AND METABOLITES OF SOYBEAN PLANTS UNDER WATER STRESS

Ryan de Sousa Araujo Melo, Ana Raquel Pereira de Melo, Jerri Édson Zilli, Vicente Paulo da Costa Neto, Aurenívia Bonifácio

The combination of beneficial microorganisms is an innovative technique to induce resistance to environmental adversities together with increased plant productivity. The present study aimed to evaluate the effects of water stress on growth and nitrogen metabolism in soybean plants inoculated with different symbiotic associations between rhizobia (Bradyrhizobium japonicum or B. elkanii) and beneficial microorganisms (Azospirillum baldaniorum and Trichoderma asperelloides). After exposure of soybean plants inoculated or coinoculated with rhizobia and beneficial microorganisms to water stress, growth parameters (absolute growth rate, plant height, stem diameter, root length and number of nodules) and concentration of leghemoglobin, photosynthetic pigments (chlorophylls a and b and carotenoids), free ammonia, soluble proteins and total soluble carbohydrates were evaluated. There was a significant interaction between treatments for all variables analyzed. Plants co-inoculated with B. elkanii, T. asperelloides and A. baldaniorum exhibited greater height with or without water deficit. In general, plants co-inoculated with B. elkanii, T. asperelloides and A. baldaniorum stood out positively and presented the best results, even when exposed to water deficit. It was observed that triple co-inoculation was beneficial to mitigate the deleterious effects of water deficit in soybean plants. Thus, this symbiotic combination may represent an environmentally sustainable strategy for mitigating water deficit in soybean plants and other legumes.

Mitigation of oxidative stress caused by drought in Glycine max

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Drought is one of the factors that can generate oxidative stress in plants, resulting in increased production of reactive oxygen species (ROS) such as hydrogen peroxide - H2O2 and lipid peroxidation - MDA. Climate change has significantly affected agricultural productivity in recent years, and soybean crops have been suffering greatly from lack of rainfall and strong heat waves, responsible for major losses in productivity. The aim of this study was to evaluate the application of the product Supremo (Prime Agro), as a mitigator of oxidative stress in soybean productivity. The experiment was conducted at the palmital-CDTT farm of the Federal University of Lavras, with a randomized block design in a 2x2x3 factorial scheme (cultivar, application time and product dose), with 3 replicates and the data were analyzed with the aid of R software. H2O2 and MDA were extracted with 0.1% trichloroacetic acid and quantified by spectrophotometry. The results indicated lower dose of Supremo higher the production of H2O2 and MDA, and for the R1 season, higher levels of these compounds were observed when compared to R5. Regarding productivity, the B5560 cultivar obtained higher values in R5 at doses 2 and 4 and lower at dose 8, compared to R1, while the NEO531 cultivar, on the other side, presented higher productivity in R1 at doses 2 and 4 and lower at dose 8. We conclude that the Supremo product helped to mitigate the oxidative stress caused by drought in soybean crops and contributed to productivity levels above 80 (sc/ha) at all doses tested, emphasizing that the dose is cultivar dependent.

MITIGATION OF THE PHYSIOLOGICAL DAMAGE OF EXOGENOUS ACETYLCHOLINE IN HEAT AND DROUGHT STRESS IN MAIZE

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Maize (Zea mays) is the third most cultivated cereal in the world, followed by rice and wheat. It can be directly affected by abiotic stresses, such as heat and drought stress. In association, these stresses can negatively affect photosynthetic activity, plant growth and productivity. Bioregulators, produced naturally by the plant or inserted synthetically, act on the plant's metabolism, influencing cellular structures and processes. An important bioregulator is Acetylcholine (ACh), which participates in the opening and closing of stomata and in regulating different cellular processes. The objective this study was to analyze whether acetylcholine influenced photosynthetic parameters in stressed plants. It was divided into plants under normal condition (temperature 31.9 ºC/19.9 ºC max./min and irrigated) and stress condition (high temperature (38 ºC/28 ºC day/night and water suspension). In both plants without application (control - C) and with acetylcholine application in seed (TS) and foliar (F) treatment of 1 mmol L-1. Statistical analysis, were compared by the Tukey test ($P<0.05$). Foliar application (F) increased CO_2 assimilation (A), stomatal conductance (gs) and intercellular CO_2 concentration (Ci) under normal condition. But, under stressful conditions, there was a decrease in gs, Ci and transpiration (E), with F application, demonstrating a way to prevent water loss through the process of stomatal opening and closing, which occurs due to changes in the volume of guard cells, influenced by the presence of ions, such as K^+, in addition, ACh is involved in this process, acting on changing the permeability of the membrane to ions. In this way, the foliar application of ACh acted to promote increased tolerance to water deficit and heat stress.

Morphoanatomical and functional leaf traits of Colobanthus quitensis and Deschampsia antarctica along an Andean-Patagonian-Antarctic gradient: ecotypical differentiation or phenotypic plasticity?

Leon Aloys Bravo Ramires, Constanza F. Ramírez, Pedro Flores Branttes, Valentina Vallejos, Francisca Fuentes, Patricia Sáez, Lohengrin Cavieres

Alpine and Antarctic habitats present extreme conditions for plant survival, with low temperatures being a major limiting factor. Colobanthus quitensis and Deschampsia antarctica, can thrive in these environments, demonstrating significant adaptation capabilities. This study investigates the morpho-anatomical, photosynthetic, and hydraulic traits of these species along the Andean-Patagonian-Antarctic gradient to understand their adaptation strategies and resilience. Field and common garden experiments were conducted to compare leaf traits, gas exchange parameters, hydraulic properties, and xylem anatomy across different geographical locations. Results show that C. quitensis and D. antarctica exhibit significant variations in leaf traits and physiological parameters depending on their habitat. For instance, C. quitensis from Antarctica displayed higher leaf mass area (LMA) and leaf density (LD) compared to those from Central Chile, while D. antarctica from Antarctica showed the highest LMA values. Gas exchange parameters such as assimilation rate (An), stomatal conductance (gs), and mesophyll conductance (gm) were notably higher in plants from Patagonia compared to those from Antarctica, both in the field and in common garden conditions. Hydraulic traits and xylem anatomy also varied significantly. In C. quitensis, the number of xylem vessels and vessel diameter were lower in Antarctic plants, which corresponded to lower hydraulic conductance. Conversely, D. antarctica from Patagonia exhibited a broader distribution of vessel diameters and higher vessel density. These differences in traits were generally preserved under common garden conditions, indicating that these species possess intrinsic adaptations to extreme environments. The study highlights that while C. quitensis and D. antarctica have evolved specific adaptations to their respective habitats, many traits related to leaf morphology, gas exchange, and hydraulic properties show consistency across the Andean-Patagonian-Antarctic gradient. This resilience suggests that the observed traits are crucial for their survival in extreme climates, providing insights into their ecological adaptation and potential responses to global climate change.

NITROGEN REMOBILISATION IN Saccharum spp. (cv. CTC9001bt) UNDER DROUGHT STRESS AND REHYDRATION CONDITIONS

Raquel Yellin Castañeda Venegas, Anderson Ricardo Trevizam, Mewael Kiros Assefa, José Lavres Junior, Paulo Eduardo Ribeiro Marchiori

Drought stress is an important environmental constraint in sugarcane production in Brazil, and one-way plants adapt to this stress is by upregulation of their nutrient remobilisation. In this study, a greenhouse experiment was carried out to examine the effects of water availability on nitrogen mobilization in sugarcane (Cv. CTC9001bt). At 25 days after transplanting (DAT), the +1 leaf was labeled with ammonium sulphate ([NH 4] 2 SO4) enriched to 10% atom of 15N. At 27 DAT two water treatment regimes were applied: stress (S, 20%FC) and hydrated (H, 100%FC), laid out in a completely randomized design. Data were collected at two different time points that corresponded to maximum stress of the dehydrated plants (38 DAT) and after rehydration (43 DAT). For the analysis of isotopic composition using an isotope ratio mass spectrometer (IRMS), root, stem, and leaf sheath were collected and oven-dried at 55°C for 3 days.

At maximum stress, the nitrogen content was higher in the leaf sheath and stem of S plants (12.1% and 6.0%) compared to H plants (4.7% and 4.2%), while the roots did not show differences. Following rehydration, higher nitrogen recovery (14.6%) was observed in the stems of S plants, likely remobilised from sheath leaves, which showed a reduction of 44% compared to when at maximum stress. The accumulation of dry matter in roots of S plants slightly increased at maximum stress. After rehydration, the accumulation of dry matter in the stems and roots of S plants was higher (+43% and +29%) compared to H plants. These findings suggest during stress sugarcane prioritises nitrogen mobilisation to sheath leaves, redistributing it to the stem upon rehydration. Increased root biomass under stress and rehydration indicates improved water and nutrient uptake, supporting plant resilience.

Non-structural carbohydrates dynamics between roots in a woody species under water deficit

Wildson da Conceição Gonçalves, Wanessa Carvalho, Gabriel da Silva Ramos, Mariana Santos de Souza Gonçalves, Mauro Guida dos Santos

Dry tropical forests experience high temperatures and low rainfall for most of the year, making them a harsh and selective environment. Some plant species have developed strategies to mitigate this environmental pressure by storing non-structural carbohydrates (NSC) in their roots after the rainy season. This study aims to understand the role of these roots in the ability to exploit soils with low moisture and in the physiological dynamics of NSC. A controlled experiment was conducted with seedlings of Cenostigma microphyllum (Mart. ex G.Don) Gagnon & G.P.Lewis, a deciduous woody species from Caatinga, a Brazilian dry tropical forest, divided into three treatments: Control, Water Deficit (WD), and Chronic Water Deficit (WD Chronic). Growth parameters, stomatal conductance (gs), relative water content in leaves (RWC), root morphology, and NSC levels were analyzed. It was observed that RWC varied according to the treatments. Seedlings subjected to chronic WD showed greater efficiency in maintaining water status compared to plants exposed only to WD. However, gs was identical in both treatments. Water deficit altered root morphology, reducing specific root length and root surface area, while increasing tissue density. Thus, water deficit caused morphological changes in the roots of C. microphyllum, with fine roots remobilizing NSC to thicker roots during acute WD and reducing NSC concentration during chronic WD. Additionally, plants under water deficit exhibited strong stomatal control and morpho-physiological adaptations in the assimilation, allocation, and use of NSC. It can be concluded that the species under stress has a higher density of fine roots, which facilitates greater resource exploration in the soil to tolerate drought.

OPTIMIZING NUTRIENT UPTAKE: TIME-SPECIFIC APPLICATION OF NUTRIENT SOLUTION MODULATES NITROGEN STRESS ON TOMATO PLANTS

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In plants, water absorption by the roots is governed by the transpiration flux, which closely follows the daily fluctuations in light, temperature and vapor pressure deficit conditions of the environment. Thus, the daily transpiration regime is responsible not only for water uptake from the soil, but also for the absorption and distribution of mineral nutrients throughout the plant. Given the urgent need in modern agriculture of understanding strategies that enhance nutrient use efficiency, we cultivated tomato plants (Solanum lycopersicum L. cv. Micro-Tom) in sand and subjected them to two nitrogen (N) levels (normal [5 mM] and low [3 mM]) and three different times of nutrient solution application (dawn, midday and dusk). The plants were evaluated for daily evapotranspiration and dry mass accumulation in both roots and shoots. Daily evapotranspiration was monitored by gravimetry for thirty days. From day 14 onwards, significantly higher evapotranspiration rates were observed in plants that received the nutrient solution at dusk. As expected, lower accumulation of shoot dry mass under N deficit was observed. However, this effect was significantly attenuated in plants that received the nutrient solution at dusk. Conversely, root dry mass was altered solely by N levels and was not affected by the timing of nutrient solution application. In conclusion, plants that received the nutrient solution at the end of the light period (dusk) presented higher evapotranspiration rates and a greater capacity to minimize the effects of N deficit. Our results have implications for the improvement of nutrients use in crops.

PERCEPTIONS OF GENDER EQUALITY WITHIN BRAZILIAN PLANT SCIENTISTS

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Scientific gender gaps have been identified worldwide, with key reasons for the "leaky pipeline" of women in science, including maternity, unequal opportunities, gender stereotypes, and harassment. However, this gap has yet to be evaluated among Brazilian Plant scientists. To explore this, an online survey was conducted among members of the Brazilian Society of Plant Physiology, the Botanic Society of Brazil, and the Botanic Society of São Paulo. Principal Component Analysis (PCA) was performed to assess whether gender, color, and academic position influence perceptions of gender equality among researchers.

The survey, with 316 respondents, revealed that female representation in workplaces is perceived to range between 40% and 79%. Interestingly, men generally perceive higher female representation than women do. Perceptions of gender discrimination vary by gender, color, and academic position. While 60.4% of respondents reported never experiencing discrimination, over 80% of those who did were women, particularly women of color. Women frequently reported discrimination in being assigned stereotypical tasks, experiencing interruptions during discussions, and feeling the need to provide additional proof of competence. Female professors also reported discrimination in recruitment and leadership opportunities.

The study further assessed the understanding of gender equality and equity, with women generally showing greater awareness of these concepts than men. These findings suggest that despite the apparent greater female representation in Brazilian Plant Sciences, women scientists, especially women of color, still face significant gender discrimination across all academic levels. Additional research is necessary to identify where the most vulnerable groups are and how to address these issues to promote a more equitable scientific environment in Brazil.

Performance of "Vislumbre@" under shading conditions in maize crops

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Maize crops require, among several factors, that temperature, precipitation and photoperiod reach levels considered optimal to obtain greater productive potential. Because it belongs to the C4 plant group, maize has a high photosynthetic rate, responding with high yields to increased light intensity, so that reductions of 30% to 40% in light availability can cause delays in grain maturation. Thus, this study aimed to evaluate the effects of shading on the physiological and productive parameters of maize. The study was conducted in the field, in a 3x2 factorial scheme, with the following treatments: 1- Control, 0% shading; 2- Vislumbre 0.4 L/ha, 0% shading; 3- Control, 40% shading; 4- Vislumbre 0.4 L/ha, 40% shading; 5- Control, 80% shading, 6- Vislumbre 0.4 L/ha, 80% shading. The application of treatments with Vislumbre (N – 5.75% w/v; P2O5 – 5.75% w/v and complexing agent -18.45%) was carried out at phenological stage V5. Immediately after treatments application, shade cloth was placed on the plots and maintained for 30 days. During this period, leaf collections were carried out at 7 and 21 days after application to quantify pigments and photoassimilates. At the end phenological cycle of the crop, productivity analysis was performed. All data were subjected to statistical analysis. Regardless of the shading level, an increase in the levels of chlorophyll a total chlorophyll and carotenoids was observed in both evaluations. For starch, there were lower values in treatments with Vislumbre in first evaluation, while during second evaluation the plants under Vislumbre application showed higher values. Both treatments with Vislumbre under conditions of 0%, 40% and 80% of shading resulted in 1%, 43% and 15% increase in productivity of the corn crop. From the work, it was possible to conclude that the use of Vislumbre contributes to mitigating damage due to low light to the maize crop.

Photosynthetic responses of energy cane and sugarcane to ozone

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Ozone (O3) is a toxic air pollutant that impairs plant growth, and its effects on C4 species remain underexplored. We investigated the impact of O3 on leaf gas exchange in energy cane and sugarcane. As energy cane is more resilient to environmental stresses than sugarcane, we hypothesized that energy cane would be more tolerant to O3 as compared to sugarcane. Both species were exposed to three O3 levels (0, 150 and 300 ppb) for three consecutive days. After one day of exposure, photosynthesis decreased at 150 and 300 ppb O3 in both species, but sugarcane performance remained similar at both levels, while energy cane exhibited the lowest rates at 300 ppb O3. From the second day, there was no further decline in photosynthesis of sugarcane and energy cane due to O3. After one day of O3 exposure, changes in photosynthesis of both species were supported by reduced photochemical efficiency (ΦPSII) at 150 ppb O3 and by low stomatal conductance (gs) and low ΦPSII at 300 ppb O3. Significant stomatal closure in sugarcane at 150 ppb O3 was noticed only after three days of exposure. After three days of exposure, the maximum carboxylation rates of Rubisco (Vcmax) and PEPC (Vpmax) were decreased at both 150 and 300 ppb O3, with the lowest values found at the highest O3 level. Energy cane presented similar or higher Vpmax and Vcmax than sugarcane under O3 exposure, which is in accordance with its higher photosynthetic rates. However, energy cane photosynthesis declined by 0.30 umol m-2 s-1 per each 10-ppb O3 increase, while sugarcane photosynthesis declined only 0.20 umol m-2 s-1. When compared to sugarcane, energy cane presented similar or lower gs under high O3. Concluding, energy cane photosynthesis was more sensitive to increasing [O3] than sugarcane, which was associated with a sharp decline in Vcmax.

Physical-chemical and bioactive characterization of grapes cv. BRS Carmem in different soil drainage conditions

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The BRS Carmem vine is a long-cycle cultivar, widely used for making juices, mainly due to its intense violet color. The objective of this study was to physically and chemically characterize the grapes cv. BRS Carmem under different water availability regimes, in a productive area in the municipality of Guarapari-ES. The fruits were analyzed for total soluble solids (TSS), titratable acidity (TA), anthocyanins, phenolic compounds and antioxidant activity (DPPH and FRAP methods). Two areas of the orchard were evaluated: one with a superficial water table (area 1) and the other with a deep-water table (area 2), due to the elevation of the terrain. The results showed the area with the greatest proximity to the water table, presenting SST of 21.0 ºBrix and AT of 0.77%, while the area with less water availability, recorded SST of 21.79 ºBrix and AT of 0.55%, which favored a higher rate of berry maturation. In relation to phenolic compounds, area 1 presented a higher concentration of anthocyanins (25.45 mg/100 g) compared to area 2 (22.03 mg/100 g). The content of total phenolic compounds was 130.14 mg gallic acid/g in area 1 and 135.47 mg gallic acid/g in area 2. The antioxidant activity, measured by the DPPH and FRAP methods, in area 1 was 1114.74 µM Fe+2 g-1 FW (FRAP) and 92.12 µmol Trolox g-1 FW (DPPH). In area 2, the values were 1062.87 µM Fe+2 g-1 FW (FRAP) and 108.86 µmol Trolox g-1 FW (DPPH). The results show that the physicochemical and bioactive characteristics of BRS Carmem grapes were negatively influenced by the presence of a superficial water table, in which there was a reduction in the TSS/TA ratio, and in the synthesis of antioxidant metabolism compounds, which may indicate damage to quality end of fruits produced under conditions of greater water availability.

Physiological and biochemical analysis of wheat (Triticum aestivum L) under different levels of irrigation

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Brazil is the world's ninth largest consumer of wheat (Triticum aestivum L) but does not produce enough to meet demand, meaning that increased production is necessary to guarantee self-sufficiency. Wheat can be grown during the off-season or under irrigation in the Brazilian Cerrado. However, wheat is susceptible to water deficit conditions and increased temperatures and decreased precipitation will likely cause reduced productivity. The development of wheat genotypes with increased stress tolerance and water use efficiency is therefore important. This project aims to understand how water stress affects the physiology and metabolism of wheat in the field under different irrigation conditions. The genotype PF020037 was planted at Embrapa Cerrados in 2022 and 2023. From emergence to the tillering stage irrigations were homogeneous, and after this phase a bar with sprinklers with different flows was used to produce a gradient of 100%, 83%, 50% and 30% replacement of transpirational water loss across the plot. Gas exchange analysis in 2023 confirmed that lower levels of irrigation resulted in decreased net photosynthesis, stomatal conductance and transpiration. Plants were collected at two points during reproductive growth in 2022 for biochemical analysis. Dry mass of organs did not vary between treatments. Starch increased in the 30% treatment in stalks, but was unaffected by irrigation in the other organs. Starch concentrations increased between the harvests in the stalks, leaves and grains, but decreased between the harvests in the flag leaves. HPLC analysis indicated that stalks accumulate sugars under water deficit. Stalks also contained a greater carbon percentage under the 50% irrigation whilst we detected decreased nitrogen in both stalks and leaves in the more stressed treatments. GC-MS analysis revealed that water deficit resulted in increased fatty acids in grains. Overall, decreased irrigation resulted in more rapid senescence together with alterations in carbohydrate metabolism in wheat stalks.

Physiological and biochemical mechanisms of acclimatization to drought stress induced by elevated CO_2 in sugarcane leaves

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Cell wall (CW) plasticity is a critical mechanism that regulates plant growth and development. Its dynamic structure is closely connected to sugar metabolism and turgor pressure. The latter is highly responsive to environmental factors such as elevated CO2 (eCO2) atmospheric concentration and water availability (1,2). These factors are particularly relevant to climate change, with global food and plant-based energy security implications. This study investigates physiological changes and CW composition in sugarcane plants cultivated in eCO2, drought, and both combined effects. We subjected plants to 780 ppm of CO2 with watering or drought and analyzed plant growth, CW composition, and molecular analysis. Our findings show that sugarcane leaves increased biomass by 63.9% under eCO2. This growth is likely associated with CW modifications in pectins, possibly linked to the reduction of homogalacturonan and galactan branches of rhamnogalacturonan-I (RG-I), as evidenced by decreased galactose levels and the underexpression of GalE. Additionally, changes in glucose solubility suggest a decrease in mixed-linkage glucan content and an increase in cellulose. Under drought conditions, we observed a 44.6% reduction in plant biomass and a 13.8% decrease in CW biomass. CW composition analysis also revealed a reduction in uronic acid, likely related to changes in arabinogalactan branches within RG-I, altering CW hydrophobicity. The observed reduction in arabinose content and decreased expression of XAT indicate reduced arabinosylation of glucuronoarabinoxylan, leading to increased CW recalcitrance under eCO2. When eCO2 and drought were combined, a buffered effect on growth was observed. However, CW composition remained similar to drought conditions, albeit with less pronounced effects. These results show that the buffered growth effect may be associated with improved water use efficiency under eCO2, detected physiologically, which is combined with increased turgor pressure under drought conditions. This work confirms previous observations of a "buffer effect" of eCO2 on drought in sugarcane.

PHYSIOLOGICAL MONITORING OF Capsicum spp. USING LEAF REFLECTANCE INDICES

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Evaluating leaf reflectance indices (LRIs) is a crucial tool for monitoring plant physiology. The aim of this study was to investigate and estimate the physiological parameters of plants of the genus Capsicum (chili and sweet peppers) at the reproductive stage, using LRIs. A total of 29 pepper genotypes were selected from the germplasm collection of the Darcy Ribeiro State University of Northern Rio de Janeiro. They were grown in a randomized block design with three replications and plots with three plants. Leaf reflectance measurements were taken with a mini leaf spectrometer (CID BIOScience, model CI-710-HB), covering the spectral range from 400 to 1000 nm, at 10-day intervals, from anthesis to full fruit development, totaling three measurements. The reflectance indices evaluated included NDVI (Normalized Difference Vegetation Index), ARI (Anthocyanin Reflectance Index) and PRI (Photochemical Reflectance Index). The results showed significant variations between the genotypes for all the indices evaluated. NDVI ranged from 0.41 to 0.74, indicating differences in green intensity and biomass density. The ARI ranged from 3.8x10-4 to approximately 0.007, suggesting variations in the proportion of anthocyanins in relation to chlorophyll, and reflecting an investment by the plants in protection against excess light. The PRI ranged from -0.015 to 0.055, showing differences in the efficiency of light use by the genotypes. The variability observed in PRI suggests increased responses in photosynthetic efficiency during fruit formation. The greatest differences in the indices occurred at the second stage, corresponding to the start of fruiting. This study highlights the importance of evaluating leaf reflectance indices as a non-destructive tool for understanding the physiology of Capsicum spp. during flowering and fruiting.

Physiological responses of sugarcane to aluminum stress: pathways to agricultural resilience and Sustainability

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Sugarcane holds global significance, serving as a vital resource in the production of biofuels and food industry. However, environmental challenges such as aluminum (Al) contamination in the soils threaten its productivity. In acidic soils, Al becomes available in Al3+ form, limiting plant growth and development, consequently reducing crop yield. This study investigated the physiological effects of Al toxicity on different sugarcane cultivars, aiming to identify tolerant cultivars to support sustainable agricultural expansion. Sixty-day-old seedlings from eight genotypes were grown in a hydroponic system containing a nutrient solution or a solution supplemented 221 µM AlCl3. The pH was adjusted to 4.5 in both conditions. On the 10th day, physiological parameters such as non-photochemical quenching (NPQt), effective quantum yield of photosystem II (Φ2), non-photochemical quantum yield of photosystem II (ΦNO), quantum yield of photosystem II due to thermal energy dissipation (ΦNPQ), linear electron transport rate (qL), and SPAD index were measured with MultispeQ (v 2.0). Pigment indices (anthocyanins, flavonoids, chlorophyll) and nitrogen (N) balance index were assessed with the MPM-100. Data were subjected to analysis of variance and Tukey's test ($p < 0.05$). The RB867515 cultivar was the most sensitive to Al, with lower averages for Φ2, ΦNO, ΦNPQ, and qL. In contrast, the RB966928 cultivar was the most tolerant, exhibiting higher values for these parameters, indicating superior photosynthetic efficiency and a better balance between photochemical and non-photochemical processes under stress. Additionally, RB867515 displayed a lower N balance index and a higher flavonoid index, suggesting a higher potential for fresh mass reduction and enhanced antioxidant activity to cope with stress, respectively. These findings contribute to the understanding of Al-induced physiological effects in sugarcane and aid in the selection of tolerant cultivars, aiming to achieve food security in the face of environmental contamination.

Plant growth-promoting bacteria alleviate drought damage in forage cactus pear plants by enhancing nitrogen accumulation and defense mechanisms

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Exploring sustainable management strategies to strengthen plant resistance to drought is essential for agriculture in challenging environments. Forage cactus pear is a CAM-metabolism plant widely adapted to dry regions, commonly used for animal feed and human consumption in various countries. Although it exhibits high performance under low water availability, its growth is still reduced during drought. This study aimed to investigate the role of Plant Growth-Promoting Bacterial (PGPB) strains on provide nitrogen and improve the performance of forage cactus pear under drought using physiological indicators. The experiment was carried out in greenhouse using forage cactus plants in randomized block experimental design, 8 × 2 factorial scheme, consisting of eight inoculation treatments [inoculation with Paenibacillus sp. IPACC38 and IPACC55, and Bacillus subtilis IPACC29 strains combined with and without nitrogen (N) fertilization] and two water regimes [well-irrigated control at 50% field capacity (FC) and drought at 25% FC]. In all cases, cladode succulence decreased, and cladode temperature increased in drought-stressed plants compared to well-irrigated ones, regardless of PGPB inoculation. Nitrogen accumulation remained unchanged or increased in the cladodes but decreased in the roots of stressed plants, depending on the treatment. Additionally, drought increased the levels of photosynthetic pigments in plants across all inoculation treatments. The best performance under drought was observed in plants grown without N and inoculated with IPACC29 and IPACC38 strains. Improved performance under drought was closely related to PGPB's capacity to provide nitrogen accumulation for strategic photosynthetic pigments content. In conclusion, the data reveal the IPACC29 and IPACC38 as the most promising PGPB strains for inoculating forage cactus pear, activating important defense responses against drought.

PLANTS AS "GREEN PHONES": NOVEL INSIGHTS INTO PLANT-PLANT COMMUNICATION

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Volatile organic compounds (VOCs) are crucial for plant-to-plant communication, playing a key role in priming plant defense responses and influencing interactions with neighboring plants. This study aims to investigate (i) how receiver plant responses are modulated by a pool of constitutive and/or induced VOCs released by emitter soybean plants, and (ii) how this information is perceived, processed, and transduced to elicit metabolic responses in receiver plants. Emitter soybean plants were divided into two groups: 1) MeSA-treated plants (100 µM) and 2) Mock-treated plants (distilled water), which stimulate the emission of induced and constitutive VOC signals, respectively. Both groups were exposed to two water conditions: irrigated and water deficit. The VOCs released by emitter plants were affected by both water deficit and MeSA treatment. Under water deficit conditions, MeSA-treated emitter plants showed increased emission of green leaf volatiles (GLVs), such as 4-hexen-1-ol acetate, compared to Mock-treated plants under the same condition. Additionally, water deficit led to increased emission of butyrolactone, 2-pentanol acetate, and benzamide. Principal Component Analysis (PCA) based on all parameters evaluated in receivers soybean plants of the VOCs signals released by emitters soybean plants after application of MeSA or H2O revealed that irrigated receiver plants exhibited similar behavior, whereas Mock-treated plants under water deficit were isolated, and MeSA-treated plants clustered closer to the irrigated plants. The VOCs pool released by MeSA-treated emitter plants resulted in increased carotenoid content and superoxide dismutase (SOD) activity in receiver plants and primed their responses upon water deficit, enhancing growth and reducing lipid peroxidation. This study explores the potential of MeSA as an elicitor of airborne defenses, improving receiver plants responses to water deficit. These findings provide new insights into how receiver plants can utilize infochemicals to optimize their defense strategies against abiotic stress.

POPCORN LINES: PHOTOSYNTHESIS AND YIELD IN SOIL WATER LIMITATION

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In many regions, popcorn is cultivated for human consumption, but soil water limitation can negatively affect growth, damaging key physiological processes such as net CO2 assimilation rate (Anet), stomatal conductance (gs), maximum quantum yield of photosystem II (Fv/Fm), and yield. This study evaluated three popcorn genotypes, L204, L291, and L391, under two water conditions: well-watered (WW) and water-stressed (WS). Water stress was applied 15 days before male anthesis and continued until physiological maturation. Agronomic traits, single-leaf gas exchange, photochemical efficiency, and leaf spectral reflectance were assessed weekly from noon to 2:00 PM, starting with the onset of water deficit. Yield was measured at the experiment's end after grain harvesting and threshing. Data were analyzed using 'ExpDes' in 'R', with means compared by Tukey's test at 5% significance. Under WS, L291 and L391 showed significant reductions in Anet, gs, and yield. In the WW condition, L204 and L291 had higher Anet and gs values, with similar yields across both water treatments. L391 maintained a high Fv/Fm under WS, indicating greater photosystem II efficiency but significantly reduced yield. This reduction may be attributed to lower Anet and gs values. L204 consistently showed higher Anet and gs values in both conditions and maintained these higher values under WS, particularly at 35 days after stress. L391 had higher Fv/Fm under WS but lower yield compared to L204 and L291. The study suggests that L204 has a higher yield potential under WS due to its superior photosynthetic capacity.

Post-harvest conservation of Alstroemeria hybrida with essential oil under refrigeration

ANNE CAROLINNE MOREIRA DE SOUZA JESUS, Isabella Lohany Ferreira Gomes

In Brazil, the flower and ornamental plant production sector has been gaining prominence as an economically growing activity of great significance in national agribusiness. One of the main cut flowers sold is Alstroemeria hybrida, due to the beauty of its flowers and because it has several uses, including arrangements as the main flower or as a complement to bouquets of other cut flowers. Despite being economically relevant, this species has an average longevity, which motivates studies to extend the vase life of flowers through preservative products in the solution, with emphasis on the use of natural products to replace synthetic products. Within this context, the present study aims to evaluate the effect of eucalyptus (Eucalyptus globulus) and rosemary (Rosmarinus officinalis) essential oil on the post-harvest conservation of A. hybrida cv. Whitney kept in cold storage. Assessments were carried out daily, observing longevity, turgidity and darkening of the stems, loss of fresh mass and absorbed volume. It was found that conditioning the floral stems in solutions containing eucalyptus and rosemary oil, under refrigeration (5°C), provided longer vase life than at room temperature (25°C), with increments of 15 and 5 days compared to room temperature. Stems of A. hybrida cv. Whitney stored at 5 °C, regardless of the concentration of eucalyptus and rosemary oil, showed a delay in the appearance of symptoms of loss of turgidity, darkening and loss of fresh mass, in addition to lower absorbed volume.Therefore, it is concluded that, regardless of the use of eucalyptus and rosemary essential oil, the conservation of A. hybrida L. cv. Whitney is promoted by cold storage.

Potential of the Bio-stimulant CropEvo in Overcoming Heat Stress in Irrigated Rice

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The occurrence of extreme climate events has led to an increase in the Earth's temperature, becoming a limiting factor for agricultural production and making this topic the focus of numerous studies. In search of ways to mitigate the negative effects of this abiotic factor on agricultural crops, this study evaluated the effect of applying the bio-stimulant CropEvo® in response to heat stress in irrigated rice plants. The experiment was conducted in the field, at the experimental area of the Federal University of Pelotas (UFPel), using the irrigated rice cultivar IRGA 424 RI. The bio-stimulant was applied at stages R0 and R2 (250 mL ha-1) via foliar spray, with the following treatments: T1: Control; T2: Heat stress (stage R0 to R4); T3: Heat stress (stage R0 to R4) + CropEvo®; T4: Heat stress (stage R5 to R8); and T5: Heat stress (stage R5 to R8) + CropEvo®. Heat stress was induced by using small greenhouses installed over the plants (3.0 m²), raising the temperature by 5±2°C compared to the ambient temperature. For treatments T2 and T3, the greenhouses were kept over the plants during stage R0 to R4, and for treatments T4 and T5, during stage R5 to R8. Chlorophyll index was assessed at stages R3 and R6, and at the end, spikelet sterility and yield were evaluated. There was a significant increase in the chlorophyll index in the treatments with the application of the bio-stimulant. Regarding spikelet sterility, heat stress caused a significant increase, although it was lower in treatments with the bio-stimulant. Comparing the heat stress treatments for yield, in the absence of the bio-stimulant, the first period (R0/R4) saw a reduction of 2.1 tons ha-1 and the second period (R5/R8), a reduction of 3.6 tons ha-1.

PROTECTIVE PARTICLE FILMS PREVENT ANATOMICAL DISORDERS IN CITRUS LEAF FROM EXCESS IRRADIATION

Gabriel Antonio Bortoloti, Lucas Giovani Pastore Bernardi, João Paulo Marques, Rodrigo Marcelli Boaretto, Dirceu Mattos Junior

Climate change impacts agricultural crops, causing yield losses linked to excess energy on leaves and high temperatures, which induce morphoanatomical leaf adaptations. Reflective kaolin or calcium carbonate films have been proposed to protect plants from heat waves. This study aimed to evaluate the reflectance of kaolin or calcium carbonate particles sprayed on leaves and the corresponding cellular and organelle changes under different irradiances. Conducted in open fields with Citrus sinensis (L.) Osb., the study involved five treatments: (1) control (water); (2) kaolin (30 g L^{-1}, 1 µm); (3) calcium carbonate (30 g L^{-1}, <1 µm); (4) aluminum shade cloth (Aluminet® 50%); and (5) LDPE plastic (150 µm, anti-UV, >80% transmissivity). Treatments were applied 15 days before high irradiance and temperature, with plant evaluations over 30 days. Leaf reflectance was measured with a spectrophotometer, and leaves were analyzed by optical microscopy. Reflectivity was averaged from 6 sprayed plants, and cuticle thickness was measured on 4 leaves per treatment. ANOVA was performed for each variable. Leaf reflectivity was ~22% higher in plants sprayed with kaolin or calcium carbonate than in control. Full-sun leaves showed anatomical differences from shaded leaves, with irregular adaxial surfaces. The cuticle was 1.9 times thicker in the full-sun control than kaolin and 1.7 times thicker than calcium carbonate. Under aluminum shade cloth, no differences were observed between treatments, but the anti-UV treatment had a similar thickness to calcium carbonate. Unlike other treatments, the fully exposed leaves exhibited mesophyll hyperplasia and anticlinal divisions in palisade parenchyma cells. Control oil cavities were irregular, with wrinkled cell walls and reduced lumens. Full-sun treatment also led to phenolic compound accumulation, unlike other treatments. These results show that protective particle films prevented tissue disorganization from excessive irradiation in citrus leaves.

Prunus Hexokinase 3 affects photosynthesis and tolerance to recurrent drought and flooding in transgenic Arabidopsis

Jonatan Egewarth, Rubén Almada, Jorge Pérez Díaz, Ixia Lienqueo, Luis Villar, Valmor João Bianchi

Hexokinases (HXKs) are important enzymes in plants, playing a significant role in signaling various metabolic activities. Studies have shown that the flood-tolerant Prunus rootstock ‘Mariana 2624’ (M2624) exhibits higher expression of HXK3 gene under flooding. To assess the role of M2624 HXK3 in plant response(es) to abiotic stresses, Arabidopsis wild type plants (wt) and Arabidopsis plants ectopically expressing M2624 HXK3 (M5 and M7) were expossed to drought, flooding, and recurrent stresses and their photosynthesis and tolerance were evaluated. Three genotypes (wt, M5 and M7) were tested under eight drought contitions (DC) [well-watered (WW); 6-day DC; 6-day DC + 5-day WW; 6-day DC + 5-day WW + 6-day DC; and after 5-day ww for all of these conditions], and under eight flooding conditions (FC) (WW; 11-day FC; 11-day FC + 4-day WW; 11-day FC + 4-day WW + 11-day FC; and after 4-day WW for all of these conditions). Both experiments took place at the Centro de Estudios Avanzados en Fruticultura (Chile). Gas exchange and fluorescence parameters were measured using a portable photosynthesis system and a Pocket-PEA portable fluorometer, respectively. The transgenic lines were visibly more tolerant to recurrent drought and flooding compared to the wt. Under drought contition, M5 and M7 presented lower gs and E, along with higher A, A/gs and A/E than wt, indicating better stomatal regulation and water-use efficiency. In terms of fluorescence parameters, the wt exhibited the highest F0 and FK values. During flooding, the wt showed the lowest values for A, E, FV/F0, ϕP0, ψE0 and ϕE0, and the highest values for F0, FK, FJ, FI, ABS/RC, DI0/RC and TR0/RC, suggesting possible damage to photosystem II. These findings demonstrate that the Prunus Hexokinase 3 enzyme in transgenic Arabidopsis enhances photosynthetic efficiency under recurrent drought and flooding, influencing both the photochemical and biochemical phases of photosynthesis.

RESOLUTION OF THE GROWTH VERSUS DEFENSE ANTAGONISM IN TOMATO (SOLANUM LYCOPERSICUM)

Thalliane Raissa da Silva Xavier Moura, Camila Santana de Amorim, Felipe Augusto Queiroz de Almeida, Maria Luísa Neri Campos, João Pedro Stabenow Gil, Marcelo Lattarulo Campos

An obstacle to generating plants that are more resilient to pest and pathogen attack is known as the “dilemma of plants”, a physiological phenomenon where the activation of defense is associated with the inactivation of growth and vice-versa. Recently, we demonstrated that it is possible to decouple growth and defense in the plant model Arabidopsis thaliana via activation of the jasmonate (JA) and gibberellin (GA) transcriptional modules. However, this strategy has not yet been proven in economically important plants. In this work, we carried out a comprehensive characterization of a tomato (Solanum lycopersicum) double mutant that carries constitutive activation of the GA and JAs pathways via removal of the DELLA repressor (procera - pro) and overexpression of the prosystemin gene (Prosystemin overexpressor - Ps) respectively. This double mutant, named proPs, showed exacerbated growth, faster stem elongation and promotion of photosynthesis parameters, as observed in the parental mutant pro. Strikingly, proPs also shows increased density of non-glandular trichomes in the leaves and higher resistance to Spodoptera frugiperda attack, suggesting a promotion of defenses as observed in the parental mutant Ps. These results indicate that rewiring of the JA/GA transcriptional module resolves the growth versus antagonism dilemma in tomato, with enormous potential for the development of high performance cultivars in this species.

SALICYLIC ACID REGULATES STOMATA AND GAS EXCHANGE PARAMETERS IN YOUNG CITRUS PLANTS UNDER WATER/SALT STRESSES

Milton Carriço Sá, Raul Antonio Araújo do Bonfim, Gustavo Kawan Almeida Costa, Camila Valentim Silva Sousa, Paulo Araquém Ramos Cairo

Both soil drought and salinity cause osmotic stress by reducing the water potential of plant cells and negatively affecting gas exchange and photosynthesis, significantly limiting plant growth and development. We hypothesized that exogenous salicylic acid may enhance stomatal control of gas exchange, improving plant tolerance to drought and salinity stresses. In this study, we evaluated the effects of SA application on gas exchange-related traits in young citrus plants subjected to these twin abiotic stresses alone and simultaneously. A greenhouse experiment was conducted with seven-month-old citrus plants using a completely randomized design in a 4 × 4 factorial scheme. Net photosynthetic rate (A), stomatal conductance (gs), and intrinsic water use efficiency (iWUE = A/gs) were measured in plants treated with 0, 1, 2, and 4 mM SA spraying under the following growth conditions: control, with well-watered plants without salinity; water deficit (WD), with 45% of pot capacity; salinity (S), with well-watered plants and salinity; and WD+S, with simultaneous water deficit and salinity. Salinity was established using 100 mM NaCl. The results showed that stress conditions reduced A and gs, notably under S and WD+S (~70%), compared to the control. However, this lowering under stress conditions was attenuated with 2 mM SA application. Under WD+S conditions, iWUE was similar to the control, even with SA application. Conversely, iWUE increased in plants under WD and S conditions (~45%), both in the absence of exogenous SA and in those treated with 1 mM SA, suggesting an enhanced stomatal control of transpiration. We conclude that under stress conditions exogenous SA acts on stomatal control, leading to different effects depending on the predominant stress, i.e., attenuation of the reduction in photosynthesis under S and WD+S conditions or enhancement of iWUE under WD and S conditions.

SALINE STRESS AFFECTS THE MORPHOPHYSIOLOGY OF LIPPIA ALBA L. IN VITRO

Elyabe Monteiro de Matos, Laís Stehling de Queiroz Nascimento, Juliana Mainenti Leal Lopes, Evandro Alexandre Fortini, Wagner Campos Otoni, Lyderson Facio Viccini

Lippia alba (Mill) N.E. Brown (Verbenaceae), is a medicinal species whose composition of its essential oil is associated with ploidal levels. Polyploidy and environmental variations can lead to significant changes in the metabolic pathway and consequently, influence the phenotype. The understanding of the spectrum of such variation requires specific experimental conditions that show the possibility of modulating the production of secondary metabolites. Here, three ploidal levels were cultivated in vitro under salt stress (60 mM of NaCl). Morphological, biochemical, and physiological traits were evaluated. After 40 days of culture, we observed that saline stress can modulate the primary and secondary metabolism. The diploid accession showed a decrease in shoot length, number of nodes, number of leaves, and total fresh mass weight. There was an increase in the length of the largest root when compared to the triploid in the absence of NaCl. A decrease in shoot length and number of leaves was identified when compared to polyploid accessions submitted to 60 mM NaCl. The triploid accession did not show significant differences for aerial growth variables. However, the length of the largest root increased under saline stress. The tetraploid accession showed significant increase for root length, total fresh mass weight, leaf fresh mass weight, and root fresh mass weight when compared to the other ploidy levels under salt stress. The diploid accession showed an increase in the antioxidant enzymes ascorbate peroxidase, catalase, and peroxidase. The triploid showed a significant reduction in the fluorescence of photochemical efficiency and, the tetraploid accession did not present significant changes for the evaluated parameters. The results indicates that saline stress can influence the phenotype and putatively the essential oil production, opening new possibilities for use and improvement of the species.

Salt stress affects metabolism, growth, and yield of rice in a spatio-temporal-multiscale perspective

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The dynamic of metabolic processes involved with salt stress and grain filling in a spatio-temporal-multiscale perspective is virtually unknown. Our hypothesis was test if salinity affects differently rice modules (roots, culms, different leaves, and panicles), in distinct ontogenetic times and under different scales of observation. Rice plants faced salinity at begin of the vegetative phase (V4/25 mM), increasing in V7/50 mM and remaining until the seed maturation (reproductive stages of R7 and R9). Different plant modules displayed distinct responses to salt stress indicating differential salt sensitivity and metabolic regulation in a temporal scale. For instance, in roots the profile of nitrogenous compounds (proteins, free amino acids, ammonium, metabolites, and GS activity) is greatly more stable, followed by culms, than in leaves. The PCA and PLS-DA analyses corroborated that different parts of the plants displayed distinct grouping in response to salt stress. Between leaves, the oldest basal ones are more sensitive to salt stress in terms of degradation of proteins and biomass, resulting great deposition of free amino acids and ammonium, compared with mature and young leaves. These responses suggest that rice utilize the oldest leaves act as an essential apparatus to receive the biggest negative impacts of the salinity, as indicated by immense accumulation of saline ions. That strategy should minimize some negative effects of salt stress (an exclusion mechanism) on the youngest tissues, but it was not enough possibly due to the salt stress intensity. Indeed, these intense metabolic disturbances induced by salt stress throughout the vegetative phases greatly impacted on the filling grain process resulting very low seed growth, yield, and poor germinative capacity. These obtained data reinforce the needed to perform integrative and systemic studies to understand the underlying physiological mechanisms involved with salt stress to establishment of confident stress physiological marketers for salt resistant genotypes.

SALT TOLERANCE AND WATER REQUIREMENTS IMPACTING BIOSALINE AGRICULTURE IN REALISTIC SCENARIOS OF THE TROPICAL SEMIARID

Claudivan Feitosa de Lacerda, Carla Ingryd Nojosa Lessa, Antonia Leila Rocha Neves

Salt stress is one of the most studied topics in plant physiology, and plant salt tolerance is an alternative for sustainable production using saline resources (salt-affected soils and brackish waters) in drylands. However, in addition to the restriction caused by salinity, water availability is another factor that affects production. In the Brazilian semiarid region, for example, most wells with brackish water have low flow rates, which limits large-scale production. Therefore, the objective of this study was to identify the potential of brackish groundwater, based on salt tolerance and the relationship between water demand and availability, in real scenario of the Brazilian semiarid. So, a database with chemical analysis of water from 6,284 wells with brackish water of the State of Ceará, Brazil, with electrical conductivity ≥ 0.8 dS m-1 and flow rate ≥ 0.5 m3 h-1, was used. Data of water requirement and threshold salinity of six production systems (full and supplemental irrigation of maize, forage cactus, melon, coconut orchard, hydroponics, and coconut seedling production) were also considered. The biosaline agriculture systems with lower water requirement (supplemental irrigation, forage cactus, coconut seedling production, and hydroponics) have greater potential compared to systems that have high salt tolerance, such as the coconut orchard, but demand a lot of water. Therefore, the productive potential of the brackish groundwater of the Brazilian semiarid region does not depend only on the crop salt tolerance, but on the set of data from the production system (salt tolerance and water demand) and the water source (water salinity and flow rate). These results show that studies on stress physiology cannot focus on just one isolated factor, without considering real scenarios of the environment's natural resources, which require applied knowledge of plant physiology.

ScRAV1 overexpression affects sugarcane carbon allocation and cell wall modification

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Sugarcane is a crucial crop used for sugar and energy production. Second-generation (2G) bioethanol is derived from cell wall hydrolysis and can potentially boost bioethanol production, improving crop productivity without expanding planted areas. With sugarcane expansion, Brazilian ethanol could significantly offset carbon dioxide emissions from fossil fuels. However, there are gaps in understanding the cell wall structure, which contains one-third of the fermentable sugars for 2G bioethanol production. One key area of study is the regulation of cell wall biosynthesis and degradation since the walls contain most of the plant's carbon. Aerenchyma, a structure with large intercellular spaces in sugarcane roots, is formed through cell wall modulation. The transcription factor ScRAV1, which negatively regulates a cell wall hydrolase (endopolygalacturonase, encoded by ScEPG), triggers several changes within the plant, including cell wall modification during root aerenchyma formation. Understanding the cell wall modification process could open opportunities to enhance technology for 2G bioethanol production. This work aimed to elucidate the participation of ScRAV1 during aerenchyma formation in sugarcane roots by evaluating the changes induced in transgenic plants constitutively overexpressing ScRAV1 (OXScRAV1). OXScRAV1 plants displayed high ScRAV1 and target of rapamycin (ScTOR - a gene that controls sugar metabolism) expression. We observed that the amounts of sucrose were higher in the wild-type roots compared to OXScRAV1. Also, we confirmed that ScRAV1 controls ScEPG expression within sugarcane plants, promoting changes in plant cell wall polymers. In general, plants overexpressing ScRAV1 displayed reduced biomass of roots (-20%) and a delay in aerenchyma formation. These findings indicate that ScRAV1 plays a role in biomass allocation among sugarcane organs as it negatively regulates aerenchyma formation. This work could increase bioethanol production capacity and develop knowledge of sugarcane carbohydrate metabolism mechanisms.

Se mitigates thermal stress in cotton plants

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Thermal stress poses a significant threat to agriculture by harming plant physiology and reducing agricultural production, especially with climate change exacerbating these effects.

In cotton cultivation, high temperatures disrupt growth at all stages, particularly between 30°C and 40°C. This stress also increases oxidative stress in plants by disrupting cellular homeostasis and elevating reactive oxygen species (ROS) production.

Selenium (Se) helps mitigate thermal and oxidative stress by boosting antioxidant enzymes like superoxide dismutase (SOD), catalase (CAT), and ascorbate peroxidase (APX). This study aimed to determine the optimal foliar Se application doses to reduce thermal stress and enhance antioxidant metabolism in cotton plants.

The experiment was carried out in the laboratory of biology of FCE/UNESP, located in the city of Tupã, São Paulo, Brazil. The TMG-51 cotton variety was used, with three doses of Se (10, 25 and 50 gha-1). The experimental design was completely randomized, with one temperature: 38 ºC. The following parameters were evaluated: MDA (Heath and Packer, 1968), H2O2 (Alexieva et al., 2001), SOD (Giannopolitis and Ries, 1977), APX (Moldes et al., 2008), CAT (Azevedo et al., 1998) and total protein (Bradfort, 1976).

The application of 10 g ha-1 caused a reduction of 29% (MDA), reduction of 14% (H2O2), increase of 28% (APX), increase of 16% (Total Proteins). The 25 g ha-1 dose caused a reduction of 23% (MDA) and an increase of 51% (APX). The 50 g ha-1 dose caused an increase of 23% (SOD), 61% (CAT), 93% (APX) and 18% (Total Proteins) .

In summary, the 10 g ha^{-1} dose offered the best benefits for stress mitigation, including an overall increase in protein content and lower concentration of damaging agents. Regarding enzymes, this dose led to a reduction, likely due to a decreased need for dismutation.

SEASONAL BALANCE OF NON-STRUCTURAL CARBOHYDRATES IN A SPECIES WITH GREEN STEM IN A DRY FOREST

Juliana de Carvalho Paes Barreto, Joana Sherylyn Nicodemos Cordeiro, Adglecianne de Sousa Melo, Mauro Guida dos Santos

Drought is a natural condition that has been extensively studied in the literature due to its severity. Plant species living in these environments need to adopt strategies to survive under limited conditions. One of the adaptive traits commonly found in plants from seasonally dry tropical forests (SDTFs) is the strategy of leaf shedding during the dry season, which helps control the transpiration rate. However, there are adverse effects on carbon gain during the dry months since the most crucial photosynthetic tissue is absent. Consequently, some species perform photosynthesis through their stems. The objective of this study was to evaluate the effects of seasonality on the dynamics of NSC (Non-Structural Carbohydrates) in a deciduous woody species with a green stem, Commiphora leptophloeos. This species has low wood density, sheds its leaves at the beginning of the dry season, and maintains a high xylem water potential until the end of the dry season. Thus, we measured xylem water potential, leaf and stem chlorophyll fluorescence, and concentrations of total soluble sugars and starch at different times under semi-arid conditions. Our results suggested that the strategy of shedding leaves at the beginning of the dry season helped maintain a high xylem water potential throughout the dry season. During the leafless period, the NSC concentration decreased by one-third, with only the starch concentration in the stem remaining stable throughout the seasonal variation. Furthermore, the photochemical activity in the green stem changed during the dry season. Although the strategy of regrowth at the end of the dry season may seem advantageous, in a future semiarid climate scenario of prolonged droughts it could represent a risk for this species.

SEAWEED-BASED BIOSTIMULANTS IMPROVE SOYBEAN YIELD AND ACTIVATE METABOLIC PATHWAYS AGAINST DROUGHT WITHOUT AFFECTING GROWTH PERFORMANCE

Jeane Ferreira de Jesus, Renato Oliveira de Sousa, Stelamaris de Oliveira Paula Marinho, Gonçalves Albino Dauala, Karolayne Ribeiro Caetano, Rafael de Souza Miranda

In recent decades, water restriction has become one of the most limiting environmental factors for growth and yield of crops. The seaweed-based biostimulants has emerged as an alternative to mitigate the damage caused by abiotic stresses. Our study aimed to evaluate the efficiency of commercial biostimulant formulations on yield and metabolic performance of soybean cultivars typical of semi-arid regions under drought. The trials were conducted in a greenhouse using the Extrema cultivar under two water regimes (well-irrigated control and drought) and exposed to five foliar-applied biostimulants (a negative control without biostimulant, and four Ascophyllum nodosum-based commercial biostimulants - Bio 01, Bio 02, Bio 03, and Bio 04). The yield, photosynthetic machinery-related parameters, oxidative stress, antioxidant system, and metabolic profile were investigated. The Bio 01, applied at 1.5 L/ha in equal amounts at V4 and R1 stages, was identified as the most effective, enhancing net photosynthesis and water status, which led to a 12% increase in grain yield under well-irrigated conditions. Drought significantly decreased the photosynthetic pigments, stomatal conductance, transpiration, leading to severe restrictions in plant growth. The poor performance under drought was associated with increased membrane damage and hydrogen peroxide levels. Although the soybean plants activated pathways for water status and antioxidant enzyme activity, these responses were insufficient to neutralize oxidative damage. Under drought conditions, the biostimulants activated the accumulation of defense pathway metabolites (such as 4-aminobutyric acid, benzoic acid, shikimic acid, erythronic acid, arabinose, phenylalanine and threonine) and reprogrammed the antioxidant system, but these responses were ineffective in mitigating drought-induced damage on soybean performance, at least during the first 30 days of stress imposition. In conclusion, the biostimulants improve the yield under well-irrigated conditions but not enhance the performance of soybean cultivar typical of semi-arid regions under water restriction.

Secondary effects of water deficit on 'Valencia' orange tree

Elisângela Aparecida Da Silva, Mariana Vitória Silverio Alves, Cyntia Stephânia dos Santos

Cultivating the 'Valencia' orange is an option for citrus grower search for a late-ripening, highly productive variety with fruits in double demand, serving the fresh fruit market and processing. In the Citrus Belt, where citrus production predominates under rainfed conditions, climate related factors have been indicated by producers as those that most harm fruit production, in addition to phytosanitary problems. In view of the above, the objective of this work was to verify the impact of water deficit on the 'Valência' orange tree variety grafted on the 'Cravo' lemon tree. The study was carried out in a commercial orchard in a rainfed system in the Citrus Belt, North Sector, Frutal-MG. The evaluations were carried out between the dry period (July) and the rainy period (December), monitoring the settings of stomatal conductance (gs), relative water content in leaves (RWC), electrolyte extravasation (EE) and moisture content in the soil (SoilH). At the end of the dry period, characterized by the absence of precipitation and low relative air humidity, the lowest SoilH values (3.08%) were recorded, which impacted gs (24.61 mmol H2O m-2 s-1) and RWC (44.77%), reflecting higher values for EE (46.80%). With the onset of precipitation, a gradual return of gs was observed in the plants, in response to the increase in SoilH. The greatest variations were observed in the SoilH, EE and gs parameters in function water availability, which demonstrates the importance of these assessments in work that seek combinations of drought-tolerant varieties, for example. Our results allowed us to observe the physiological disorders caused by water deficit, resulting in secondary effects, such as reduction in stomatal conductance and destabilization of membranes. Such information, added to the production history, can assist the citrus grower in making management adjustments, recommending varieties and adopting irrigation systems.

SEED PRIMING WITH BIOSTIMULANT INDUCES MEMORY CAPACITY WHEN SOYBEAN PLANTS ARE SUBJECTED TO HEAT STRESS LATER ON THEIR VEGETATIVE STAGE

Helena Chaves Tasca, Rafaela Nunes Deves, Nícolas Xavier de Castro, Luís Felipe Basso, Douglas Antônio Posso, Thiago Franscisco de Carvalho Oliveira, Gabriela Niemeyer Reissig, Gustavo Maia Souza

Plant memory is a crucial adaptive mechanism for acclimation and survival, especially in response to the increasing intensity and frequency of abiotic stressful fator that challenge global agricultural production. Priming prepares plants for more effective responses, highlighting the use of biostimulants as a sustainable alternative to the increasing use of agrochemicals in agriculture, aiming to ensure ecological and human safety for future generations. Our objective was to investigate the effectiveness of using a biostimulant as seed priming in mitigating high-temperature stressful fator and acquiring short- and medium-term memory in soybean plants. A greenhouse experiment was conducted with Valente soybean cultivar, applying different biostimulant doses to seeds (0, 2, and 4 ml) and subjecting plants to high-temperature stressful fator at the V3 or V6 stages. Stomatal conductance and evapotranspiration in plants stressed at V3 were reduced across all priming treatments. However, when stress was applied at V6, plants primed with 4 ml of biostimulant showed increased values in these variables, suggesting the presence of medium-term memory. This same group of plants exhibited a higher electron transport rate when stressed at V3 and evaluated at V6 to verify their recovery. No differences were observed in plants stressed at V3, but those stressed at V6 with 4 ml seed priming had higher photosystem II quantum efficiency, suggesting medium-term memory. Supporting these physiological data, superoxide radical content was lower in V6-stressed plants that received seed priming. These findings suggest that 4 ml biostimulant seed priming promotes better responses in V6-stressed plants, likely due to enhanced physiological support under these conditions.

SELENIUM REGULATES ROS SCAVENGING SYSTEMS ENHANCING CARBON METABOLISM TO MITIGATE DROUGHT STRESS IN MAIZE PLANTS

Andre Rodrigues dos Reis, Pedro Henrique Gorni

Drought stress alters plant metabolism, reducing photosynthesis, disrupting water uptake, and triggering protective mechanisms to enhance survival under dehydration. Selenium (Se) is considered benefit element for higher plants due to antioxidant capacity and mitigation of abiotic stresses. Drought stress limits maize growth by interrupting biochemical and physiological functions. This study aimed to investigate the physiological responses of Se-fortified maize plants to drought stress. Maize seedlings were exposed to water deficit (50% of soil water retention capacity) and foliar Se application at 50 g ha−1. Maize seedlings not exposed to water stress or Se were used as controls. Exposure of maize seedlings to WD resulted in a significant decrease ($p < 0.05$) in growth parameters and biochemical parameters compared to the control. In addition, decreased photosynthetic pigments, gas exchanges, chlorophyll fluorescence, PEPCase and Rubisco activities, and N-compounds were observed. Plants fertilized with Se showed increases in maize growth under WD and favorable conditions. Gas exchanges, chlorophyll fluorescence, photosynthetic pigments, PEPCase and Rubisco activities increased in response to Se fertilization. Enhanced antioxidant (SOD, CAT, APX, GR, GPx and LOX) and carbon enzyme activities and sugar metabolism resulted in the mitigation of ROS formation. Positive responses were also found in proline metabolism enzymes (P5CS, P5CR and ProDH) and osmolyte levels in maize plants treated with Se. Foliar application of Se at the V3 stage led to the accumulation of this element in the grains. Therefore, Se supplementation in maize plants under WD and favorable conditions enabled an osmotic adjustment, providing better drought tolerance increasing the growth and yield of maize plants.

SILICON INDUCES ROOT BORDER CELL PRODUCTION IN SOYBEAN MITIGATING ALUMINUM TOXICITY

Thaís Vida Catini, Bruno Guilherme Gonçalves, Elen Silma Oliveira Cruz Ximenes, Cleberson Ribeiro

High saturation of aluminum (Al) it is typically observed in acid soils, a toxic condition for crops, which can result in low agricultural yields. Several studies have been carried out to mitigate this toxicity, the use of silicon (Si) has been a promising path. Another mechanism involved with plant Al resistance is the external detoxification performed by root border cells (RBCs) associated with mucilage. In this study, we evaluated the association of Si and RBCs in the mitigation of stress effects by Al in soybean seedlings. The experiment was conducted for 48 hours, in a completely randomized design with 5 replicates, cultivated in a nursery and using hydroponic system. The treatments were a combination of the presence and absence of Si (1mM) with three concentrations of Al (0, 100, 300 μM). After exposure to higher concentration of Al (300 μM), the seedlings showed limited development and inhibited root growth due to high accumulation of Al in the root tips, which resulted in oxidative stress and cell death. However, the treatment with 100 μM did not affect the development of seedling. On the other hand, the addition of Si increased the presence of RBCs and mucilage biosynthesis, decreasing the accumulation of Al which avoided oxidative stress and damage to the root tip membrane, allowing improved soybean performance. Proline, phenolic compounds and malate biosynthesis are closely linked with response mechanisms of Al tolerance, and under severe stress, the roots accumulate glucose and starch. In the current study, we report that Si mitigates the toxic impacts of Al on soybean, operating as a beneficial element to improve crop development in acidic soils.

SILICON SUPPLEMENTATION ENHANCES SUGARCANE YIELD BY REGULATING TECHNOLOGICAL PARAMETERS RATHER THAN PHYSIOLOGICAL RESPONSES

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Silicon (Si) is recognized as a beneficial nutrient for various plant species, playing a crucial role in enhancing plant defenses against both biotic and abiotic stresses. Thus, Si may constitute an alternative for improving the nutritional management of sugarcane in semiarid climate conditions. This study aimed to investigate the impacts of a soluble Si source (sodium silicate - Na2SiO3) on the physiological performance, productivity, and certain technological parameters of sugarcane plants. The experiment was conducted at a commercial site (COMVAP Açúcar e Álcool LTDA) located in União, Piauí, Brazil. It employed a 2 × 2 factorial design, comprising two sugarcane varieties (RB92579 and RB021754) and two Si concentrations applied via soil spraying (0 and 2 mmol L^{-1}), arranged in a randomized block design with four replications. Gas exchanges, chlorophyll a fluorescence, and photosynthetic pigments were measured during the vegetative stage of the crop. Stalk productivity was estimated at harvest, and after harvest, the total sugar yield and apparent sucrose content of the juice were determined. In general, the RB92579 sugarcane variety exhibited higher values for net photosynthesis, transpiration, stomatal conductance, chlorophyll a, total chlorophyll, and carotenoids compared to the RB021754 variety. However, gas exchanges, photosynthetic pigments, and photosystem II efficiency were not significantly affected by Si treatment in either varieties, except for stomatal conductance in RB92579, which increased with Si supplementation. On the other hand, Si supplementation significantly increased stalk productivity in both cultivars, as well as total sugar yield and sucrose content, with no significant differences between the varieties. In conclusion, while the RB92579 variety demonstrates superior physiological performance, this does not translate into higher productivity. Silicon in the form of sodium silicate (Na2SiO3) does not improve physiological conditioning but enhances stalk productivity and technological parameters associated with better industrial quality.

Spatial Diversity of Memory Responses Induced by Halopriming in the IRGA 424 RI Rice Cultivar

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Salinity is one of the primary environmental adversities for rice, a crop of global importance. Strategies such as halopriming, which induce memory formation in plants, are crucial for mitigating the effects of salt stress. This technique not only enhances plant survival but also optimizes their acclimation responses to future stresses. These responses can exhibit spatial variations within the plant, reflecting its complex organization and modularity. To elucidate the impact of halopriming on different locations within rice plants, seeds of the IRGA 424 RI cultivar (Oryza sativa L. spp. indica) were subjected to halopriming treatments with 0 and 60 mM NaCl. Upon reaching the V5 stage (five fully expanded leaves), a group of plants was again subjected to salinity conditions with 150 mM NaCl, applied gradually (50, 100, and 150 mM) every 24 hours, resulting in four distinct treatments: P0V0 (no halopriming and no salinity at V5); P0V1 (no halopriming and 150 mM NaCl at V5); P1V0 (60 mM NaCl halopriming and no salinity at V5); P1V1 (60 mM NaCl halopriming and 150 mM NaCl at V5). After seven days under salinity conditions, leaf porometry was performed, and samples were collected for biochemical analysis (amino acids, sucrose, total soluble sugars, lipid peroxidation, and hydrogen peroxide), relative water content (RWC), and electrolyte leakage. To investigate the spatial heterogeneity of responses, samples were collected from different positions within the same plant. This approach considered the modularity of the plants, encompassing both the younger, intermediate, and older leaves. The dataset was subjected to Principal Component Analysis (PCA). The results indicated different groupings among treatments, demonstrating the plants' responses to salinity and suggesting positive memory effects induced by saline priming in different parts of the same leaf, characterizing the spatial heterogeneity of stress responses.

Spatial variation in the distribution of Na+ and K+ in rice plants subjected to salinity

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Rice, a staple food for over half of the world's population, is significantly affected by factors such as soil salinity and irrigation water. Halopriming has emerged as a promising strategy to enhance plant responses to saline conditions by inducing stress memory. Given that plants are complex modular organisms, their responses to stress can vary across different spatial scales. To investigate the impact of halopriming on different spatial scales in rice plants, seeds of the cultivar IRGA 424 RI (Oryza sativa L. spp. indica) were treated with 0 and 60 mM NaCl for 12 hours during pre-germination. At the vegetative V5 stage, they were again treated with NaCl at concentrations of 0 and 150 mM, applied gradually (50, 100, and 150 mM every 24 hours), resulting in the treatments P0V0 (no halopriming and no salt at V5), P0V1 (no halopriming and 150 mM NaCl at V5), P1V0 (halopriming with 60 mM NaCl and no salt at V5), and P1V1 (halopriming with 60 mM NaCl and 150 mM NaCl at V5). After seven days under these conditions, the apical halves (AH) and basal halves (BH) of a mixture of younger, intermediate, and older leaves as well as roots, were collected for sodium and potassium analyses. The results showed distinct spatial distribution of Na^+, with greater accumulation in the BH of leaves and roots in plants treated with NaCl at the vegetative stage (P0V1 and P1V1). For K^+, the greatest accumulation occurred in the BH of leaves and roots of plants without salt at the vegetative stage, with no differences in the AH. The Na^+/K^+ ratio was higher in the BH and roots of plants under salinity at the vegetative stage, regardless of halopriming. The results highlight the spatial heterogeneity of the responses, especially between the basal and apical parts of the leaves.

STUDY OF ATTENTION IN PLANTS: SYNCHRONIZATION OF ELECTRICAL MODULES IN RICE PLANTS UNDER SALINE STRESS

Thiago Francisco de Carvalho Oliveira, DOUGLAS ANTONIO POSSO, HELENA CHAVES TASCA, GABRIELA NIEMEYER REISSIG, GUSTAVO MAIA SOUZA

Plants, as cognitive beings in continuous interaction with their environment, may possess attention mechanisms that assist in decision-making. According to Marder (2012), attention involves a deliberate choice and requires an energetic investment in a specific action. In this study, we investigated this hypothesis in rice plants by analyzing their electrome, monitoring electrical signals in the stem and apical region of the plants and their tillers before and after the application of a saline solution. Rice seeds (Oryza sativa, cv. Nippobare) were used, and at the end of the vegetative stage, 100 mL of saline solution (NaCl 150 mM) was applied directly to the root. The analysis included extracting relevant features from the electrical signals, employing the TDAF technique for temporal visualization, and calculating correlations between the modules. The results showed that, before stress, the mother plant's stem exhibited behavior distinct from the other modules, but after stress, this behavior aligned with that of the other modules. There was a higher correlation among the modules, particularly between the mother plant's stem and the daughter plant's stem, with Pearson's correlation increasing from 0.1 to 0.7. These findings suggest that stress may induce synchronization among modules as part of an attentional response, with the stem playing a central role in the transmission and adaptation of electrical information.

Supra-optimal temperature and photochemical efficiency in three popcorn genotypes contrasting for drought tolerance

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Climate change is a reality, and the increase in heat waves represents a significant threat to agricultural productivity. Supra-optimal temperatures (SOT) can affect light-absorbing photosystems, the rate of electron transport, and the synthesis of NADPH and ATP, thereby reducing photosynthetic efficiency and the utilization of photoassimilates. Consequently, the efficiency of the photochemical machinery exposed to SOT in the leaves of three popcorn genotypes with differential sensitivity to drought tolerance was analyzed. At 82 days after sowing, leaf parts (LPs) (230 mm²) were taken from fully expanded leaves of each genotype studied [LM61 (sensitive), LM71 (tolerant), and H (hybrid)] grown at water-vessel capacity. The LPs were placed in perforated containers in an ultrathermostatic water bath and subjected to temperatures of 25, 35, 40, 45, and 55°C. Potential photosynthesis (Apot, µmol O2 m-2 s-1) and membrane permeability were assessed after 15 minutes, and chlorophyll fluorescence was measured after 15, 30, 45, and 60 minutes of immersion in the water bath, in a completely randomized design.Temperatures above 45°C caused a reduction in the maximum quantum yield of PSII (Fv/Fm) for all three genotypes, reducing the flow of electrons from QA to the final acceptors of PSI (REo/CSo) and increasing energy dissipation (DIo/CSo). When the temperature exceeded 45°C, membrane permeability remained stable, and the oxygen evolution complex (OEC) had its activity reduced. Therefore, temperatures ≥40°C due to SOT caused damage to the photochemical machinery of the three popcorn genotypes. Specifically, LM61 proved to be the most sensitive to supra-optimal temperature stress, followed by H and LM71.

Synergism between melatonin and nickel in the biochemical metabolism of soybean plants under water stress.

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Soybean (Glycine max) is an important legume in agriculture and the economy. However, it is highly sensitive to water deficit, which causes morphological and biochemical damage. In this context, the application of the micronutrient nickel (Ni) and the bioregulator melatonin (MEL), which boosts the enzymatic antioxidant system, emerge as significant allies in mitigating damage caused by water deficit stress. The objective was to analyze the isolated and combined application of MEL and Ni in soybean plants subjected to water deficit stress. The treatments were: 1) Control (distilled water); 2) Exogenous application of MEL; 3) Application of Ni; and 4) Combined exogenous application of MEL and Ni, under two water regimes—without (control) and with water deficit—forming a double factorial with a 4 x 2 arrangement (4 forms of MEL/Ni application x 2 water regimes). The treatments were applied via seeds (10 µM MEL and 45 mg kg-1 Ni) and foliar spraying at V4 (100 µM MEL and 20 g ha-1 Ni). The concentrations of sugar, SOD, APX, POD, proline, superoxide, peroxide, and MDA were evaluated. The data were analyzed using analysis of variance, and the means were compared using Tukey's test ($p<0.05$). All treatments, under both conditions, increased the total sugar concentration. Overall, in stressed plants, MEL increased SOD activity by 21%, and APX activity decreased when treated with Ni and MEL+Ni. POD activity decreased by 8.7% in the MEL+Ni treatment. MEL and MEL+Ni caused a decrease in proline. Ni increased superoxide concentration by 22%. MEL, Ni, and MEL+Ni caused a decrease in peroxide content. MDA was reduced when treated with MEL and MEL+Ni. Therefore, treatment with isolated use of MEL mitigated stress by increasing antioxidant enzyme activity, leading to a reduction in oxidative damage caused by ROS.

Synergism of nickel and melatonin in the photosynthetic apparatus under water deficit.

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Soybean (Glycine max) is an important legume in the global economy. With the increase in global temperature, its cultivation has become increasingly challenging due to the effects caused by abiotic stresses. Nickel (Ni) is an essential micronutrient for plants, mainly due to its structural role in enzymatic activation. The synergy with the bioregulator Melatonin (MEL), a stress-mitigating bioregulator, can act in physiological processes such as gas exchange and in the photochemical apparatus. The objective of the study was to evaluatethe synergism of Ni and MEL on the photosynthetic rate of soybeans. The experiment was carried out in a completely randomized design with a double factorial scheme, 2 conditions (constant irrigation and water suspension) x 4 application methods (water, MEL, Ni, and MEL+Ni), with four repetitions. Treatments were applied via seed treatment (10 µM of MEL and 45 mg of Ni kg^{-1}) and foliar application at V4 (100 µM of MEL and 20 g ha^{-1}). Analyses of gas exchange, CO_2 assimilation rate (A), stomatal conductance (gs), intracellular CO_2 concentration (Ci), transpiration (E), water use efficiency (WUE), and Rubisco carboxylation efficiency (Vcmax) were performed. Photochemical apparatus electron transport rate (ETR) and chlorophyll a fluorescence (Fv'/Fm'). In stressed plants, MEL increased A by 301%, decreased Ci by 61%, and increased E by 380%. In A, gs, and E decreased under stress conditions, regardless of treatment. WUE, (Vcmax, ETR, and Fv'/Fm' decreased under stress conditions, regardless of treatment. However, there was a 153% increase in WUE, 831% increase in Vcmax, 95% increase in ETR, and a 23% increase in Fv'/Fm' in stressed treatments with MEL. Therefore, we can conclude that MEL influenced the physiological adjustment of gas exchange and the photochemical apparatus in stressed plants.

TESTING OF METHODS FOR ISOLATION AND PURIFICATION OF CHLOROPLASTS IN Al3+-ACCUMULATING WOODY SPECIES

Mateus Gomes Thomé, Mario Nicolas Caccalano, Juliana Sartori Rodrigues, Gustavo Habermann

Aluminum (Al), present in naturally acidic soils (pH < 5.0), is toxic to most plants. However, there are Al-accumulating woody species, particularly from the Brazilian savanna (Cerrado vegetation) that do not show toxicity symptoms. In these species, Al is accumulated in the leaves, and some studies evidenced its positive histochemical reaction with chlorophyll parenchyma. This could possibly link Al with the photosynthetic process, more specifically with some possible physiological role in the chloroplasts of these plants. Therefore, evidencing the Al presence in chloroplasts of these plants becomes scientifically relevant. We tested three protocols for isolation and purification of chloroplasts in Vochysia tucanorum (Vochysiaceae), an Al-accumulating species from the Cerrado. The chloroplast extracts obtained were observed under light microscopy using phase contrast. The only protocol that allowed obtaining isolated and purified chloroplasts was the ‘sucrose gradient’ method. The other two protocols, ‘Hill reaction’ and ‘Percoll® gradient’ failed to isolate and purify chloroplasts from this plant. The ‘Hill reaction’ method did not allow the release of chloroplasts from the photosynthetic tissue, and these organelles were not observed after centrifugation. The ‘Percoll® gradient’ method showed colorless material at the final phases, resulting in uncertainty as to whether chloroplasts could be isolated and purified, indeed. Thus, the ‘sucrose gradient’ protocol was effective in isolating and purifying chloroplasts from V. tucanorum and could be used to possibly find Al inside this organelle.

The Effects of Arsenic on Lettuce (Lactuca sativa L.) and the Mitigating Role of Silicon: Biochemical Analysis

Victor Issamu Uesugi, Antonio Aristides Pereira Gomes Filho, Ana Júlia Carvalho Defeo, Vinícius Melo da Silva, Juraci Alves de Oliveira

The environmental contamination by arsenic (As), primarily in the oxidized states arsenate (AsV) and arsenite (AsIII), poses a risk of entering the food chain, which can occur through the consumption of contaminated foods. Among these foods, lettuce (Lactuca sativa L.), a globally consumed leafy vegetable, becomes a potential vehicle for biomagnification of this pollutant when grown in contaminated environments by As. Arsenic is highly toxic even at low concentrations, disrupting plant metabolism, particularly photosynthetic processes. One possible approach to attenuate the harmful effects of As is using silicon (Si), which is known as a mitigator of various abiotic stresses. This study evaluated the biochemical and enzymatic responses of lettuce grown hydroponically for 40 days and subsequently exposed to 50 µM AsIII and AsV, with and without Si and silicon nanoparticles (SiNP) at a concentration 2mM for 24h and 72h. Lipid peroxidation was indirectly quantified via malondialdehyde (MDA) levels - a reactive species of thiobarbituric acid (TBARS). Antioxidant enzymes such superoxide dismutase (SOD), catalase (CAT), and peroxidase (POX) were analyzed as well. The results indicated that As exposure caused significant membrane damage compared to control treatments, however, the application of silicon in both forms was able to reduce arsenic-induced stress. Enzymatic activity in plants exposed to As treatments also increased. It was observed that silicon nanoparticles resulted in a reduction of POX activity for both forms of As and its exposure times. It was also noted that the presence of silicon reduced enzyme activity, regardless of the presence of As. These findings suggest that Si, particularly in nanoparticle form, effectively mitigates As toxicity in lettuce, offering a potential strategy for reducing health risks associated with As-contaminated food.

THE EFFECTS OF SOLUBLE SILICON SOURCES APPLIED IN SOYBEAN PLANTS UNDER DROUGHT STRESS

Felipe Sousa Franco, Renan Caldas Umburanas, Jonas Pereira de Souza Junior, Renato de Mello Prado, Milton Garcia Costa

The effects of climate change are already evident in agriculture, particularly with the increased frequency of droughts due to thermal and water instability. This study aims to evaluate the performance of soybean plants under drought stress in response to soluble silicon sources applied via soil irrigation and foliar supplementation in sandy-clay soil. The hypotheses are that silicon (i) alleviates drought stress and enhances plant performance, (ii) stimulates the production of non-enzymatic antioxidants in soybean cells, and (iii) has a greater absorption when stabilized with sorbitol. The experiment was conducted in 8 dm^3 pots in a greenhouse using a 3×2 factorial design with 8 replications. The first factor included: control (no Si), potassium silicate (SiK), and potassium silicate stabilized with sorbitol (SiKe). The second factor involved soil water conditions at 40% and 80% of water retention capacity, simulating drought and non-drought scenarios. Si was supplied through irrigation at 2.8 mmol L^{-1}, with pH adjusted to 7.0 using HCl (1 Molar). Three foliar applications, totaling 4.1 mmol L^{-1} of Si in 150 L ha^{-1}, were conducted during stages V5, V8, and R1. The silicate solution was prepared immediately before application, with pH adjusted to 7.0 using HCl. Potassium was balanced in the control treatment with KCl. Biometric attributes (stem height, diameter, root growth), harvest productivity (grain mass per plant), and non-enzymatic antioxidant components (ascorbic acid, phenols, carotenoids, pheophytin) were evaluated. Results indicated increased foliar absorption of Si with sorbitol stabilization, enhanced agronomic parameters, and higher chlorophyll, pheophytin, carotenoid, and ascorbic acid content. The study concluded that Si is a promising and sustainable option for mitigating drought stress in soybean plants.

The ethylene-insensitive Never ripe tomato plant presents unique biochemical responses to the phosphorus stress

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Phosphorus (P) is a macronutrient required as a structural and functional component of biomolecules. It can interact with phytohormones, such as ethylene, leading to plant responses. Tomato plants (Solanum lycopersicum L. cv. Micro-Tom) are used as a model for physiological studies, and its ethylene-insensitive mutant Never ripe (Nr) is useful for understanding how ethylene interferes and coordinates biological processes, including responses to nutritional stresses. Here we aimed to understand how the Nr responds to P stresses (absence and excess), from a biochemical level. For this, tomato plants of the wild type (WT) and Nr genotypes were submitted to fertigation with an adapted Hoagland solution in growth room conditions, two factors in a factorial arrangement, distributed in six treatments, two genotypes x three P levels: (i) WT in P absence; (ii) WT in control; (iii) WT in P excess; (iv) Nr in P absence; (v) Nr in control; and (vi) Nr in P excess. We quantified carbohydrates (total soluble sugars, reducing sugars, sucrose, and starch), N compounds (amino acids and proteins), stress markers (phenolic compounds, proline, MDA, and H2O2), and antioxidant enzymes (APX, CAT, and SOD) from leaves samples. Nr plants showed lower levels of carbohydrates and increased amino acids and proteins, and its higher N compounds levels indicate that these plants perceive and respond to P stress differently to WT. Between the stress markers, proline presented a singular pattern, being constitutively higher in Nr, which demonstrates its better osmoregulation capacity. The activity of the three antioxidant enzymes was higher in WT than Nr and decreased with increasing P levels, indicating that these plants sense completely the P stress, modulating their antioxidant defenses. These results demonstrate that ethylene perception plays an essential role in signaling P stresses, with the insensitive plants presenting a mitigation of the nutritional stress effects.

The impact of abscisic acid biosynthesis and high CO2 concentration on growth of tomato plants

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Abscisic acid (ABA) is one of the main regulators of plant tolerance to salt stress conditions. In addition, the elevated concentration of carbon dioxide (CO2) is able to stimulate plant growth and mitigate the effects of salinity in plants. However, physiological mechanisms of plants regulated by eCO2 and ABA under salinity conditions remain poorly understood. In this study, we investigated how carbon assimilation and biomass accumulation are affected by eCO2 in wild type tomato (Solanum lycopersicum L.) cv. Micro-Tom (MT) and in mutants producing low (notabilis, not) and high (NCED) endogenous levels of ABA. Tomato seeds were sown in pots containing commercial substrate and grown in open-top chambers under ambient (aCO2, 410 ± 20 µmol mol^{-1} air) or elevated CO2 (eCO2, 750 ± 50 µmol mol^{-1} air) concentrations. Plants in the open-top chambers were watered with deionized water (control) or 75 mM NaCl for 21 days. Growth of not genotype was strongly reduced compared to MT and NCED genotypes under both CO2 concentrations, mainly when not plants were submitted to treatment with NaCl. However, eCO2 increased total biomass and leaf area of MT, not and NCED genotypes under saline stress compared to ambient aCO2. Moreover, NCED plants under eCO2 showed higher growth performance compared to MT and not genotypes in non-saline and saline conditions. Elevated CO2 significantly increased the net photosynthesis rates in all genotypes under salinity. Collectively, our results suggest that ABA is essential to support plant growth under saline stress, but eCO2 can mitigate the effects of salt stress through increasing photosynthesis.

The Interplay of Ethylene Sensitivity and Nitrogen Source Alterations on the Biochemistry of Solanum lycopersicum

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Nitrogen (N) is an essential macronutrient for plants, in the soil the main sources of N are ammonium and nitrate, the second one being the most bioavailable and the most absorbed by plants. In major nutrient solutions, such as Hoagland's, N is offered in both ways, but in adequate proportions to avoid stress and toxicity. Additionally, ethylene is a phytohormone that modulates plant growth, development, and senescence processes, as well as regulating responses to abiotic stresses such as N deficiency and excess. The aim of this study was to evaluate the effect of ethylene perception on the biochemistry of Micro-Tom tomato plants under different sources of N. To this end, Wild-type (Wt) and ethylene-insensitive Never ripe (Nr) Micro-Tom plants were grown in sand under Hoagland's solution (1 strength) [control], modified Hoagland's solution I: solution with ammonium as the primary source; and II: solution with nitrate as the primary source, and the biochemical analysis were performed during the vegetative period of the plants, between 35 and 40 days. For total chlorophylls (Chl a+b), carotenoids, starch, protein, sucrose, and reducing sugars, the plants presented reductions in the content of these metabolites under ammonium solution, but under nitrate solution, both Wt and Nr plants showed an increase in Chl a+b, carotenoids and leaf protein and reductions in sucrose and reducing sugars, compared to their respective treatments under control solution. Notably, for most of the characteristics, plants under nitrate solution showed higher average values than those observed in plants under control solution and under ammonium solution. Beside that, it is notable that Nr plants were more resistant when submitted to Hoagland’s solution with ammonium as the primary source of N and thus showed more growth and better numbers for most of the characteristics analyzed.

THE METABOLIC RESPONSES TO SALT STRESS ARE ORGAN-SPECIFIC IN RICE PLANTS

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Soil salinity negatively affects agricultural productivity, but the impact of excess NaCl on different plant organs is still poorly understood. This study evaluated the metabolic responses of rice plants subjected to salt stress. The plants were grown hidrponically and subjected to three cycles of five NaCl concentrations (0, 16, 25, and 50 mM). Each cycle corresponded to 7 days under NaCl excess followed by three days of recovery in Hoagland solution. Roots, flag leaves, panicle and leaves and stems from different parts of the plants were harvested for growth biochemical analyses. The data were analysed using ANOVA, Tukey's test, and partial least squares discriminant analysis (PLS-DA). The results showed that plants under salt stress exhibited greater Na+ accumulation and a reduced K+/Na+ ratio in roots, stems, and leaves, except for apical leaves, flag leaves, and panicles. Excess NaCl also reduced plant growth, particularly in accumulated biomass. The metabolic responses varied depending on the organ and the intensity of the stress, with no common metabolite accumulated across all organs at different salinity levels. The roots had the most distinct metabolic profile, compared to the other organs. PLS-DA analysis indicated that treatment with 50 mM NaCl clearly differentiated from the control in almost every organ, except in panicle and flag leaf. Under 16 mM NaCl, three metabolic groups were identified: root, panicle+stem, and leaves. At higher concentrations, the flag leaves were grouped with the stem and panicle, while at 50 mM, four distinct groups were observed. The results suggest that excess NaCl accentuates spatial differences in metabolism between different parts of the plant, providing insights into the responses of rice plants to salt stress.

THE NEGATIVE METABOLIC IMPACTS OF ARSENIC IN DNA DAMAGE RESPONSE IN *Arabidopsis thaliana* MUTANTS

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Contamination by chemical pollutants, such as Arsenic (As), poses a significant environmental threat, especially in areas with intense mining activities, like Minas Gerais. However, the effects of As on plant systems remain poorly understood. This study aimed to elucidate the mechanisms of DNA Damage Response (DDR) and metabolic changes in plants exposed to As. Mutant lines for CDK (cdkb1), SOG1 (sog1-101), and E2F (e2fb-1), all in the same wild-type background (Col-0), were cultivated under optimal conditions (without As [0]) and with As ([200 µM]). In the absence of As, total amino acid, fumarate, and proline concentrations were similar among genotypes. However, malate levels exhibited significant differences among the mutant lines. When exposed to As, all mutant lines showed significant increases in total amino acid, fumarate, malate, and proline concentration, with cdkb1 displaying particularly distinct responses. Unlike other mutants, cdkb1 mutant plants did not exhibit increases in amino acids, though it showed a notable increase in fumarate and malate concentrations. Under control conditions, none of the genotypes displayed visible damage to the aerial parts or root systems. However, upon exposure, the e2fb1 mutant demonstrated damage to the aerial parts, while the other genotypes remained unaffected. Our study reveals that As exposure induces significant differential metabolic responses in Arabidopsis mutant lines involved in the DDR pathway.

The overexpression of the transcription factor ScRAV1confers drought stress adaptive advantages in sugarcane

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Sugarcane is crucial to Brazil's economy, particularly in bioethanol production, which constitutes a sustainable alternative to fossil fuels. However, ongoing sugarcane production is limited by water availability. The transcription factor Related to AB13 and VPI (ScRAV1), which regulates responses to abiotic stresses, emerges as a potential means to enhance drought tolerance in the crop. This study aimed to evaluate the impact of ScRAV1 constitutive overexpression (OXScRAV1) on drought resistance, focusing on physiological and growth mechanisms in sugarcane. Plants were grown in a greenhouse under controlled conditions and exposed to different water regimes: regular irrigation (control), moderate drought, severe drought, and rehydration. Assessments included gas exchange measurements, leaf water potential (Ψw), and growth and biomass parameters. The OXScRAV1 plants exhibited reduced sensitivity to water stress compared to Wild-type, as evidenced by a smaller decrease in Ψw during water deficit periods, despite significant reductions in photosynthetic capacity across all water regimes. Notably, the OXScRAV1 plants demonstrated superior recovery in terms of photosynthesis (AN), stomatal conductance (gs), and transpiration (E) following drought stress, attributed to the rapid stabilization of Ψw. OXScRAV1 did not result in superior growth phenotypes in height and number of leaves. However, these plants were associated with more tillers, internodes, and reduced leaf and root biomass. The overexpression of ScRAV1 plants displayed more efficient recovery after drought periods, highlighting a significant adaptive advantage. Future studies will investigate the physiological and molecular mechanisms underlying post-stress recovery in these plants, aiming to enhance their adaptive responses and contribute to developing more resilient and productive sugarcane varieties.

Thermotolerance in Eucalyptus spp. and Corymbia spp. clones

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Eucalyptus is a widely exploited species in Brazil due to its rapid growth, high wood quality, and adaptability to various potentially stressful edaphoclimatic conditions. The minicutting technique provides viability to the large-scale seedling production process. Mini-tunnels modify the microclimate of the mini-garden and can enhance its productivity. However, challenges in managing the mini-tunnels suggest that temperature will be the primary parameter to consider in automating the opening and closing of these structures. The aim of this study was to assess the heat tolerance of clones of Eucalyptus spp. and Corymbia spp. in three contrasting environments. The environments compared were a standard mini-garden (without a mini-tunnel), a mini-garden with a mini-tunnel (temperature-automated), and a mini- garden covered with black nylon mesh. The mini-cuttings were subjected to ten temperatures (32 to 59°C) in 3°C intervals for 15 minutes and kept in the dark for 24 hours. After this period, F v /F m was measured. Chlorophyll a fluorescence is sensitive to temperature increase, allowing the assessment of photochemical damage to the membrane via the T50. T50 is the temperature at which 50% of damage occurs to the photosystem II membrane, considered a severe and difficult-to-reverse inhibition. The maximum difference between T50 averages did not exceed 3°C. However, a few degrees Celsius in air temperature were significant enough ($p \leq 0.05$) to cause different levels of damage. Among the evaluated clones, the Corymbia spp. (C3) and Eucalyptus dunnii (C5) clones achieved the highest average heat tolerance (47°C). Among the environments, the black mesh showed the lowest level of damage. Therefore, the heat tolerance of Eucalyptus spp. and Corymbia spp. clones were defined in different environments and should be used as a guiding factor in the management of clonal mini-gardens.

TUNICAMYCIN PRIMING SPRAYING IMPROVES ION HOMEOSTASIS IN COWPEA PLANTS UNDER SALINITY

Francisco Lucas Pacheco Cavalcante, Igor Rafael Sousa Costa, Enéas Gomes Filho, Humberto Henrique de Carvalho

High levels of salt can reduce water availability and interfere with crucial processes such as photosynthesis and protein synthesis, limiting the growth of many plant species, including cowpea (Vigna unguiculata L. walp), a valuable source of protein, fiber, and minerals. In addition, salinity can cause endoplasmic reticulum (ER) stress, characterized by the accumulation of misfolded proteins that will result in the activation of a signaling pathway to these proteins, the Unfolded Protein Response. Thus, the development of technologies to improve crop productivity is relevant. As an alternative, there is tunicamycin (TM), an ER stress inducer, which in low concentrations can mitigate the effects of salinity. The present study aims to investigate the effect of tunicamycin priming on the growth and ionic homeostasis of cowpea plants subjected to salinity. Cowpea plants at the V4 stage were sprayed with TM 0.25 µg.mL-1. After 24h, the plants were transferred to 75 mM salt. Leaves, stems and roots were collected after 14 days of salinity for analysis. The results showed that salt stress severely impacted plant growth and promoted sodium accumulation. Conversely, the plants primed with TM had 1. their dry mass increased by 61%, 86% and 70% for leaves, stems and roots, respectively. 2. Regarding the concentration of Na+, K+ and Cl- ions, a decrease in Na+ and Cl- ions was observed in leaves and stems and an increase in roots than non-primed plants. There was a reduction in K+ ion only in the roots and an increase in leaves and stems. It is concluded that TM pretreatment significantly may act increasing plant tolerance to salt through homeostatic maintenance of ions, especially in the aerial part of the plant, continuing important cellular processes, such as photosynthesis, evidenced by the considerable gain in dry mass.

UNRAVELLING SUBERIZATION IN COWPEA ROOT UNDER WATER DEFICIT

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Suberin stands out as a macromolecule of high potential for obtaining more resistant agronomic crops, by acting as a transmembrane barrier in regulating the movement of water, ions, and the uptake of nutrients. This also occurs as a mechanism of action of plants in response to various stresses, including water deficit. This work evaluated the response of two cowpea genotypes Pingo-de-Ouro 1,2 (Po) and Santo Inácio (Si) submitted to three different water availability conditions (75% FC, 25% FC and 0% FC). The genotypes were analyzed with respect to developmental, physiological and anatomical parameters. Our results indicated significant differences between the stress conditions (25% FC and 0% FC) when compared to the control condition 75% FC, whose total stomatal closure in response to water deficit was consistent with the stagnation of the development of both genotypes. The differences between the genotypes (Po and Si) in response to water deficit were noted in the quantification of malonaldehyde (MDA), electrolyte extravasation and water potential (ψwf), reinforcing the greater tolerance of Po to stress damage. However, our water potential (ψwf) results point out that the severe drought state did not reach the fatal pressure state on the analyzed plants. Suberin deposition was analyzed in distinct sections of the root, where the quantification estimated by fluorescence indicates higher suberin deposition in the transitional portion in plants at 0% FC, with Po standing out. We conclude that water deficit treatment favored suberin deposition in cowpea genotypes, primarily in Po, which may be related to the increased efficiency of water control mediated by suberin deposition in the roots of this genotype, already described as tolerant.

USE OF PROCESSED KAOLINITE PARTICLES AS AN INNOVATIVE SOLUTION FOR ENVIRONMENTAL RESTORATION IN THE ATLANTIC FOREST

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Global climate change poses a growing threat to forest biodiversity and can cause severe and negative impacts on the Atlantic Forest (AF) biome. Among the main challenges are those related to changes in solar radiation quality (supra-optimal effects of ultraviolet radiation) and rising global temperatures. These effects can threaten the survival of plant species. Environmental restoration programs face significant difficulties, particularly in the initial establishment of plants, due to the stress caused by high intensity and increased incidence of ultraviolet radiation on leaves. This study aims to explore the potential of Processed Kaolin Particle Film (PKPF) technology as a solution to mitigate the harmful effects of solar radiation at supra-optimal levels. The application of PKPF on the leaves of two native AF species, Cordia superba and Citharexylum myrianthum, was performed under full solar radiation exposure. The main objective was to evaluate the effectiveness of PKPF in reducing radiation damage over different days of solar radiation exposure (DSRE) (1, 2, 3, 4, 7, and 15 DSRE). To this end, assessments of leaf gas exchange and optical microscopy images were analyzed. As a result, PKPF (0.9985 g.m-2 per leaf area) significantly altered the photosynthetic machinery of the plants, leading to an increase in net CO_2 assimilation. In the case of C. superba, in the absence of PKPF, the leaf mesophyll structure was compromised, negatively affecting the photosynthetic machinery. Thus, PKPF facilitated the acclimatization of plants under supra-optimal light conditions.

UV Reduction Unveils Damage to Photoprotection Mechanisms in Juvenile Plants of Coffea canephora Under Supra-Optimal Solar Radiation

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This study investigated the effects of reduced ultraviolet (UV) intensity on physiological responses of Coffea canephora cv. LB1. The juvenile plants were grown in two environments (Campos dos Goytacazes, 21° 45' 16", South; 41° 19' 28", West) with different UV radiation incidences: (1) near ambient UV (UVam): corrugated glass compartment, and UV intensities was similar to the external environment, excluding 16% UV-A and 0% UV-B; (2) reduced UV (UVre): transparent polycarbonate compartment, which excludes 70% UV-A and 90% UV-B, with reduced UV intensities compared to the external environment. Solar radiation had a decline period in which tagged leaves were grown and had elongation and SPAD index registered. The decreased period of solar radiation was followed by a three-times shorter increasing period, reaching a peak that caused sunburn on UVre plants. Specific Leaf Mass (SLM) of the tagged leaves was measured, as well as modulated chlorophyll a fluorescence, to analyze Steady-state PSII Quantum Yield (QYLss), Steady-state Non-photochemical Quenching (NPQLss), Photochemical Quenching in Steady State (qLLss) and Fluorescence Decline Ratio in Steady State (RfdLss). Total leaf area was also measured. UVam leaves had lower elongation but attained a higher SPAD. UVam plants showed higher values of fluorescence parameters, demonstrating higher photochemical efficiency and acclimation to high PAR, allowing plants prevent or limit UV-induced damage such as sunburn, which was observed only in UVre plants. The acclimation of UVam plants is correlated to the lower leaf area and higher SLM. The leaves invested in thickness at the expense of expansion, protecting the mesophyll from photooxidative UV damage. C. canephora tolerance on UVam was triggered by exposure to UV, protecting leaves against damage to photosynthetic capacity and sunburn. Therefore, the current UV radiation intensities in the region under study can be important for leaves of young coffee plants during a short supra-optimal PAR conditions.

VARIABILIDADE ESPACIAL DAS RESPOSTAS METABÓLICAS DE PLANTAS DE ARROZ SOB SALINIDADE

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O arroz é uma das principais fontes alimentícias no mundo. No entanto, a sua produtividade é substancialmente afetada pelo estresse salino. Assim, torna-se importante entender as respostas de plantas de arroz à salinidade, como forma de mitigar as perdas causadas por este fator de estresse e fornecer novos alvos para a engenharia metabólica de plantas. Nesse contexto, embora diversos estudos venham desvendando mecanismos de aclimatação de plantas de arroz ao excesso de sal, pouco se sabe sobre como essas respostas variam espacialmente na planta. Neste trabalho, objetivamos elucidar como o estresse salino altera o metabolismo primário de diferentes órgãos de plantas de arroz. Plantas foram crescidas em solução hidropônica e submetidas ao excesso de NaCl (50 mM) no estágio R3. Após 40 dias nessa condição, raiz, colmo, folhas bandeiras, intermediárias e senescentes foram coletados separadamente, sendo parte utilizada para determinação da biomassa seca acumulada e outra congelada imediatamente em nitrogênio líquido para análise de perfil metabólico via cromatografia gasosa acoplada a espectrômetro de massas. Os resultados demonstraram que a biomassa seca total de plantas de arroz diminuiu após a imposição do excesso de NaCl, aumentando consideravelmente a senescência das folhas. As respostas metabólicas à salinidade variaram fortemente entre os diferentes órgãos, sendo mais drásticas nos órgãos fonte, sobretudo folhas bandeira e intermediárias, como revelado pela análise de componentes principais (PCA). Neste sentido, diversos metabólitos pertencentes ao grupo de aminoácidos, açúcares e ácidos orgânicos foram alterados após a salinidade. O nível de diversos aminoácidos aumentou nas folhas, principalmente nas folhas bandeiras e senescentes. Por exemplo, lisina, isoleucina, prolina, treonina e valina foram identificadas como biomarcadores da condição de estresse salino nas diferentes folhas. No entanto, nenhum metabólito foi identificado como biomarcador em comum entre todos os órgãos da planta de arroz, ressaltando que as respostas metabólicas ao estresse salino são órgão-específicas.

WATER DEFICIT PRIMING AS A TOOL TO ALLEVIATE OXIDATIVE STRESS IN SOYBEAN PLANTS

Luciano do Amarante, Adriano Udich Bester, Eduardo Pereira Shimoia, Douglas Antônio Posso

Climate change is making global food production increasingly unstable. The development of new tools that mitigate the effect of plant stress can reduce the negative impacts on productivity. The objective of this study was to evaluate the ability of water deficit priming to mitigate the effect of water deficit stress on soybean plants. The experiment was conducted in a completely randomized design, in a greenhouse, with three treatments and four replications. Soybean seeds were sown in plastic pots and kept at field capacity. At vegetative 4 (V4) stage, a group of plants was subjected to water deficit priming by suspending irrigation for five days. When plants reached the reproductive 1 (R1) stage, three groups were separated, one maintained at field capacity (Control), another kept under WD and the third received a second period of water stress (WD priming), both groups kept without irrigation for 5 days. On the last day of stress, leaf material was collected for analysis of hydrogen peroxide content, lipid peroxidation and antioxidant enzymatic activity: catalase (CAT), superoxide dismutase (SOD) and ascorbate peroxidase (APX). Plants subjected to WD priming showed a 13% reduction in hydrogen peroxide content compared to plants subjected only to a period of WD. Similar response was observed in relation to lipid peroxidation. The activity of CAT, APX and SOD enzymes in primed plants were higher by 26%, 36% and 100%, respectively, compared to WD treatment plants. We conclude that WD priming is a tool that can be used to mitigate water deficit stress in soybean plants, as it reduced the concentration of H2O2 and lipid peroxidation in the leaves and increased enzymatic antioxidant activity.

Water relation and dynamics of nonstructural carbohydrates in a deciduous woody species from tropical dry forests under recurrent drought events

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In tropical dry forests, both the dry and short rainy seasons have become increasingly unpredictable. This scenario may lead plants to change their responses to drought, especially related to carbon dynamic and allocation. The study simulated these conditions to explore the effects of two water deficit cycles on Cenostigma microphyllum seedlings. The impacts were evaluated by analyzing growth characteristics, water relations, gas exchange, and the dynamics of nonstructural carbohydrate (NSC) content in the entire plant under greenhouse conditions with potted specimens. During the first water deficit cycle, leaf relative water content (RWC) was preserved at the expense of a rapid decline in gas exchange. Additionally, there was a slight accumulation of NSC, primarily soluble sugars (SS), in the stem wood and roots, which came at the cost of reduced height and stem diameter growth. In the second cycle, leaf RWC remained 40% higher than the lowest level recorded during the first water deficit, and CO2 assimilation persisted twice as long in previously stressed plants. The SS content in the stems and roots showed a strong correlation with predawn leaf RWC. No significant depletion was observed in the bark reserves, despite the gradual increase of SS in the wood. Our findings suggest that under recurrent water deficit, prior to leaf drop, a wood deciduous species from tropical dry forest sustains CO2 assimilation by maintaining optimal leaf relative water content (RWC), despite reduced stomatal conductance. This strategy supports SS transport to the wood and roots, which is no longer used to promote growth of the aboveground portions.

Wood Density and its Relationship with Leaf Cost and Nitrogen Concentration in Seasonally Dry Forests

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Wood density is a functional trait associated with plant growth, survival, and carbon storage, playing a crucial role in the classification of plant functional groups, which share similar ecological functions. Species with low wood density adopt acquisitive strategies, exhibiting greater water storage capacity and carbon assimilation. Conversely, species with high wood density are conservative, demonstrating greater mechanical stability and resistance to xylem cavitation. The aim of this study was to analyze the response of different plant functional groups in the Caatinga regarding leaf construction cost (LCC) and nitrogen concentration (NC) in relation to seasonality. The species were divided into three groups: Low-Density Deciduous - LDD (Amburana cearensis, Spondias tuberosa, and Commiphora leptophloeos), High-Density Deciduous - HDD (Cenostigma pyramidale, Aspidosperma pyrifolium), and High-Density Evergreens - HDE (Sarcomphalus joazeiro, Cynophalla flexuosa). Means were contrasted using variance analysis. During the dry season, LCC was 7.63% higher and NC was 20.7% lower in HDD species compared to HDE. No significant differences were observed between HDD, LDD, and HDE groups for any parameter during the rainy season. In the dry season, we observed an 8% increase in LCC and a 50% reduction in NC in the HDD group compared to the rainy season, while HDE showed no differences in LCC and NC between seasons. These differences indicate that species with varying wood densities adjust their physiological strategies to optimize survival and performance in environments with pronounced seasonal variations, reinforcing the importance of wood density in plant functional ecology. We conclude that wood density directly influences their adaptive strategies, particularly in relation to leaf construction cost and nitrogen concentration as a function of seasonality.