
II
SIFV

II Simpósio Interdisciplinar em Fisiologia Vegetal

II Plant Physiology Interdisciplinary Symposium

Plant Physiology and its Contributions to Society

September 2nd - 5th, 2020

PROMOTED

SPONSOR

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History

It is with great pleasure that the Núcleo de Estudos em Fisiologia Vegetal (NEF) of the Graduate Program in Agronomy/Plant Physiology at Universidade Federal de Lavras (PPGFV-UFLA) shows the community the Annals of II Plant Physiology Interdisciplinary Symposium (SIFV), which took place in a completely online format from September 2nd – September 5th, 2020. The first edition of SIFV occurred in 2018 at UFLA and was carried out by the NEF coordination, under the tutorship of Professor Dr. Paulo Ribeiro Marchiori.
In partnership with the PPGFV faculty, its central theme was "Approach to the Insertion of Plant Physiology in Different Areas of Knowledge", bringing together 180 participants from different Brazilian states. In order to bring together professors and students of undergraduate, graduate and professionals of the Agronomy/Plant Physiology area, the plan is for the symposium to happen every two years and to promote a healthy exchange of knowledge in favor of scientific, technological and social development.
The second edition of SIFV carried out by the current NEF management under the tutorship of Professor Elisa Monteze Bicalho, which had as its central theme "Plant Physiology Contributions to Society". In this context, the aim of the II SIFV was to integrate knowledge about plant science that has been produced, enable the exchange of experiences and scientific, technological and social advances as well as provide a discussion about future trends of Plant Physiology and other related areas in Brazil and worldwide.
Due to the pandemic caused by COVID-19 and its limitations, the idealization, preparation and realization of the II SIFV was carried out entirely remotely in order to keep us all safe. Nevertheless, besides all the difficulties that the current context overlaps us all, the realization of this event allowed us to gather, even though virtually, an excellent potential of human resources in the area of Plant Physiology and related areas. Thereby, we hope that you enjoyed everything that we prepared for this event and were able to broaden horizons.

We hope we, NEF, made all possible efforts to make this II Plant Physiology Interdisciplinary Symposium once again memorable!

Summary

Scientific programming

Time	Wednesday | September 2nd, 2020
4:00 pm	Opening Ceremony
4:30 pm	Opening Lecture: "Using plants to improve lives on a crowded planet" **Panelist:** Professor Michel Labrecque (Université de Montréal)
	Panel I Ecophysiological interactions and perspective in the climate change scenarios
5:10 pm	Lecture: "Predicting wild plant responses to climate change: Multiple scales, multiple dimensions, multiple challenges" **Panelist:** Professor Sershen Naidoo (University of the Western Cape)
5:50 pm	Lecture: "The Holistic Ecophysiologist" **Panelist:** Professor Kacilda Naomi Kuki (UFV)
6:30 pm	Lecture: "Plants under climate changes: special awareness to cerrado plant ecophysiology" **Panelist:** Professor João Paulo de Souza (UFV)
7:10 pm	**Round Table** **Mediator:** Professor Milton Costa (Unesp)
7:40 pm	Oral presentation: "Plant growth and oxidative responses in mung bean exposed to co-stress of salinity and aluminium" **Panelist:** Victor Breno Lima (UFPI)
7:50 pm	Oral presentation: "Calcium applications enhance drought stress tolerance in diploid potato" **Panelist:** Wendy Tatiana Pira-Cárdenas (UNAL)
8:00 pm	Oral presentation: "Interactive effects of recurrent water stress and phosphorus deficiency results in oxidative damage in *Glycine max* L." **Panelist:** Isadora Medina Rodrigues (UFLA)
8:10 pm	Oral presentation: "Coffee trees supplemented with foliar magnesium accumulate more carbohydrates in the roots in drought conditions" **Panelist:** Paulo Cássio Linhares (UFLA)
8:20 pm	**Round Table** **Mediator:** Professor Renato Paiva (UFLA)

Time	Thursday | September 3rd, 2020
	Panel II Plant physiology applied to teaching and scientific communication
4:00 pm	Lecture: "Experiences in teaching plant physiology" **Panelist:** Professor Carlos Henrique Brito de Assis Prado (UFSCar)
4:40 pm	Lecture: "Teaching botany: how may we prepare plant physiologists that improve students' learning?" **Panelist:** Professor Denise Maria Trombert de Oliveira (UFMG)
5:20 pm	Lecture: "The plant physiologist as the protagonist at the forefront of knowledge" **Panelist:** Msc. Deivisson Pelegrino de Abreu (UENF)
6:00 pm	**Round Table** **Mediator:** Professor Tiago Mendonça (UFRPE)
6:40 pm	Oral presentation: "Different responses to the same conditions: Ecophysiological functions of two tree species in the Brazilian Caatinga" **Panelist:** Maria Jucicléa Medeiros (UFPI)
6:50 pm	Oral presentation: "Hexanoic acid application in roots can modulate secondary metabolism and redox state-related genes in coffee leaves" **Panelist:** Douglas Domingues (UNESP)
7:00 pm	Oral presentation: "Ecophysiological traits of native and exotic tree species in response to sun and shade conditions" **Panelist:** Lucas Haiduki (URI)
7:10 pm	Oral presentation: "Silicon alleviation of cadmium toxicity in mangroves (*Lagungularia racemosa*) (L.) C. F. Gaertn" **Panelist:** Janaína Garcia (UFMG)
7:20 pm	**Round Table** **Mediator:** PhD João Paulo Pennacchi (UFLA)

Time	Friday | September 4th, 2020
	Panel III Plant physiologists acting on public and private institutions
4:00 pm	Lecture: "Beyond the metabolic routes: the role of the plant physiologist in management activities in public and private institutions" **Panelist:** Professor Alan Carlos Costa (IFGoiano)
4:40 pm	Lecture: "Strategic planning for insertion of plant physiologists on private institutions" **Panelist:** PhD Débora de Oliveira Prudente (CTC)
5:20 pm	Lecture: "From the Method to the "Madness": the path of a scientist managing a graduate program" **Panelist:** Professor João Paulo A. Delfino Barbosa (UFLA)
6:00 pm	**Round Table** **Mediator:** Professor Paulo Eduardo Ribeiro Marchiori (UFLA)
6:40 pm	Oral presentation: "Be prepared: survival strategies of *Handroanthus heptaphyllus* (Vell.) Mattos seedlings after hydration-dehydration cycles" **Panelist:** Geovane da Silva Dias (UFLA)
6:50 pm	Oral presentation: "Guard cell TCA cycle is differentially regulated in the light compared to mesophyll cell" **Panelist:** Valéria Lima (UFC)
7:00 pm	Oral presentation: "Mild reductions in guard cell sucrose synthase 2 expression alter the speed of light-induced stomatal opening and the whole plant transpiration in *Nicotiana tabacum* L. under both well-watered and water deficit conditions" **Panelist:** Francisco Bruno Freire (UFC)
7:10 pm	Oral presentation: "Blue and red led light effects in tobacco seed germination and seedling development" **Panelist:** Ana Luiza Reale (UFLA)
7:20 pm	**Round Table** **Mediator:** Professor José Márcio Rocha Faria (UFLA)

Time	Saturday | September 5th, 2020
	Panel IV Contributions of plant physiology on technology and improving life quality
4:00 pm	Lecture: "Proteases inhibitors of the cacao: a perspective against Sars-CoV-2" **Panelist:** Professor Carlos Priminho Pirovani (UESC)
4:40 pm	Lecture: "Peptide hormones in plants: RALF Family of peptides and their role in plant physiology" **Panelist:** Professor Daniel Scherer de Moura (USP/ESALQ)
5:20 pm	Lecture: "Real Yield X Potential Yield of herbaceous cotton in African countries" **Panelist:** Professor Heloisa Oliveira dos Santos (UFLA)
6:00 pm	**Round Table** **Mediator:** Professor Eduardo Gusmão Pereira (UFV)
6:40 pm	Oral presentation: "Antifungal and antibiofilm activities of the major constituents of the essential oil of *Lippia gracilis* Shauer against *Fusarium oxysporum*" **Panelist:** Tawanny de Aguiar (UERN)
6:50 pm	Oral presentation: "Impact of inoculation with *Bacillus amyloliquefaciens* BV03 on the physiological processes of soybean exposed to salinity" **Panelist:** Igor de Abreu (IFGoiano)
7:00 pm	Oral presentation: "The application of electronic-nose as a non-invasive tool to monitoring plants under water stress" **Panelist:** Matheus Santos Luccas (ICMC/USP)
7:10 pm	Oral presentation: "Canonical correlations between water potential and spectral index in coffee under water deficit" **Panelist:** Meline Santos (EPAMIG)
7:20 pm	**Round Table** **Mediator:** Professor Michele Valquíria dos Reis (UFLA)
7:50 pm	**Closing Ceremony and Awards** Closing Lecture: "Plant Physiologist: A multitask professional?" **Panelist:** Elisa Monteze Bicalho (UFLA)

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Awarded presentations

Oral presentation

Line of research - Biotic and abiotic stress

"Interactive effects of recurrent water stress and phosphorus deficiency results in oxidative damage in Glycine max L.", Medina, I.R, Rocha G.H., Pereira, E.G.

Poster presentation

Line of research - Plant growth and development

"Germination of conditioned seeds of Handroanthus heptaphyllus in iron mining tailings", Silva, V.N.; Pereira, A.A.S.; Ferreira, R.A.; Bicalho, E.M.

Lectures and Oral Presentations

Wednesday | September, 2nd, 2020.

Opening lecture: Using plants to improve lives on a crowded planet

Professor Michel Labrecque

Université de Montréal, Canada.

Michel Labrecque works on plant ecophysiology in his positions as Curator of the Montreal Botanical Garden, Head of the Garden's Research & Scientific Development division and adjunct professor of biological sciences at the Université de Montréal. Through his work with his students and collaborators, he has explored and studied the plant world in Canada and around the world for more than 25 years. His research focuses on applying the potential of plants to solve environmental problems. The natural functions of plants - photosynthesis, growth, transpiration, and their capacity to absorb nutrients - are mechanisms that can be exploited to solve a range of environmental issues. Michel Labrecque presents several concrete examples of conflicting urban or industrial infrastructures for which he has proposed plant-based approaches as a green solution to municipalities, government agencies and private companies. The world of plants still holds many mysteries, and for the physiologists of tomorrow there remains much work to be done, in terms of advancing knowledge, disseminating information, and raising awareness among the general public and politicians.

Panel I | Ecophysiological interactions and perspective in the climate change scenarios

Lecture: Predicting wild plant responses to climate change: Multiple scales, multiple dimensions, multiple challenges

Professor Sershen Naidoo

University of the Western Cape, South Africa.

Predicting the future of any wild plant species represents an unprecedented challenge, given the array of environmental and biological factors that influence organismal performance, and also interact with drivers of global change. Using lessons from our research and others we argue that understanding plant responses to global change requires a multi-scalar and multidisciplinary effort that integrates the sub-disciplines of ecology, evolutionary ecology, biogeography, seed biology and whole plant physiology. Our research has shown that investigating floristic patterns of indigenous and alien species in relation to drivers of global change such a disturbance, temperature and landuse at the local scale can be valuable for designing regional biodiversity management decisions. However, our research on plant vegetative and reproductive traits across environmental gradients and vegetation types suggests that for in situ biodiversity conservation measures to have any impact globally, predictions need to be extended to the scale of bioregion and biome, and be informed by broader systematic monitoring of environmental conditions, ecological processes (e.g. recruitment and competition), organismal interactions (e.g. alien-indigenous and plant-microbe), and landuse change. Importantly, these predictions should also be based on a fundamental understanding of propagule and whole plant physiological responses to various climate change scenarios. Comparative studies along environmental gradients (e.g. altitude and disturbance) should also be used to generate predictive indices that are widely applicable and have enough integrative power to enable a systems biology approach to predicting plant responses to climate change.

Lecture: The Holistic Ecophysiologist

Professora Kacilda Naomi Kuki, DSc. Bonaty

Universidade Federal de Viçosa, Brazil.

The ecophysiologist has a fundamental role in offering measures that aim to reduce the impacts on agricultural and natural ecosystems resulting from climate change. For this, throughout his training as a researcher, he will be exposed to content from different areas of knowledge, leaving him with the arduous task of integrating information and providing society with coherent solutions.

Lecture: Plants under climate changes: special awareness to cerrado plant ecophysiology

Professor João Paulo de Souza

Universidade Federal de Viçosa, Brazil.

The CO_2 concentration [CO_2] varies naturally over geological time. This change in [CO_2] is accompanied by modification in atmospheric temperature. However, the records of the high [CO_2] found today are unprecedented. The increase in the [CO_2] in the atmosphere results in morphophysiological changes in plant species. In general, plants increase net photosynthesis and decrease stomatal leaf conductance, becoming more efficient in the use of water. In addition, plants growing at a high [CO_2] show greater growth and biomass production. In the cerrado, plants show these same changes in their physiology and morphology when grown at high [CO_2]. Owing to these morphophysiological changes, woody cerrado plants may benefit in the competition for resources with herbaceous species. Thus, the structure of the cerrado (two-layer system, woody plants vs. herbaceous plants) may be altered, as well as the biological invasion in this ecosystem, due to climate change. The high [CO_2] may attenuate the effect of environmental factors, such as soil water deficit and leaf herbivory, on cerrado plants. The greater efficiency in the use of water in the woody cerrado species will probably result in a decrease in the stem sap flow and, consequently, in leaf transpiration. All of these changes may result in shiftings in the dynamics of water in the soil and in the atmosphere, with direct implications for the ecology of this plant community.

Oral Presentation: Plant growth and oxidative responses in mung bean exposed to co-stress of salinity and aluminium

Lima, V.B.C.[1]; Souza, C.C.S.[1]; Melo, A.R.P.[1]; Araújo, M.D.F.[1]; Bonifacio, A.[1]

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Plants are continuously exposed to a combination of various types of abiotic stresses in nature that constrain crop productivity. Salt and aluminium stresses results from higher levels of toxic ions in rhizosphere and alters physiological and metabolic responses in plants. The present study aimed to evaluate the effect of isolated or combined salt and aluminium stresses on growth and oxidative responses of mung bean under greenhouse conditions. Salinity was imposed with 100 or 200 mM of sodium chloride (NaCl) and aluminium stress was applied using 1.0 µM of aluminium chloride ($AlCl_3$). Control plants (non-exposed to stresses) also were evaluated. After stress exposure, biometric, biomass and biochemical responses of mung bean plants were measured. The results showed that salinity and aluminium affected absolute growth rate, plant height, stem diameter, root length and plant biomass, however the simultaneous exposure to 200 mM NaCl combined with 1.0 µM $AlCl_3$ increases some of these parameters. The levels of hydrogen peroxide was increased in plants exposed to individual salt stress, but combined stresses of salt and aluminium decrease this parameter in around 20% when compared to single salt stress or control. Plants exposed to 200 mM NaCl combined with 1.0 µM $AlCl_3$ exhibits 79% decrease in lipid peroxidation when compared to isolated salt stress. The reduced ascorbate was 70% superior in mung bean exposed to 200 mM NaCl combined with 1.0 µM $AlCl_3$ in relation to isolated salinity with 200 mM NaCl, while dehydroascorbate was decreased in around 20% when compared to isolated salt stress or control. The ascorbate redox state were increased in response to aluminium, mainly when plants were exposed to 200 mM NaCl combined with 1.0 µM $AlCl_3$ (110% superior to isolated salinity with 200 mM NaCl). The principal component analysis (PCA) reinforces the differential responses identified in plants exposed to 200 mM NaCl combined with 1.0 µM $AlCl_3$ and this treatment was separated from the others. The PCA indicates an idiosyncratic response to severe stress combination in mung bean. Our analyses suggest that aluminium exposure promote better regulation of antioxidant system and reduces detrimental effects of higher salt stress. The study about the combination of different abiotic stresses can reveal important strategies adopted by plants to prevent harmful effects of stresses, such as ionic stress, that is useful to enhance crop tolerance under field conditions.

Keywords: Leguminous, Abiotic stresses, Toxic ions, Ascorbate status redox.

Acknowledgments: CNPq, UFPI.

Plant Physiology and its Contributions to Society IISIFV

Oral Presentation: Calcium applications enhance drought stress tolerance in diploid potato

Cárdenas-Pira, W.[1]; Moreno, L.P.[1]; Rodriguez, L.M.[1]

Universidad Nacional de Colombia (Bogota), Colombia. wtcardenasp@unal.edu.co

Diploid potato (*Solanum tuberosum* L. Group Phureja) is susceptible to water deficit, which reduces its yield. Criolla Colombia is the most cultivated cultivar in Colombia; however, it has a high susceptibility to water deficit. Due to an increase in drought occurrence caused by changes in weather patterns, it is necessary to evaluate alternatives that mitigate this stress. This work's objective was to assess the effect of different calcium (Ca) doses and sources on physiological parameters and yield under water deficit in potato cultivar Criolla Colombia. The research work was carried out in a greenhouse at Universidad Nacional de Colombia (Bogotá). Seed tubers were planted in bags with soil irrigated at field capacity until tuber initiation. The experiment was completely randomized; each treatment was represented by three replicates in six bags with one plant per bag. Thirty-five days after sowing Ca was applied in edaphic sources: 2.4 $gplant^{-1}$ CaO, 4.5 $gplant^{-1}$ $CaCl_2$ and 7 $gplant^{-1}$ Ca $(NO_3)_2$, and foliar: 4.6 cm^3L^{-1} Ca gluconate, 20mM$plant^{-1}$ $CaCl_2$, and 20mM$plant^{-1}$ $Ca(NO_3)_2$. Doses were selected according to a prior assay. Forty-five days after sowing, the plants were subjected to two water regimes: well-watered and water deficit by irrigation suspension for ten days. The data were analyzed with SAS 9.4, through PROC MIXED, with repeated means overtime at 0.05 probability level, and Compound Symmetry Model. Water deficit reduced leaf water potential (215.8%), relative water content (30.4%), and stomatal conductance (89.1%), electrolyte leakage increased (40.3%), and yield decreased (55.3%) respect to plants with constant water supply. Foliar 20mM$plant^{-1}$ $CaCl_2$ and 20mMplant-1 $Ca(NO_3)_2$, along with edaphic 4.5 $gplant^{-1}$ $CaCl_2$ applications, presented higher yield. Edaphic 4.5 $gplant^{-1}$ $CaCl_2$ had higher relative water content (10.5%), lower electrolyte leakage (25.2%), and higher yield (30.5%), compared to plants without Ca. Results suggest that Ca applications can alleviate the harmful effects of drought, through its impact on cellular metabolism. It improves leaf water status, membrane integrity, stomatal conductance, and yield.

Keywords: Tuber initiation, Leaf water status, Electrolyte leakage, Stomatal conductance, Tuber yield, Stress tolerance.

Acknowledgments: CIER, Ingeplant.

Oral Presentation: Interactive effects of recurrent water stress and phosphorus deficiency results in oxidative damage in *Glycine max* L.

Medina, I.R.[1]; Rocha G.H.[2]; Pereira, E.G.[2]

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[2] *Universidade Federal de Viçosa, Brazil.*

Soybean cultivation in the Cerrado region is important for the Brazilian economy. Understanding how soybean cultivars are affected by common stressors found in this biome, such as phosphorus (P) deficiency and periods of drought, might contribute to increase productivity in cultivated areas, avoiding agriculture expansion. The objective of the work was to understand the extent of oxidative stress in two soybean cultivars (TMG7063 and EMBRAPA048) exposed to two water deficit cycles under P deficiency conditions. The experiment was carried out in a greenhouse in a randomized block design, in a 3x2 factorial scheme, with five replications. Treatments comprised three water stress conditions: well-watered control (WW); severe water deficit during grain filling stage (WS-R5); moderate water deficit in the vegetative stage (V5) and severe water deficit in grain filling stage (WS-V5 + R5); and two nutritional conditions: P deficiency (Pd) and recommended P fertilization (Ps). The leaf water potential decreased significantly due to water deficit in both cultivars, regardless of P nutrition conditions (Pd and Ps). However, only the cultivar EMBRAPA048 showed significantly higher proline accumulation when exposed to water deficit, which resulted in reduced hydrogen peroxide production and lower lipid peroxidation, especially in Pd plants from the WS-V5 + R5 treatment. When grown under Ps the plants from both cultivars showed higher lipid peroxidation under water deficit than Pd plants. It can be concluded that the efficient mechanisms for osmoprotection mainly in conditions of Pd presented by the cultivar EMBRAPA048 contributed to less oxidative damage under water deficit stress.

Keywords: Proline, Lipid peroxidation, Reactive oxygen species, Drought, EMBRAPA048, TMG7063.

Acknowledgments: CAPES, CNPq.

Oral Presentation: Coffee trees supplemented with foliar magnesium accumulate more carbohydrates in the roots in drought conditions

Linhares, P.C.A.[1]; Rubio, Z.C.C.[1]; Silva, A.A.[1]; Zambrosi, F.C.B.[2]; Marchiori, P.E.R.[1]

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Coffea arabica L. is one of the species most affected by water deficit, due to the sensitivity of photosynthetic activity to this abiotic stress. Considering that magnesium (Mg) is the cofactor of several enzymes and participates in the translocation of sugars, the following hypothesis was tested: coffee trees supplemented with leaf Mg would show tolerance to drought due to the maintenance of the translocation of carbohydrates to the root system. Aimed, therefore, to evaluate whether the foliar application of Mg in coffee trees under water deficit would stimulate sugars translocation and root growth. Young coffee plants (cultivar Mundo Novo) were submitted to two foliar Mg supplements ($MgSO_4 \cdot 7H_2O$) (Without, Mg0% and With, Mg2%) and two water conditions [well-watered (WW) and water deficit (WD)], in three evaluation moments defined from the intensity of the stress [50 and 30% of the field capacity (FC)] and rehydration (REC). The following were evaluated: concentration of leaf Mg, predawn leaf water potential (Ψw), roots dry mass (RDM), total soluble sugars (TSS) and reducers (RS), starch and sucrose (SUC) in roots and leaves [old (OL) and new (NL)]. Higher leaf Mg content was observed in plants with this treatment. In the 1st collect (50% FC), WD + Mg2% plants reduced Ψw, RS and starch in OL. However, there was an increase of the RS in OL, RDM and root starch. In the 2nd collect (30% FC), WW + Mg2% plants increased RS in root, RDM, starch and SUC in OL. In this period, there was more TSS and SUC in roots of plants WD + Mg2% than in WD + Mg0%. In the REC period, the plants recovered their water status, without difference between treatments. In addition, there was less RS and TSS in WD + Mg2% plants. However, these plants increased TSS and SUC in OL, in addition to starch, TSS and SUC in root. Coffee trees supplemented with leaf Mg are more tolerant to water deficit for keeping the translocation of sugars and accumulate more starch in the roots.

Keywords: *Coffea arabica* L., Water stress, Mg, Sugars.

Acknowledgments: CAPES, CNPq and UFLA.

Thursday | September, 3th, 2020.

Panel II | Plant physiology applied to teaching and scientific communication

Lecture: Experiencies in teaching plant physiology

Professor Carlos Henrique Brito de Assis Prado

Universidade Federal de São Carlos – UFSCar
Departamento de Botânica, São Carlos, São Paulo, caique@ufscar.br

Our authoring experiences in teaching during these 25 years in Plant Physiology (PP) have gone through various media and formats. From the book printed in black and white to the color PDF distributed on the internet. From face-to-face classes to remote teaching under the current COVID-19 Pandemia, and the attempt to combine contents into portals. The internet has significantly expanded the social impact of PP education and can be used to record reach in public. The translation of a classic work about Plant Ecophysiology was one of our first experiences resulting in a book printed in black and white in 2000. In 2006 we launched a book of practices and theory in PP with a linked portal and in 2012 a dedicated portal in an attempt to combine all our PP research and teaching products. A theoretical book concerning mineral nutrition was launched in 2013, emphasizing the acquisition of the mineral nutrient in the soil solution. Before the Pandemic COVID-19, we had about 40 teaching videos distributed on the topics of photosynthesis, water relations and mineral nutrition, and several PDF texts of water relations published only on the portal. These water relations texts were revised and organized in a book to be released in October of this year 2020 in PDF format, free of charge, having as principal authors the undergraduate students of the Biological Science course at Federal University of São Carlos. There are 13 chapters distributed under the title "movement of water in the body of the plant." Several of these teaching products (mainly those about practices and some sections of theoretical books) can be used with adaptations in high school and all of them in undergraduate courses in Biological Sciences, Agronomy, Forest Engineering, and other related areas. The impact of these products on society goes through tens of thousands of users. Some certainties remain after these (unfinished) experiences. Authorial products are essential for teaching in PP, not because they are better than those already available, but because they add a particular vision, a specific approach, and an accumulated experience that can only be narrated by its actors and authors. In each Professor and his relationship with students, there are inherent and unique potentialities that must be treated not as patients in an existing literary production but as agents of a new and permanent output based on what already exists. It is

not about improving what is available, but about showing your vision, your approach, narrative, and a set of specific values. As an author of teaching products, is it possible to feel a participant in the construction of daily practice with the world through PP.

Lecture: Teaching botany: how may we prepare plant physiologists that improve students' learning?

Professor Denise Maria Trombert de Oliveira

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As professors in a University, we are responsible for finding the best teaching methods that would allow our students to learn. As botanists, we are challenged to banish plant blindness. When we are botany professors, we must improve our pedagogical practices for preparing future biology teachers to catch their students' attention, promoting their motivation. Only this may improve students' learning. Plant blindness is a sad reality; frequently, people do not see that plants participate in their lives – and plants do this 24 hours a day! At schools, many children and teenagers reject botany classes because they found them annoying, with many confusing names to memorize and complicated processes to learn, like photosynthesis. This rejection is also seen in college students. Therefore, it is necessary to prepare our biological science undergraduates, and our graduate students to face all these challenges. And how may we do this? In the last decades, we saw many curriculum changes acting in this way. Instrumental courses of Teaching Lab in all disciplines of the biological sciences are a good beginning. At Universidade Federal de Minas Gerais (UFMG), we have a successful experience with Botany Teaching Lab in the undergraduate biological science course, in which we discuss the bases of preparing suitable classes for primary and secondary scholars. Among the activities, Botany Teaching Lab details some practices in structural and functional subjects, the production of models, games, and other materials, and the principles for preparing well-structured exams. In the graduate program of plant biology at UFMG, we have a teaching internship in attention to the requirements of the Brazilian agency of graduate studies (CAPES). In our teaching internship, master and doctorate students choose an undergraduate course to act during a semester; the interns are supported by the undergraduate professor and by the coordinator of the graduate program, who discuss the improvement of teaching skills in the graduate students. Both initiatives, in the undergraduate and graduate courses, are effective, and we are graduating best biology teachers and professors. Regarding plant physiology, the adoption of practical classes promotes meaningful learning for the student. There are several suggestions for experimental activities of plant physiology, and, in all of them, we can explore inquiry-based learning and the scientific method. Doing this, your students will love botany.

Keywords: Inquiry-based learning, plant blindness, practical classes, teaching internship, teaching lab.

Acknowledgments: UFMG, CNPq, CAPES.

Lecture: The plant physiologist as the protagonist at the forefront of knowledge

Msc. Deivisson Pelegrino de Abreu

Universidade Estadual do Norte Fluminense - UENF

A fisiologia vegetal vai além de uma disciplina ministrada em sala de aula ou de experimentos em laboratório ou casas de vegetação. Estudar e conhecer o funcionamento das plantas é fundamental para a tomada de decisão, seja para realizar a recomposição de uma vegetação degradada ou formar um grande pomar. O fisiologista vegetal é o profissional responsável por estudar e entender as funções fisiológicas e as causas de estresse nos vegetais, além de desenvolver as técnicas para minimizar esse estresse e garantir que a planta possa expressar o máximo potencial genético. Por esses motivos entendo que é nossa responsabilidade traduzir e comunicar o conhecimento adquirido em nossas pesquisas para toda a sociedade.

Plant Physiology and its Contributions to Society IISIFV

Oral Presentation: Different responses to the same conditions: Ecophysiological functions of two tree species in the Brazilian Caatinga

Medeiros, M.J.S[1]; Wright, C.L[2,3]; Lima, A.L.A[1]; Brito, N.D.S[1]; Souza, E.S.[1]

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Seasonally dry tropical forests (SDTFs) are characterized by high rainfall seasonality, which influences plant water use dynamics. Differential plant responses to wet and dry conditions are indicative of water acquisition strategies, particularly with regards to drought tolerance. Carried out in the Caatinga SDTF of northeast Brazil, this study analyzed two species of contrasting wood densities: Cenostigma pyramidale and Commiphora leptophloeos. The main objective was to clarify the relationships between tree water status and a suite of ecophysiological and environmental variables under wet and dry conditions. The ecophysiological variables we measured were leaf water potential (ΨLeaf), sap flux velocity (Js), and stomatal conductance (gs) for five individuals per species. The environmental variables we measured were soil water storage (SWS), vapor pressure deficit (VPD), rainfall (P), and evapotranspiration (ET). To analyze the relationship between these variables, we performed Pearson's correlation coefficient tests. Our results show that, although both species are deciduous, they differ in their ecophysiological responses. For C. leptophloeos, we found that ΨLeaf had a positive relationship between Js, gs, ET, soil water storage and rain, and a high negative relationship with the VPD. Still, ΨLeaf had small gradient of variation. For C. pyramidale, we found that ΨLeaf had a positive relationship with gs and SWS. Also, ΨLeaf had a large gradient of variation. This suggest that the water status of C. leptophloeos is sensitive to various factors, whereas the water status of C. pyramidale is more related to soil water availability. These results show that coexisting species in SDTFs can exhibit different functional behavior according to the individual characteristics of each species. This information is relevant to predict the responses of trees in future climate change scenarios.

Keywords: Seasonality, SDTFs, sap flow, stomatal conductance, water potential, wood density.

Acknowledgments: FACEPE (APQ-1196-5.03/15); FACEPE (IBPG-1009-5.01/18). ONDACBC: FACEPE (APQ-0532-5.01/14); CNPq (465764/2014-2); CAPES (88887.136369/2017-00); AIC-GRHASSA: FACEPE (APQ-0296-5.01/17); PEGASUS: CNPq (441305/2017-2). CAPES/TAMU (006/2014).

Oral Presentation: Hexanoic acid application in roots can modulate secondary metabolism and redox state-related genes in coffee leaves

Domingues, D.S[1], Rosa, R.S[1], Calzado, N.F[1], Camargo, P.O[1], Budzinski, I.G[1]

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Hexanoic acid (Hx) is a short, naturally occurring monocarboxylic acid that is a potent natural priming agent against pathogens. The molecular mechanism that rely Hx induced resistance is not fully understood, since most studies were focused on reducing the symptoms of plant diseases. However, previous studies in some crops showed that the exogenous application of hexanoic acid can induce a long distance modulation in key genes of plant metabolism. Here we hypothesized that, similarly to what occurs in several plant systems, hexanoic acid can induce a long distance modulation in relevant genes to plant metabolism. For this, we evaluated by RNA-seq the leaf transcriptome of two *Coffea arabica* cultivars with contrasting genetic background (Catuaí Vermelho and Obatã), in response to the application of hexanoic acid in an eliciting concentration in nutrient solution. Hx modulate more genes in Catuaí Vermelho than in Obatã. A total of eight genes have significant similar transcriptional modulation in both cultivars, including genes related to redox balance, jasmonate signalling and the phenylpropanoid metabolism. Hx significantly repressed only an electron acceptor in chloroplasts. All other genes were upregulated. They include a glycosyltransferase associated to the salicilate-jasmonate signaling crosstalk, an ATPase, aldo keto reductases and genes related to the biosynthesis of hydroxycinnamic acids and terpenoids. These results demonstrate that the application of Hx in roots can alter the gene expression patterns of leaves, activating genes involved in redox regulation and synthesis of specialized metabolites.

Keywords: transcriptome, differential responses, plant metabolism.

Acknowledgments: CAPES (Code 001), FAPESP (#2016/10896-0), CNPq

Oral Presentation: Ecophysiological traits of native and exotic tree species in response to sun and shade conditions

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Land use changes are the main sources that promote global environmental changes, altering the functioning of ecosystems and facilitate the establishment of invasive species. Studies indicate that the higher abundance of invasive exotic tree species occurs especially in forests border. Edge environments are characterized by a high canopy opening, which implies a higher light and temperature. This study aimed to compare the morphological responses of native and invasive tree species to different light conditions. To carry out the experiments, two tree species with occurrence in riparian zones of subtropical forests were selected. Greenhouse experiments were conducted to understand how low and high light availability influence the growth of *Eugenia uniflora* L. (native species) and *Hovenia dulcis* Thunb. (invasive alien species). After 30 days under shade and sun conditions, growth evaluations were performed at 10-days intervals. The results indicated that for the species *H. dulcis* a significant degree of phenotypic plasticity was observed. A progressive increase in growth in both light conditions was observed throughout the experiment. Differences between sun and shade *H. dulcis* plants were observed for the leaf number, chlorophyll content and specific leaf area (SLA). The native species, *E. uniflora*, in contrast, invested in growth only between 10 and 20 days, reducing this investment at the end of the experiment (30 days). In addition, differences between sun and shade plants were observed only for chlorophyll content and root:shoot ratio. A remarkable acclimation capacity for the two species in response to different light conditions was highlighted. Both species were tolerant of sun and shade conditions, but with different growth strategies. *H. dulcis* shows variations in growth over the experimental period (30 days), while *E. uniflora* seems to acclimatize rapidly (20 days) to the difference in light conditions. These results are particularly important in the use of *E. uniflora* in environmental restoration projects, whereas *H. dulcis* presents a series of morphophysiological adaptations, which can facilitate the invasion process in forest fragments.

Keywords: acclimation capacity, chlorophyll, forest fragmentation, phenotypic plasticity, specific leaf area.

Acknowledgments: URI, CNPq.

Oral Presentation: Silicon alleviation of cadmium toxicity in mangroves (*Lagungularia racemosa*) (L.) C. F. Gaertn

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Cadmium (Cd) induced stress is known in plants, and it also promotes changes in the photosynthetic metabolism. In recent years, the increase in Cd concentration has been detected at high levels in various ecosystems, including mangroves. Cd induced toxicity for most plants can be mitigated by interactions with other chemical elements. Silicon (Si), for example, is a chemical element widely known for its attenuating effect on biotic and abiotic stresses. However, the important mechanisms involved are still only partially understood. Based on this premise, this study aims at evaluating the effect of sodium silicate (Diatom®) in the attenuation of Cd effects on CO_2 assimilation and in the photochemical step in *Laguncularia racemosa*, a species that showed greater susceptibility to metal in previous studies. Young plants of *L. racemosa* were collected in Itacaré, Bahia, Brazil, and cultivated in (1) nutrient solution; (2) Diatom® 0.1% (Si); (3) 5mg L^{-1} Cd and (4) the Cd + Si association for a period of seven days. The mangrove seedlings were able to absorb the Cd and translocate it to the shoot, causing chlorosis and senescence of the mature leaves. The results showed that Cd induces a reduction in CO_2 assimilation and causes photoinhibition of photosystem II. Silicon was able to reduce the visual effects of heavy metal on plants, maintaining the turgidity of plants grown in nutrient solution with the addition of Si, increasing the amount of starch deposited in the mesophyll. It was observed that the maximum quantum yield (*Fv/Fm*) of the plants treated with the association Cd + Si was similar to the control, showing that Si participates in the prevention of photoinhibition effects. However, the tested 0.1% Si concentration was not sufficient to mitigate the Cd effects on gas exchange measurements. Preliminarily, it was considered that in a more moderate Si concentration the stress induced by Cd could be reduced. Further studies will test other Si concentrations in association with Cd and investigate the ultrastructural effects on chloroplasts.

Keywords: Remediation, Heavy Metal, Plant Physiology, Pollution, Costal Ecosystem.

Acknowledgments: CAPES, UESC, UFMG.

Friday | September, 4nd, 2020.

Panel III | Plant physiologists acting on public and private institutions

Lecture: Beyond the metabolic routes: the role of the plant physiologist in management activities in public and private institutions

Professor Alan Carlos Costa

Instituto Federal Goiano, IFGoiano

Professor Alan Carlos da Costa is a researcher and professor in the field of plant physiology and he has worked at the Instituto Federal Goiano since 2007. Throughout his career, along with the implantation of the infrastructure and the research lines in the field of plant physiology at the referred institution, he has also worked in different administrative activities that directly or indirectly contributed to his performance as a plant physiologist, as well as the scientific development of the institution in the state of Goiás. Reflections concerning the following topics will be addressed in the lecture: formation and training of human resources at different levels; development of research and contributions to the development of agriculture and environmental conservation; physiology as a solid basis for other areas of knowledge; the role of the physiologist as an intermediary between public research institutions, private companies and market demands, new demands and perspectives for the performance of plant physiology professionals.

Lecture: Strategic planning for insertion of plant physiologists on private institutions

PhD Débora de Oliveira Prudente

Centro de Tecnologia Canavieira - CTC

The competition between competitors who work in an academic environment has different characteristics from that between agents already inserted in the competitive organizational market. The career planning in a graduate program must include the characterization of the corporate environment and the identification of the main demand in relation to the type of professional and his market.

Lecture: From the Method to the "Madness": the path of a scientist managing a graduate program

Professor João Paulo A. Delfino Barbosa

Universidade Federal de Lavras - UFLA

It's not trivial for a scientist to become a manager. The scientist is thought to think and to work in the scientific method: having ideas, making hypotheses, drawing experiments and analysing results aiming for a high impact publication, of course! In my scientific career, I was always putting plants out of their comfort zone and then using the scientific method to observe how they would respond to this stressful situation. But, when it is your turn to be out of your comfort zone? This happened to me when I was chosen to manage the plant physiology graduate program in UFLA at the end of 2013. In my talk, I will draw a parallel between a scientist and a manager: what abilities and traits they share? and in which issues they do not match at all?. In my talk I will point out some skills that need to be trained in scientists so they can be prepared for work in public institutions teaching, researching, extensioning and doing a lot of management!

Oral Presentation: Be prepared: survival strategies of *Handroanthus heptaphyllus* (Vell.) Mattos seedlings after hydration-dehydration cycles

Dias, G. S.[1], Chaves, J.T.L.[1], Bastos, L.S.[1], Bicalho, E.M.[1]
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Seeds of tropical plants, after dispersion, are subject to various environmental stressors such as water deficit and seasonal dehydration. Occurrence of hydration and dehydration cycles (HD) during the residence of the seeds in the soil seed bank influences the establishment and regeneration of natural populations. The main of this study was evaluating the establishment of seedlings of *Handroanthus heptaphyllus* whose seeds underwent HD cycles in different phases of imbibition. Ten seedlings were selected randomly, from seeds that passed through 0, 1, 2, 3 and 4HD in two imbibition phases, Phase I-FI (10 hours) and Phase II-FII (35 hours), and drying for 12 hours. Growth parameters (height, root length, number of leaves and dry mass) and biochemical parameters (chlorophyll *a*, *b* and total, carotenoids, total soluble sugars - TSS, reducing sugars - RS and non-reducing sugars - NRS) were evaluated at the end of 60 days. The seedlings showed a reduction in height in relation to the control in both phases, with seeds that passed through FII showing smaller seedlings than in FI. However, compared to the control, they showed a significant difference in the length of the root, chlorophyll a and carotenoids in the first two cycles regardless of the phase. Total chlorophyll was higher in FI than FII in 1HD in both phases. As for the dry mass of the aerial part, the root, number of leaves and chlorophyll b, there was no significant difference. In relation to the TSS, there is a significant difference for the phases and cycles in the accumulation of sugars from the 2HD, with higher values for the FII, while for the RS there is a reduction in 3HD in both phases. There is significant interaction between the cycles and the phases for NRS, with a greater accumulation in all cycles of the FII compared to those of the FI, and within the two phases the 2HD presented the highest values. Thus, it is concluded that seeds that have undergone HD cycles produce smaller seedlings in height, but with a larger root system, greater production of photosynthetic pigments and accumulation of soluble and non-reducing sugars that gives them a metabolic adjustment in defense against likely future stressful conditions.

Keywords: Ipê-rosa, Bignoniaceae, chlorophyll, sugars, seedling establishment.

Acknowledgments: CAPES, UFLA.

Oral Presentation: Guard cell TCA cycle is differentially regulated in the light compared to mesophyll cell

Lima, V.F.[1]; Medeiros, D.M.[2]; Cândido-Sobrinho, S.A.[1]; Freire, F.B.S.[1]; Daloso, D.M.[1]

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The tricarboxylic acid (TCA) cycle provide substrates for numerous metabolic pathways and the mitochondrial respiration of living organisms. In plants, whilst the carbon fluxes throughout leaf TCA cycle are light-inhibited, recent evidence suggests that both glycolysis and the TCA cycle are activated in guard cells in the light. Here we have established a mass spectrometry-based ^{13}C-positional isotope labelling approach to compare the ^{13}C distribution through the TCA cycle and glutamate/glutamine (Glu/Gln) synthesis. This approach allowed us to distinguish the ^{13}C-incorporation in Glu/Gln coming from phosphoenolpyruvate carboxylase (PEPc) activity from those of the TCA cycle and glycolysis. We used this approach and performed a meta-analysis using data from previous ^{13}C-metabolic flux studies from C3 and C4 mesophyll cells. We further performed a ^{13}C-isotope labelling experiment using guard cells under light and dark conditions. In general, guard cell ^{13}C distribution did not resemble those observed in C4 or C3 leaves. Interestingly, minor differences in the metabolic changes in guard cells between dark and light conditions were observed. Furthermore, whilst the ^{13}C incorporation in pyruvate is similar, the fluxes from PEPc, glycolysis and the TCA cycle toward Gln synthesis are much higher in guard cells when compared to both C3 and C4 mesophyll cells in the light. Collectively, our data reinforce that guard cell TCA cycle occurs in a non-cyclic mode in the light, which is probably associated to a particular mode of regulation of both glycolysis and TCA cycle enzymes in these cells.

Keywords: Guard cells, metabolic fluxes, metabolic regulation, mitochondrial metabolism, tricarboxylic acid cycle.

Acknowledgments: CAPES, CNPq.

Plant Physiology and its Contributions to Society IISIFV

Oral Presentation: Mild reductions in guard cell sucrose synthase 2 expression alter the speed of light-induced stomatal opening and the whole plant transpiration in *Nicotiana tabacum* L. under both well-watered and water deficit conditions

Freire, F.B.S.[1]; Bastos, R.L.G.[1]; Bret, R.S.C.[1]; Cândido-Sobrinho, S.A.[1]; Daloso, D.M.[1]

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Plant scientists are looking to understand the dynamic of stomatal movements in order to improve plant water use efficiency (WUE) through genetic manipulation of plant metabolism. This is extremely important given that the current scenario of climate changes is likely to lead to increased incidence of drought, that are in turn expected to reduce plant productivity. In this context, genetic manipulation of guard cell metabolism has been demonstrated to be an effective strategy to alter stomatal movements toward plant WUE improvement. Previous results showed that plants overexpressing *sucrose synthase 3* (*StSUS3*) specifically in guard cells had higher stomatal conductance (g_s), photosynthetic rate (*A*) and whole plant transpiration (WPT). In our study, we inserted *StSUS3* in the antisense orientation into guard cells of *Nicotiana tabacum* L. Phylogenetic analysis showed that *StSUS3* corresponds to *NtSUS2*. Reduced guard cell *NtSUS2* expression altered guard cell metabolite profiling, with several amino acids and the TCA cycle intermediates having low relative content, and strongly reduced (up to 44%) daily WPT compared to wild type plants. Although a minor reduction in total biomass accumulation was observed, the transgenic lines allocated the carbon preferentially to the aerial part, which leads to increased harvest index and yield WUE under well-watered conditions. By contrast, the transgenic lines have higher WPT than WT plants under water deficit conditions. We further demonstrated that the transgenic lines have slower light stomatal response, but with no difference in *A*, which leads to an improved WUE during dark-to-light transition. Collectively, our results revealed that *NtSUS2* is an important regulator of WPT and highlight the role of guard cell sucrose metabolism in regulating the speed of stomatal response. Our results further strengthen the idea that engineering guard cell metabolism represents an effective strategy to improve plant WUE.

Keywords: Guard cell metabolism, water use efficiency, plant metabolic engineering, stomatal movement regulation, sucrose, water stress.

Acknowledgments: CAPES, CNPq.

Oral Presentation: Blue and red led light effects in tobacco seed germination and seedling development

Reale, A.L.[1]; Tirelli, G.V.[1]; Moraes, H.M.[1]; Frota, G.J.[1]; Santos, H.O.[1]

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One of the most important non-food agricultural crops in the world is the tobacco, which contributes substantially to the economy of more than 200 producers countries. Brazil is the second largest producer and the main exporter of processed tobacco and seeds in the world. The use of red and blue light emitting diodes (LED) is a promising technology for indoor agriculture, thus studies involving the influence of light on the uniformity and speed germination of seeds is vital for different species. Therefore, the objective of this research was to determine the germination rate and development of tobacco seedlings under white led light and the combination of red and blue lights (specific lights for plant growth) in BOD. Tobacco seeds from the Virginia varietal group, cultivar CSC 439, were used, in two treatments, one with white LED light and the other with red / blue LED light. The physiological tests performed were: germination rate, first germination count, germination speed index, emergency rate, emergency speed index and initial stand. The development of seedlings from the germination and emergence test were also evaluated by image analysis using the GroundEye® system, version S800, which measured primary root length (RL), hypocotyl length (HL), seedling length, and the root to hypocotyl ratio. Based on the physiological tests it was possible to observe a significant difference between treatments for germination rate, first germination count, germination speed index, emergency rate, emergency speed index and initial stand, which the combination of red and blue lights showed superior averages comparing to the white led light treatment. As for the image analysis, only the size of the aerial part of the seedlings from the emergency test showed a significant difference, pointing that the combination of red and blue lights surpassed the values from white light. Therefore, the initial seed development was faster when they were submitted to red / blue light. The combination of red / blue light can be used to accelerate the germination process of tobacco seeds to obtain a greater seedling development.

Keywords: *Nicotiana tabacum*, image analysis, LED, plant physiological tests.

Acknowledgments: CAPES, FAPEMIG, UFLA, CNPq, SOUZA CRUZ /BRITISH AMERICAN TOBACCO S.A.

Saturday | September, 5th, 2020.

Panel IV | Contributions of plant physiology on technology and improving life quality

Lecture: Proteases inhibitors of the cacao: a perspective against Sars-CoV-2

Professor Carlos Priminho Pirovani

Universidade Estadual de Santa Cruz – UESC.

The coronavirus disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome–coronavirus 2 (SARS-CoV-2) is a global health emergency. An attractive drug target among coronaviruses are its proteases (Mpro, also called 3CLpro and PLpro) because of the essential role in processing the polyproteins that are translated from the viral RNA. In our laboratory, we have analyzed proteases inhibitors from Theobroma cacao L. previously identified in ESTs libraries of the interaction with the fungus *Moniliophthora perniciosa*. We have bacterial clones for expression of the recombinants cacaocystatins named TcCYS1, TcCYS2, TcCYS3 and TcCYS4, inhibitors of the papain-like cysteine proteases. So, characterize an inhibitor or the serpin family that named TcSERPIN. This protein inhibit cysteine- and serine-proteases. A serine-protease inhibitor like Kunitz is expressed in soluble extract of *Escherichia coli* in our laboratory. Front to impact of the COVID-19 around of world, our aim is testing the hypothesis that proteases inhibitors from cacao inhibit Mpro and PLpro proteases and show pharmacological potential against Sars-CoV-2. The potential interaction between cacao inhibitors and viral proteases PLpro and Mpro, and human cathepsin B, cathepsin L and furin are test by computational docking. The viral proteases will be produced by recombinant expression in *E. coli* as with as the human interferon related to ubiquitin ISG-15 that is used how substrate for PLpro protease. Has been showed that PLpro suppresses the host innate immune responses by virtue of its ability to reverse host ubiquitination and ISGylation events. The cacao inhibitors that show inhibitory activity against recombinant viral proteases will be tested against Sars-CoV-2 in cell culture at Inhibitors that show activity against the proteases will be tested against the virus kept in cell culture in the laboratory of the UFMG vaccine production center. This research has the collaboration of researchers from UESC, UFMG and UFV.

Supported by: SECTI/FAPESB

Lecture: Peptide hormones in plants: RALF Family of peptides and their role in plant physiology

Professor Daniel Scherer de Moura

Universidade de São Paulo –USP/ESALQ.

Numerous factors determine cellular fate, the development of a plant organ, the organism as a whole and its interaction with its surroundings. Among these factors, hormones and, certainly, hormones of protein nature (peptides), are increasingly occupying a prominent role not only in plant development, but also in plant defense and interaction with other organisms. From the start, our laboratory has been dedicated to produce and gather scientific knowledge about a specific group of these hormones called Rapid Alkalinization Factor or simply RALF. RALFs were discovered using an alkalinization assay and they were proved to be inhibitors of cell expansion through an antagonistic mechanism against brassinosteroids. FERONIA, a plasma-membrane-localized receptor kinase was the first RALF receptor isolated from Arabidopsis thaliana seedlings. Since then, several others were isolated and proved RALF involvement with other important cellular functions and also assisted in unraveling RALF signal transduction pathways. The current array of the peptide functions and its current model of perception will be discussed.

Lecture: Real Yield X Potential Yield of herbaceous cotton in African countries

Professor Heloisa Oliveira dos Santos

Universidade Federal de Lavras – UFLA.

The Universidade Federal de Lavras (UFLA), in its 112 years of existence, has a long institutional legacy, surrounded by facts that marked its trajectory as one of the most important higher education institutions in Brazil. UFLA was able to build a story over time, efficiently exercising its social role in teaching, research, extension and providing services, in one of the most strategic areas for the entire nation: the area of Agriculture Sciences. The UFLA Internationalization Program includes actions under development, both at the institution and abroad, which aims to increase its competitiveness on global academic activity in different areas of knowledge. This process presupposes the encouragement to build structures for the reception and qualification of foreign professionals and exchange students, through the improvement and strengthening of the entity's international links. It also presupposes the delivery of assistance for different quarters of the globe, wherever the University is requested to assist the partner nations, in international cooperation projects in the agricultural area. The cotton growing is a central economic activity for several African countries and has been generating international cooperation actions between UFLA and this continent for years. The crop that promoted the approach is now beginning to be associated with other work possibilities, in new extension projects that advances toward social purposes. Technology sharing type of projects developed by UFLA have promoted the development of knowledge regarding cotton crop in African countries since 2014, through the "Training and Technology Transfer in Cotton Crop" course, carried out in partnership with ABC/MRE and the Brazilian Institute do Cotton (IBA), which served 30 professionals from four Portuguese-speaking countries: Cape Green, Angola, São Tome and Principe and Mozambique. In 2017, the same course was given to French-speaking countries, composed by a delegation of 35 professionals from Benin, Burundi, Burkina Faso, Cameroon, Ivory Coast, Chad, Mali, Togo and Senegal in Brazil and attended to lectures, inside the University, and practical classes, in the north of Minas Gerais state, learning cotton growing techniques for the semiarid region. In a third stage, in 2018, the training included the English-speaking African nations such as Malawi, Kenya, Tanzania and Zimbabwe, as well as Mozambique, with the participation of 36 African technicians. Based on this initiative, partner institutions started the most important project in the segment called Cotton Victoria, aiming to develop the competitiveness of the cotton sector in Kenya, Tanzania and Burundi. Between 2015 and 2016, a multidisciplinary team from UFLA combined technical, climatic and technological studies to verify, in each of the three countries mentioned above, the possible obstacles to achieve greater efficiency of the cotton production system. This data survey made it possible to identify what types of training and equipment were needed, in order to increase cotton yield in the areas. From these projects, other sustainability projects

for cotton production began in Senegal, Cameroon and Mali, currently constituting 11 projects in the cotton crop that are encouraging other areas of food production to start new projects.

Oral Presentation: Antifungal and antibiofilm activities of the major constituents of the essential oil of *Lippia gracilis* Shauer against *Fusarium oxysporum*

Aguiar, T. K. B.[1]; Silva Filho, C. M. S.[1]; Malveira, E. A.[1]; Albuquerque, C. C.[1]; Vasconcelos, M.A.[1,2]

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Phytopathogenic fungi can cause serious problems in important agricultural crops. Synthetic fungicides have effectively controlled phytopathogenic fungi, however, the continues use of these substances can lead to several problems, such as emergence of resistant pathogens. In addition, microorganisms have ability to form communities more resistant to conventional antimicrobials, the biofilms. Several studies have focused on the use of natural products as sustainable alternatives in the control of plant diseases, including essential oils. *Lippia gracilis* Shauer (Verbenaceae) is an aromatic plant used in traditional medicine and its essential oil have potential as a natural antimicrobial agent, this activity is generally associated with the presence of its major constituents, the monoterpenes thymol and carvacrol. Therefore, this study aimed to evaluate the antifungal and antibiofilm effects of monoterpenes thymol and carvacrol against *Fusarium oxysporum* URM6704 strain. The antifungal activity was evaluated by vegetative growth in the presence of different concentrations of the thymol and carvacrol (0.0078 - 1 mg/mL). In addition, fungal biofilms were developed in the presence of thymol and carvacrol for 72 h. The biofilms were characterized by total biomass quantification (crystal violet staining) and cells metabolic activity (MTT assay). Both monoterpenes, thymol and carvacrol, were able to inhibit the growth of *F. oxysporum* at concentrations ranging from 0.125 – 1 mg/mL. Regarding biofilm formation, the compounds significantly reduced the total biomass and metabolic activity of the fungal biofilm. The results obtained in this work confirm the antifungal potential of the major compounds of essential oil of *L. gracilis*, and suggest the thymol and carvacrol as potential alternative agents in the control of the diseases caused by phytopathogenic fungi and its biofilm.

Keywords: biofilm, carvacrol, thymol, essential oil, phytopathogenic fungi.

Acknowledgments: CAPES, CNPq, FUNCAP.

Oral Presentation: Impact of inoculation with *Bacillus amyloliquefaciens* BV03 on the physiological processes of soybean exposed to salinity

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Brazil is the second-largest producer of soybean (Glycine max) in the world, which is an essential source of nutrients, protein, and oil. The development of this crop, however, is compromised by the high degree of soil salinization in many producing states, and the introduction of agricultural technologies aiming at greater productivity in these conditions is essential. Several microorganisms that promote plant growth have been identified as capable of reducing the effect of stressors, contributing to a more sustainable agriculture. Therefore, we analyzed the effect of inoculation with Bacillus amyloliquefaciens (BV03, for reference: No-Nema), provided by the company Biovalens, on the physiological processes of soybean exposed to salinity. The experiment was carried out in a greenhouse in the Instituto Federal Goiano – Campus Rio Verde. Soybean plants were cultivated until reaching the V3 stage and then exposed to four treatments: Control (irrigated plants), BV03 (plants inoculated with BV03, 2mL for 1 Kg of seeds), Salinity (plants submitted to 150 mM NaCl) and Salinity + BV03 (plants inoculated with BV03 and submitted to NaCl). The experimental design was completely randomized, with five replications, and physiological and biochemical traits were evaluated after 15 days of exposition to the treatments. The water potential was more negative in plants exposed to salinity, and although there was no significant difference between Salinity and Salinity + BV03, there was a tendency of improvement in this parameter in the treatment with inoculated plants. The treatments Salinity and Salinity + BV03 showed lower osmotic potential compared to other treatments, which can be a plant strategy to maintain water uptake. Although salinity significantly reduced the photosynthesis of plants, inoculation with BV03 was able to mitigate this harmful effect of NaCl, increasing carbon fixation. Regarding photosynthetic pigments, a decrease in the concentration of chlorophylls a, b, and total was observed only in the treatment Salinity + BV03, which may represent a strategy to decrease the light absorption and, thus, protect the photosynthetic apparatus, avoiding the formation of reactive oxygen species. It is possible to conclude, therefore, that inoculation with B. amyloliquefaciens BV03 can mitigate the negative effects of salinity, contributing to a more efficient and sustainable agriculture.

Keywords: Glycine max, Saline stress, Plant physiology, Sustainability.

Acknowledgments: IF Goiano, Biovalens, Laboratório de Metabolismo e Ecotoxicologia Vegetal.

Oral Presentation: The application of electronic-nose as a non-invasive tool to monitoring plants under water stress

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Interdisciplinarity is an important issue in plant physiology. It is growing fast, mainly in function of complexity that permeates the area. The development of non-invasive methods and accessible tools for research are considered breakthrough. The systems to detect plant scent, applied to crop stress, are considered of basic importance to physiology and agriculture. This work presents the preliminary results using an electronic nose (E-Nose), as an affordable tool for plant phenotyping. An E-Nose is an electronic system used for smell global analysis, which emulate the structure of the human nose. The soybean (*Glycine Max*) was used to conduct this experiment under water stress, since this is one of the main cultures of agribusiness, with great importance in Brazil´s agricultural GDP. A commercial E-Nose has been used, and a cuvette was design and built to conduct the measurement of the gas sample from the soybean. This experiment was conducted for 30 days, observing the stages of plant growth during this period. This container has embedded with relative humidity (RH (%)), temperature (°C) and CO_2 (ppm) sensors. These systems allowed for frequent monitoring of each of the parameters, measuring them every 5 minutes and storing in a data base. The soil used was the red-yellow dystrophic type, and was covered to avoid evapotranspiration effects. The measurement with the electronic nose was done daily, during the morning and afternoon, and in two phenological situations of the plant (with the healthful soy irrigated with deionized water and under water stress) until the growth V5 stage to obtain the plant gases emissions. The natural light intensity has monitored with the variation in the range from 2.0 K Lux to 46.0 K Lux. From the evaluation of the sensors database, a dynamic variation of plant respiration pattern was observed, with the emission of CO_2 changing during the day and night, as well as the temperature and the relative humidity in the same period of this experiment. With the initial results, obtained with the electronic-nose signals, it was possible to distinguish the two situations, i.e., the irrigated plant standard and under water stress. Future investigations should be carried out under controlled conditions, and using machine learning investigations, as well data mining, that will enable early detection of the stress level.

Keywords: E-Nose, Smell Global Analysis, Water Stress, Non-invasive, Soybean.

Acknowledgments: EMBRAPA INSTRUMENTATION, EESC/ICMS-USP, CNPq (scholarship 129877/2019-0).

Plant Physiology and its Contributions to Society
IISIFV

Oral Presentation: Canonical correlations between water potential and spectral index in coffee under water deficit

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Coffee plants under water deficit display changes in the metabolic components that alter the spectral reflectance of leaves. The objective of this study was to determine the canonical correlations between leaf reflectance indexes and the water potential of the coffee tree. To this end, analyzes of water potential data and spectral indexes were carried out on coffee trees at 42 months after the imposition of the water deficit in field conditions, in the Vale do Jequitinhonha. The pre-dawn water potentials were measured with the Scholander pump and the spectral index with the leaf mini spectrometer. The reflectance index of: photochemistry (PRI), normalized difference vegetation (NDVI), water band (WBI), anthocyanins (ARI1), carotenoids (CRI1), structure-insensitive pigment index (SIPI), flavonoids (FRI) and senescence (PSRI) were analyzed. The canonical analyzes showed that the total variance explained by the first two canonical variables was 73.02%, with 51.72% of accumulated variance in the first canonical and 21.30% by the second canonical. Based on the scores, the main variable in Can1 was PSRI while in Can2 it was water potential. Highlighting Can1's greatest contribution, the PSRI index showed a negative correlation with water potential. The variations in water potential occurred in the range of 0 to -5.1 Mpa. Thus, the strong negative correlation between PSRI and water potential indicates that the lower the water potential values, the higher the PSRI values and the greater leaf senescence. As for the other index, the correlation was positive, highlighting the NDVI. The positive correlations between the potential and the WBI may indicate that the higher water potential, higher water content in the leaves. The positive correlation between water potential and the SIPI, ARI, CRI, NDVI and FRI index indicates that the severe deficit impairs the synthesis of pigments related to photosynthetic efficiency and antioxidative mechanisms. Canonical correlations indicated that higher PSRI values negatively correlated with NDVI and water potential may indicate severe water deficit in coffee.

Keywords: Senescence, NDVI, drought, multivariate analysis, *Coffea arabica*.

Acknowledgments: CONSÓRCIO PESQUISA CAFÉ, INCTCafé, FAPEMIG, CAPES, CNPq.

Closing lecture: Plant Physiologist: A multitask professional?

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Plants are fabulous organisms capable to tolerate the most broadly the environmental conditions. With them, we have learned how they get and transform light energy into biochemical energy, how they use this energy into growth, development, and defense process. Beyond physiological and biochemical processes, plants have been teaching us how to behave. Why is it so curious and why are we, as humans, so blind in front of plant physiology since they are an important part of our days? We eat plants, we breathe due to the oxygen produced by plants. We have no answers to this question. This way, being a plant physiologist in a plant blindness world is more than challenging, is hard work. While we are surrounded by plant physiologists, botanists, agronomists, and related professionals, we are comfortable to talk about plants´ importance. Outside of this ball, the interests are others. Nevertheless, plants are there to teach us besides physiology, much more. Plant physiologists not always will work with only that knowledge we have read in the books since graduation. There is a kind of knowledge that books do not teach us. This is how to solve problems in the field, to teach, and to motivate students, to advise, to get financial support for research, to improve food security, to manage post-graduation programs and entire institutions. In other words, plant physiology impacts society. However, the academy does not teach us how to do that, we need to learn them with the career we choose, with practice. So, be opened to embrace and discovering features is a great part of the job. This way, interdisciplinarity must be discussed in its totality, not only between related subjects. The Plant Physiology Interdisciplinary Symposium is, undoubtedly, the greatest opportunity to bring up all potential skills the plant physiologists must root. Nonetheless, the knowledge around plants is beyond physiology per se, it is a way to the pursuit, and use plants to better improve life quality in many ways.

Keywords: interdisciplinarity, society, life quality, learning, teaching, knowledge.

Acknowledgments: UFLA, SBFV, PPGFV, NEF.

Poster Presentations

LINE OF RESEARCH | Biotic and abiotic stress

Evaluation of tolerance to induced water stress in young citrus plants

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The use of rootstocks with drought tolerance characteristics allows the diversification of materials in citrus. This study aimed to evaluate the degree of drought tolerance in citrus hybrids in the early stage of development, based on stomatal conductance and growth variables. The experiment was carried out in a protected and controlled environment (FITOTEC), with temperature and relative humidity of 26°C and 70%, respectively, for the daytime, and 21°C and 80% for the night period, with a 12h photoperiod. 120 days after sowing, seedlings of nucellar origin were transplanted into PVC tubes containing washed sand, and the substrate moisture was maintained at maximum water retention (0.15 cm^3 cm^{-3}) for all experimental plots, using a solution nutritious. After the incubation period, the irrigation of the experimental plots for the treatment of water deficit was suspended and the volume of water used to restore the substrate humidity in the field capacity for the control plots was based on the volume of transpired water by the gravimetric method. After 48 days without irrigation, stomatal conductance (gs) was evaluated and growth variables, such as leaf area and dry mass of the aerial part. The design used was completely randomized, and the factorial scheme was 4x2, with four hybrids ('LCR x TR - 001', 'TSKC x CTSW - 041', 'TSKC x (LCR x TR) - 059' and 'HTR – 069') and two water managements (control and water deficit), with three replications. The data obtained were submitted to analysis of variance and the means were compared using the Tukey test at 5% probability. The substrate humidity recorded for this hybrid 041 was 0.84%, while for the other hybrids, it was between 1.36 to 3.41%. Under control conditions, hybrid 041 was the one with the highest gs and the opposite is registered for hybrid 069, which does not present a significant difference between the control treatment and water deficit. The restriction of water in the soil limited the growth of the plants, compromising the increase of the leaf area and the dry mass of the aerial part. The analyzed hybrids present different strategies and mechanisms of tolerance to stress due to water deficit. In a condition of water deficiency, the evaluated hybrids present similar responses of stomatal closure, but different responses in terms of soil water extraction and growth, with 041 showing a behavior of tolerance to stress while 069 seems to use water conservation strategies as drought escaping mechanisms.

Keywords: Abiotic Stress, Drought, Stomatal Conductance, Ungrafted.

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Plant Physiology and its Contributions to Society IISIFV

Copper increase sugar and nitrogen compounds in nodules of mung bean inoculated with bradyrhizobia

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Copper is an important micronutrient involved in vital biological processes, however it is toxic when in large quantities in the environment. The aim of this work was to investigate the effects of copper sulfate ($CuSO_4$) on content of sugar and nitrogen compounds in nodules of mung bean (*Vigna radiata* (L.) Wilczek)) inoculated with bradyrhizobia. In greenhouse, plants were inoculated and cultivated in absence (control) or presence of 20, 40, 60, 80 and 100 µM CuSO4. After 45 days, root nodules were excised and used to measure total soluble carbohydrates, leghemoglobin, ureides, free proline, free ammonia, total free amino acids and soluble protein under laboratory conditions. Total soluble carbohydrates increased in around 80% in nodules of mung bean cultivated in presence of 60 or 80 µM $CuSO_4$ and, at 100 µM $CuSO_4$, this compound was 102% superior to control. In addition, the copper led to a linear increase in leghemoglobin, ureides, free proline and soluble protein. Leghemoglobin are proteins with high affinities for oxygen found in root nodules and that prevent inhibition of biological nitrogen fixation (BNF). In this study, leghemoglobin was 92, 93 and 112% superior to control when mung bean was cultivated in presence of 60, 80 and 100 µM $CuSO_4$. Increases in ureides and free proline superior to 60 and 85%, respectively, were registered in mung bean exposed to 60 to 100 µM $CuSO_4$. Interestingly, free ammonia and total free amino acids decreased in response to increase levels of copper. In nodules of mung bean exposed to 100 µM $CuSO_4$, 53% decrease in total free amino acids was registered. The soluble protein increased linearly in response to copper levels and was 30% superior to control when cultivated in presence of 100 µM $CuSO_4$. Leghemoglobin was positively correlated with total soluble carbohydrates, ureides, free proline and soluble protein, while free ammonia and total free amino acids were negatively related with these variables. The principal component analysis accounted for 85% of the total variation and separates treatments according their copper levels. Our results shows that carbon and nitrogen metabolism were rearranged in nodules of mung bean in response to copper. The higher levels of ureides indicates that BNF was unaffected. It is possible that free ammonia and total free amino acids has been consumed to provide leghemoglobin, free proline and soluble proteins useful to cope with the harmful effects of copper at higher levels.

Keywords: Carbohydrates, Leghemoglobin, Ureides, biological nitrogen fixation.

Acknowledgments: CAPES, CNPq and UFPI.

Plant Physiology and its Contributions to Society IISIFV

Influence of roots on cold tolerance in rice (*Oryza sativa* L.)

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Rice (*Oryza sativa* L.) is one of the most consumed cereals in the world. Brazil stands out as the largest producer of this cereal outside Asia and the state of Rio Grande do Sul responsible for close to 70% of brazilian production. Nevertheless, low temperatures, especially at night, are common in the region during the months of September to November, which coincide with the early sowing, and harm plant development. The purpose of this study was to characterize the physiological and molecular root responses of two rice genotypes which were previously characterized as cold tolerant (CT) and cold sensitive (CS) to low temperature stress. Thirty-day old plants were submitted to cold (10°C) or control (28°C) condition for 10 days. Root dry weight, length, and number of root hairs, were higher in CT than CS when exposed to cold treatment. Likewise, histochemical analyses indicated that roots of CT genotype present lower levels of lipid peroxidation and H_2O_2 accumulation, as well as a lower loss of plasma membrane integrity than CS during low temperatures. In addition, roots from seedlings plants of both genotypes under cold (10°C) or control (28°C) condition for 24h were used to identify differentialy expressed mRNA using RNAseq. Transcriptomic analyses revealed that the contrasting genotypes present different molecular responses to cold stress, with the number of over-represented functional categories lower in CT than CS under cold condition, suggesting that CS genotype is more impacted by low temperature stress than CT genotype. Several genes found as differentially expressed might contribute to cold tolerance, including proteins related to cell wall remodeling, cytoskeleton, signaling, antioxidant system, lipid metabolism, and stress response. On the other hand, high expression of the genes *SRC2* (defense), *root architecture associated 1* (growth), *ACC oxidase*, *ethylene-responsive transcription factor*, and *cytokinin-O*33 *glucosyltransferase 2* (hormone-related) seems to be related with cold sensibility. These results indicate that roots from contrasting rice genotypes can differentially respond to low temperature stress. As these two genotypes have a similar genetic background (sister lines), the afore mentioned genes might be involved with the cold tolerance or sensitivity and may be useful in the future for genetic improvement of rice culture, contributing to the agricultural needs of regions where low temperature impacts rice productivity.

Keywords: Cell wall, Cold tolerance, Growth, Oxidative stress, Root responses, Signaling.

Acknowledgments: CAPES and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Sugarcane varieties feature differences in susceptibility to sodium in response to potassium supplementation

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Salinity causes toxicity and osmotic stress in plants, compromising their productivity. Many plants feature susceptibility to the effects of salinity, such as sugar cane (*Saccharum* spp), however, these effects may change between varieties. This may be related to the responses induced by potassium (K^+) ions. Supplementation with this element can be a viable strategy for relieving sodium (Na^+) stress, since these ion competes for absorption sites and participates in the osmoregulation of plants. Thus, we tested the hypothesis that supplementation with K^+, favors sugarcane plants submitted to salinity, relieving stress and allowing growth. For this, the objective was to increase the K^+concentration in sugarcane plants under the addition of sodium chloride (NaCl) and to evaluate the effects on growth and photosynthesis. The experiment was carried out in a greenhouse. Two varieties of sugar cane were used: SP80-3280 (susceptible) and SP80-1816 (less susceptible) exposed to two concentrations of chloride potassium (KCl) (131.4; 262.8 mg d^{-3}) and two concentrations of NaCl (5.30; 2,920.0 mg dm^{-3}). Analyzes were performed of global photosynthesis of the canopy, leaf area (LA), leaf number (LN), plant height (PH) and shoot biomass (SB). It was observed that the SP80-3280 variety reduced LA, LN, PH and SB when submitted to a higher concentration of NaCl, and did not respond to the increase in K^+concentrations. However, SP80-1816 obtained greater LA when supplemented with K^+. This variety was not affected in relation to the LN and PH and obtained higher values of photosynthesis of the canopy, resulting in greater SB under a higher concentration of K^+, even when submitted to a high concentration of NaCl. Thus, the SP80-1816 variety was responsive to the increase in K^+concentration and was not affected by salinity. SP80-3280 had its growth affected regardless of the amount of K^+ imposed. Thus, supplementation with K^+can relieve stress by NaCl in varieties of sugarcane responsive to K^+.

Keywords: *Saccharum officinarum,* sodicity, KCl, NaCl.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Quantification of proline in *Toona ciliata* seedlings submitted to water deficit cycles

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Toona ciliata is a tropical and subtropical forestry species that has a great capacity for reforestation activity and has been cultivated in regions of the Brazilian Cerrado. During their life cycle in their natural environment, plants are exposed to repeated drought periods that differ in duration and intensity. Proline is an osmoprotective amino acid and is considered an indicator of water stress. In this way, the accumulation of proline can promote the maintenance of cell turgor and organelles protection from oxidative damage. Thus, the objective was to quantify the content of proline in leaves of seedlings of *Toona ciliata* under water deficit cycles. The experiment was carried out under greenhouse conditions with approximately 8 months old commercial clones (BV 1110, BV 1210 and BV 1321) trees. These were separated into groups of continuous irrigation plants - WD0, submitted to a water deficit cycle - WD1 and submitted to three water deficit cycles - WD3, followed by rehydration (RH). The design used was completely randomized and the means were compared using the Scott-knott test at 5% probability. The leaves were collected after the imposition of water deficit cycles, at the point of maximum stress (MS) and after rehydration (RH). For the BV 1110 clone, when relating the groups of plants in the periods of WD, it was noted that the groups WD1 and WD3 increased their proline content by 76% and 77%, respectively, compared to plants in the WD0 group, which did not experience water deficit. Clones BV 1210 and BV 1321 increased in 68% and 70% respectively, the content of proline in the folioles of the group of plants WD1, and 58% and 34% in the WD3 plant group under water deficit compared to the group of plants WD0. After the rehydration period, all clones showed a reduction in proline content, with the BV 1110 clone of 59,6% and 66,4% in the WD1 and WD3 groups, the BV 1210 clone reduced 42% in the WD1 group, while clone BV 1321 reduced by 43,8% also in the WD1 plant group. Thus, it was possible to observe changes in the content of proline in the studied clones when subjected to water restriction cycles, with proline being an efficient indicator of water stress.

Keywords: Abiotic stress, water stress, Australian cedar, amino acid.

Acknowledgments: CAPES, FAPEMIG, UFLA, CNPq and Bela Vista Florestal.

Plant Physiology and its Contributions to Society IISIFV

Responses of *Aechmea blanchetiana* (Bromeliaceae) under salt stress in a controlled microenvironment

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Salinity is responsible for multiple effects that may reduce plant growth and survival. The *in vitro* culture techniques can allow us to analyze the plants' strategies because it is an efficient way to control any external environmental interference. The aim was to evaluate the effects of salt stress on the physiology of *Aechmea blanchetiana* plants under *in vitro* conditions. Plants previously established *in vitro* were transferred to glass containers (268 mL) containing MS culture medium (Murashige and Skoog 1962) supplemented with 30 g L^{-1} sucrose, 4 µM naphthalene acetic acid and solidified with 6 g L^{-1} agar. At 30 days of culture, 30 mL modified stationary liquid MS medium, regarding saline concentration (25% strength), and containing different concentrations of NaCl (0, 100, 200 or 300 µM) was added, forming a two-phase medium. The plant material was kept in a growth room with temperature of 26 ± 2°C and 16:8 hour active photoperiod. After 45 days of NaCl treatments, the modulated chlorophyll *a* fluorescence was measured using a MINI-PAM II portable photosynthesis yield analyzer. Plants grown with NaCl showed a reduction of 24.8% in the effective photochemical quantum yield of photosystem II (PSII) (ΦPSII) and 24.3% in the electron transport rate (ETR). This indicated a partial inhibition of electron transport and photochemical activity of PSII. Besides, the yield for dissipation by down-regulation (ΦNPQ) increased 18%, as well as the non-photochemical dissipation (fluorescence) parameters (qN and NPQ), which increased 15.5% and 32.55%, respectively, in plants cultured under the highest NaCl concentration; it certainly occurred due to high levels of Na^+ directly on the aerial part. This led to an excitation energy excess and, consequently, a reduction in the photochemical step and biochemical processes. Similarly, there was an 18.6% increase in the quantum yield of non-regulated energy dissipation (ΦNO), which indicated photodamage as a result of salt stress. It suggests that excess energy cannot be effectively dissipated as heat, especially under high levels of NaCl. *A. blanchetiana* plants showed clear signs of physiology stress caused by NaCl excess during *in vitro* growth. Under *in vitro* conditions, salinity can affect negatively on photosynthetic apparatus performance of *A. blanchetiana* plants.

Keywords: modulated chlorophyll fluorescence, salt tolerance, toxicity, plant physiology, plant tissue culture.

Acknowledgments: CAPES, UFES, FAPES, CNPq and UFLA.

Plant Physiology and its Contributions to Society IISIFV

Metabolic rearrangements improve plant biomass and enhance the tolerance of dwarf cashew to salt stress

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Cashew tree is one of the main perennial crops produced in the Brazilian semiarid region where the use of irrigation with brackish water is common. This agricultural practice, together with high evapotranspiration present in these environments, results in the accumulation of soluble salts in soils that can affect plant development and crop productivity. This study aimed to analyze the physiological and biochemical responses of dwarf cashew genotypes submitted to salt stress. The experiment was carried out with a completely randomized design in a 5 x 2 factorial scheme, with five salinity levels (0, 25, 50, 75 and 100 mmol L^{-1} NaCl) and two dwarf cashew genotypes (EMBRAPA51 and CCP76). Changes in biometric variables, photosynthetic pigments and concentration of organic and inorganic solutes in response to salinity were evaluated. The salinity was evaluated using the regression analysis (in each genotype), while the comparison between the genotypes at each level of salinity was performed using the Tukey' test ($p<0.05$). Multivariate analyses were performed using all data (previously standardized). There was no significant effect of salinity on plant height, leaf number and stem diameter; however, the dry biomass and biochemical parameters were significantly altered. The concentration of chlorophylls, starch and total free amino acids decreased with salinity, mainly with 75 and 100 mmol L^{-1} NaCl. On the other hand, salt stress induced an increase in carotenoids, anthocyanins, total soluble carbohydrates, reducing sugars and sodium and potassium ions that was higher in CCP76 than EMBRAPA51. Free proline increased in response to salt stress in dwarf cashew genotypes. Interestingly, sucrose concentration declined in EMBRAPA51 and increased in CCP76 in response to salt stress. When submitted to 75 and 100 mmol L^{-1} NaCl, i.e., under severe stress, CCP76 present more sucrose than EMBRAPA51. Non-metric multidimensional scaling, cluster and principal component analyses reinforce the physiological and biochemical differences between dwarf cashew genotypes. Our results indicate that sucrose accumulation play an important role in the acclimation of CCP76 to salinity. This disaccharide induces metabolic rearrangements, mainly in levels of soluble carbohydrates and amino acids, that contributes to rebalance the osmotic potential and helps to maintain favorable plant metabolism under salt stress. Overall, the dwarf cashew CCP76 was most tolerant to salinity than EMBRAPA51.

Keywords: *Anacardium occidentale*, salinity, osmoprotectors, sucrose.

Acknowledgments: CAPES, CNPq and UFPI.

Plant Physiology and its Contributions to Society IISIFV

Use of biostimulant as attenuator of saline stress in cowpea

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The high concentration of salts present in water used for irrigation impair the growth and development of crops. The effects range from reduced plant size, changes in metabolism, and can even cause death. Therefore, further research is needed to mitigate the deleterious effects of salinity. Although widespread, research on biostimulants with attenuating action on abiotic stresses, such as saline, is still recent. The aim was to to determine the best time of application of the FH ATTIVUS biostimulant and its best dosage in the cowpea culture. The experiment was conducted in a greenhouse, at the Federal University of Ceará. The experimental design used was completely randomized in a 2x4 factorial scheme, with two application times (before and after the imposition of stress) and four doses (0; 0.1; 0.25 and 0.5 kg ha^{-1}), applied via foliar spraying, totaling eight treatments, with five repetitions and one control (without imposition of stress and without product). The variables analyzed were: plant height, stem diameter, dry shoot weight and number of leaves. The application of the biostimulant after the imposition of stress, favored greater plant height in the dose of 0.1 kg ha^{-1}. In the other evaluated variables, the best averages were obtained with the dose of 0.25 kg ha^{-1} before the imposition of stress. This shows that even the greatest growth does not necessarily imply greater biomass production. In general, the use of FH ATTIVUS reduced the deleterious effects of salinity and a good dose is recommended at 0.25 kg ha^{-1} and before stress.

Keywords: *Vigna unguiculata* (L.) Walp., FH ATTIVUS, salinity.

Acknowledgments: CAPES, FAPEMIG, UFLA, CNPq and FUNCAP.

Plant Physiology and its Contributions to Society IISIFV

Photosynthetic response and chlorophyll content of *Inga uruguensis* in soil contaminated with lead

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Heavy metals are naturally occurring elements in the environment. Some of them have a relevant role in plant nutrition, while others have deleterious effects on various components of the biosphere. Lead is characterized as one of the main contaminants in the soil, being a non-essential metal the life of any living being and which has the ability to easily accumulate in different biological tissues, which can cause severe effects on them. Even so, its use is very wide and covers several areas. Phytoremediation is a sustainable and economically viable technique, based on the use of plants and their microbiota, to remove, stabilize or degrade the soil contaminant, being a viable alternative for the recovery of lead-contaminated soils. When in contact with plants, this metal can trigger a series of damages, such as the inhibition of photosynthesis and in some cases the reduction in the synthesis of chlorophylls. Such damage can compromise all plant development and even lead to death. Thus, the objective of this work was to evaluate the photosynthetic response and the synthesis of chlorophyll of *Inga uruguensis*, a native tree legume that has characteristics favorable to phytoremediation, in soil contaminated with lead. The experiment was carried out in a greenhouse for 240 days, in a completely randomized design, with 6 treatments, composed of the control and 5 different doses of lead acetate solution (100, 200, 300, 400 and 500 mg/dm³), having 5 repetitions each and one seedling per pot. The measurements of gas exchange (photosynthesis and transpiration) were carried out using the portable analyzer CIRAS-3 (Portable Photosynthesis System- PP Systems), after 90 and 180 days of the installation of the experiment, already the analysis of chlorophyll (*a*, *b* and Total) was performed after 240 days when the experiment was set up. The rates of photosynthesis and transpiration did not show statistically significant differences between treatments in either period. The same was observed in the rates of chlorophyll *a*, *b* and total, where there was no statistically significant difference in any of the treatments. Therefore, even in higher amounts, lead did not affect the photosynthetic response and chlorophyll synthesis of *Inga uruguensis*, being an indicator of the species' tolerance to this metal.

Keywords: Heavy metal, native arboreal, phytoremediation.

Acknowledgments: CAPES and UNESP.

Plant Physiology and its Contributions to Society II SIFV

Action of biostimulant in the morphology of soybean subjected to water deficit

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The water deficit (WD) it is a major limiting factor to the growth plant, being very common in the Semi-arid region. Thereat, the technologies have been developed to improve plant performances and relieve the effects of WD in production, for instance, the use of biostimulant. The objective of this paper was to evaluate the effect of the biostimulant FH ATTIVUS in the mitigation of effects of WD in the growth of soybean crop. The experiment was conducted in green house, at Federal University of Ceará. Were used hybrid seeds Monsoy 8349 IPRO. The experimental design was completely randomized in a factorial scheme 2x4, with two application times (before and after the stress imposition) and four doses (0; 0.1; 0.25 e 0.5 kg ha^{-1}) with five repetitions and an additional witness (without stress imposition and without the product). The irrigation was based in the field capacity (FC) in which was used 40% and 80% of FC in plants under stress and in the control, respectively. The application of product occurred 24 days after sowing (DAS) with the stress imposition in the day after, staying until the end of the experiment. The second application occurred at 35 DAS. The evaluated variables were: water potential (Ψw), plant height (PH), number of leaves (NL) and diameter of stalk (DS). The NL and the DS did not differ statistically. However, the PH, presents an interaction of dose and time factors. Only the dose 0.1 kg ha^{-1} differed from the others, showing greater PH when the application was before the stress, but none of the treatments differed from the control. For the Ψw differed both in relation to doses, as in the interaction between dose and time and differed from the control. The doses 0 e 0.5 kg ha^{-1} applicated before stress were those with lower Ψw, being lower than the control and statistically differing from this. The doses 0.1 e 0.25 kg ha^{-1} before stress they did not differ from each other, however they differed from the control because they obtained a lower Ψw, demonstrating that the cells remained turgid even in the WD. It can be concluded that the genotype used tolerated the WD by the morphological parameters analyzed because, regardless of the biostimulant, it did not differ from the control. For Ψw, the use of biostimulant, when applied before stress, and in the doses 0.1 e 0.25 kg ha^{-1} mitigated the effects of WD by improving hydraulic conductivity.

Keywords: *Glycine max*; FH ATTIVUS, Water availability.

Acknowledgments: CAPES, CNPq, FUNCAP and UFC.

Plant Physiology and its Contributions to Society IISIFV

Arbuscular mycorrhizal symbiosis influences yield and chemical composition of the essential oil *Ocimum basilicum* L. production under salinity stress

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Basil (*Ocimum basilicum* L.) is a medicinal plant used in the popular context due to its extensive therapeutic activity, in which the best known is its antioxidant action. During the cultivation of this and other plants, abiotic environmental conditions, such as salinity, affect secondary metabolism due to the toxicity caused by the accumulation of Na^+ and Cl ions. Thus, the use of arbuscular mycorrhizal fungi (AMF) has been a sustainable way of minimizing damage, as they manage to reduce the effects of stress. Thus, this work aimed to evaluate the impact of AMF on the yield and chemical composition of essential oil (OE) of basil leaves, submitted to different salt concentrations. When assembling the experiment in a greenhouse, cuttings of basil were planted in five-liter plastic pots, with a mixture of soil, vermiculite, sand, and organic matter with vegetable remains. Then, fungal strains of *Claroideoglomus etunicatum* (*C.e.*), *Rhizophagus clarus* (*R.c.*), and interaction of *C. etunicatum* (*C.e.*) plus *R. clarus* (*R.c.*), collected from the UNIPAR Glomales bank, have been added. After thirty days of cultivation, saline stress with NaCl in concentrations of 50, 100, and 150 mM was applied, furthermore, a control with water was used. After two months of the experiment, the plants were collected to extract and analyze the yield and chemical composition of the OE. Treatments with AMF, *C.e.* and *C.e.*+*R.c.*, about the others used, increased the oil yield by about 1.80%. AMF helped produce the compounds, in which an increase was observed, which varied between 33- 43 compounds in the OE chemical composition. As for the majority compounds, the ones that stood out the most were 1,8-cineole, linalool, camphor, and eugenol. The increase observed in these variables possibly occurred because AMF helped to protect basil under this adverse condition. As the use of medicinal plants in industry and natural form has gained more space, and the use of these microorganisms in their production in agriculture would be a way to improve plants' chemical characteristics, mitigating the effects of saline stress. Furthermore, to obtain compounds with properties of greater effectiveness, the use of AMF helps in the production of compounds when in symbiosis with plants.

Key-words: medicinal plants, environmental stress, sodium chloride, mycorrhiza.

Acknowledgment: UNIPAR, CAPES and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Growth and functional traits of mahogany family as affected by herbivory and light

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Biotic stress directly affects the growth of forest species. Moreover, this stress can be even greater when the light conditions are not suitable for the growth of the species. However, the species responses to this biotic stress factor as modulated by light remains unclear. The mahogany family has highly desired wood all over the world, but the susceptibility to pests can impair the establishment of plantations with species of this family. Here, we investigate whether contrasting light conditions affects the responses of growth and functional traits to herbivory in this family. We measured the relative growth rates in diameter and height, herbivory indexes and 11 functional leaf traits of two forest species belong to mahogany family (*Carapa guianensis* Aubl. and *Swietenia macrophylla* King) in a field planting under two contrasting light conditions, gap (PPFD = 33.1 mol m^{-2} d^{-1}) and understory (PPFD = 2.6 mol m^{-2} d^{-1}) over 18 months. The associations were tested by Analyses of Covariance (ANCOVA) with light conditions as covariant. Our results showed that herbivory had a strong negative correlation with both relative growth rates (height and diameter) and this relationship is similar among light conditions. The herbivory also was negatively associated to leaf traits (sclerophyll, phenolic compounds, total tannin, condensed tannin and starch); and positively with relative water content independent of light conditions The species analyzed here seem to better express their functional defense traits (secondary compounds and physical defense) in gaps, however this capacity is not dependent on light conditions. The absence of interaction with the light conditions indicates that the association of herbivory with growth remains between extreme light conditions.

Keywords: biotic stress, non-structural carbohydrates, chemical defense, tropical tree species.

Acknowledgments: CAPES, FAPEAM, UFAM, FAEXP-UFAM and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Be prepared: survival strategies of *Handroanthus heptaphyllus* (Vell.) Mattos seedlings after hydration dehydration cycles

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Seeds of tropical plants, after dispersion, are subject to various environmental stressors such as water deficit and seasonal dehydration. Occurrence of hydration and dehydration cycles (HD) during the residence of the seeds in the soil seed bank influences the establishment and regeneration of natural populations. The main of this study was evaluating the establishment of seedlings of *Handroanthus heptaphyllus* whose seeds underwent HD cycles in different phases of imbibition. Ten seedlings were selected randomly, from seeds that passed through 0, 1, 2, 3 and 4HD in two imbibition phases, Phase I-FI (10 hours) and Phase II-FII (35 hours), and drying for 12 hours. Growth parameters (height, root length, number of leaves and dry mass) and biochemical parameters (chlorophyll *a*, *b* and total, carotenoids, total soluble sugars - TSS, reducing sugars - RS and non-reducing sugars - NRS) were evaluated at the end of 60 days. The seedlings showed a reduction in height in relation to the control in both phases, with seeds that passed through FII showing smaller seedlings than in FI. However, compared to the control, they showed a significant difference in the length of the root, chlorophyll a and carotenoids in the first two cycles regardless of the phase. Total chlorophyll was higher in FI than FII in 1HD in both phases. As for the dry mass of the aerial part, the root, number of leaves and chlorophyll b, there was no significant difference. In relation to the TSS, there is a significant difference for the phases and cycles in the accumulation of sugars from the 2HD, with higher values for the FII, while for the RS there is a reduction in 3HD in both phases. There is significant interaction between the cycles and the phases for NRS, with a greater accumulation in all cycles of the FII compared to those of the FI, and within the two phases the 2HD presented the highest values. Thus, it is concluded that seeds that have undergone HD cycles produce smaller seedlings in height, but with a larger root system, greater production of photosynthetic pigments and accumulation of soluble and non-reducing sugars that gives them a metabolic adjustment in defense against likely future stressful conditions.

Keywords: Ipê-rosa, Bignoniaceae, chlorophyll, sugars, seedling establishment.

Acknowledgments: CAPES and UFLA.

Plant Physiology and its Contributions to Society IISIFV

Bioherbicidal effect of ethanolic extract of *Campomanesia lineatifolia* seeds on germination, growth and damage of the weed *Sonchus oleraceus* L.

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Campomanesia lineatifolia is a fruit tree whose seeds have a bioherbicidal effect. *Sonchus oleraceus* is a weed that generates high losses in crops due to its competitive ability and resistance to some chemically herbicides. To find management alternatives, the bioherbicidal effect of ethanolic extract of *C. lineatifolia* seed on the germination, growth and damage of *S. oleraceus* plants was evaluated under laboratory conditions. The study was carried out in two phases. In the first phase, germination was evaluated in a petri dish with two experiments, the first one consisted of adding the ethanolic extract of *C. lineatifolia* every third day, in the second experiment the extract was only added at sowing. The germination percentage, mean germination speed, mean germination time, number of leaves, root and stem length were determined. In both cases, four treatments corresponding to four concentrations of the ethanolic extract (0, 3, 6 and 9%) were evaluated. In the second phase, the extracts were applied over the leaves of the plants with the same concentrations to juvenile plants, the incidence and severity of the damage was measured. The results indicated that the *C. lineatifolia* seed extract inhibited the germination of the *S. oleraceus* seeds, with continuous application of the extract as applied only once at sowing. As there was no germination with the extracts of *C. lineatifolia*, no direct inhibitory effect could be seen on the growth of the seedlings through the number of leaves, length of roots and stem. With the foliar application, an incidence of 100% was observed with any of the concentrations evaluated, with symptoms of chlorosis and necrosis and with 74.5% of damage with 9% extract application, but it was not possible to cause the death of the plants. It is considered that the ethanolic extract of the *C. lineatifolia* seeds acts as a bioherbicide on the *S. oleraceus* weed and has the potential to be used in agriculture.

Keywords: Allelopathy, bioherbicide, germination, growth, damage.

Plant Physiology and its Contributions to Society IISIFV

Hydrogen peroxide helps to recover gas exchange in *Passiflora incarnata* L. submitted to drought

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Passiflora incarnata L. is used worldwide as a herbal medicine because it presents anxiolytic substances of interest to the brazilian health system. Environmental variations and interactions between plants and exogenous substances can influence photosynthetic metabolism and biosynthesis of specialized metabolites. Application of hydrogen peroxide and water restriction can influence the response mechanism of the stomata and gas exchange. The objective was to study the hydrogen peroxide application in the recovery of gas exchange in *Passiflora incarnata* L. submitted to drought. The experiment was conducted at São Paulo State University, Botucatu Campus, with *P. incarnata* seedlings in pots, with corrected Dark-Red Ferralsol. The plants were grown in field capacity and water restriction combined with foliar application of 1.5 mM H_2O_2 or water, five replications in a 2x2 factorial design. At 215 days after transplantation, hydrogen peroxide (H_2O_2) was applied and two days later, irrigation was interrupted in plants subjected to water restriction. Fourteen days after water restriction, the plants were evaluated and rehydrated. Four days after rehydration, a new evaluation was performed. Transpiration rate (E), stomatal conductance (G_s), net CO_2 assimilation (A_{net}) were determined, calculating water use efficiency (WUE), using infrared gas analyzer equipment (IRGA, GFS-3000 Walz). The data were submitted to analysis of variance ($p < 0.05$) and the means compared by the Tukey test. Fourteen days after water restriction, plants with H_2O_2 application showed lower rates of E and G_s. Four days after rehydration, plants with H_2O_2 application showed higher E, G_s and A_{net}, equaling plants without water restriction. The largest WUE was found in plants subjected to water restriction. Hydrogen peroxide acts in defense, as a signal for antioxidant enzymes, and in stomatal closure. Thus, plants that received H_2O_2 under water restriction revealed mechanisms to reduce water loss (lower G_s, E). Hydrogen peroxide helped the photosynthetic recovery of plants submitted to water stress during rehydration.

Keywords: Maypop, RENISUS, flavonoids, vitexin, photosynthesis**.**

Acknowledgments: CAPES.

Plant Physiology and its Contributions to Society IISIFV

Silicon alleviation of cadmium toxicity in mangroves (*Laguncularia racemosa*) (L.) C. F. Gaertn.

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Cadmium (Cd) induced stress is known in plants, and it also promotes changes in the photosynthetic metabolism. In recent years, the increase in Cd concentration has been detected at high levels in various ecosystems, including mangroves. Cd induced toxicity for most plants can be mitigated by interactions with other chemical elements. Silicon (Si), for example, is a chemical element widely known for its attenuating effect on biotic and abiotic stresses. However, the important mechanisms involved are still only partially understood. Based on this premise, this study aims at evaluating the effect of sodium silicate (Diatom®) in the attenuation of Cd effects on CO_2 assimilation and in the photochemical step in *Laguncularia racemosa*, a species that showed greater susceptibility to metal in previous studies. Young plants of *L. racemosa* were collected in Itacaré, Bahia, Brazil, and cultivated in (1) nutrient solution; (2) Diatom® 0.1% (Si); (3) 5 mg L^{-1} Cd and (4) the Cd + Si association for a period of seven days. The mangrove seedlings were able to absorb the Cd and translocate it to the shoot, causing chlorosis and senescence of the mature leaves. The results showed that Cd induces a reduction in CO_2 assimilation and causes photoinhibition of photosystem II. Silicon was able to reduce the visual effects of heavy metal on plants, maintaining the turgidity of plants grown in nutrient solution with the addition of Si, increasing the amount of starch deposited in the mesophyll. It was observed that the maximum quantum yield (*Fv/Fm*) of the plants treated with the association Cd + Si was similar to the control, showing that Si participates in the prevention of photoinhibition effects. However, the tested 0.1% Si concentration was not sufficient to mitigate the Cd effects on gas exchange measurements. Preliminarily, it was considered that in a more moderate Si concentration the stress induced by Cd could be reduced. Further studies will test other Si concentrations in association with Cd and investigate the ultrastructural effects on chloroplasts.

Keywords: Remediation, Heavy Metal, Plant Physiology, Pollution, Costal Ecosystem.

Acknowledgments: CAPES, UESC and UFMG.

Plant Physiology and its Contributions to Society IISIFV

Ethylene effect on hydraulic traits and in the survival of *Dipteryx alata* exposed to drought

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Native plants from Central Brazil (Cerrado) are exposed to frequent drought events and present adaptive strategies aimed at the maintenance of hydraulic safety and survival. These adaptations require the involvement of signaling molecules, such as ethylene, although little is known about the influence of this phytohormone hydraulic properties and on the occurrence of cavitation in plants exposed to intense drought. Therefore, this study analyzed the vulnerability to drought and survival rate in baru plants (*Dipteryx alata*), a key species in the Brazilian Cerrado, exposed to water deficit until plant mortality, evaluating hydraulic behavior, and ethylene involvement in this process. For this, baru seedlings were irrigated to field capacity (FC), and half of the plants were treated with a solution containing ethylene action inhibitor (silver thiosulfate). The plants were then monitored daily as the soil gradually dried until plant death. The following traits were evaluated: whole plant transpiration, leaf water potential (Ψw), plant hydraulic conductivity (Kplant), percentage of leaf abscission, and vulnerability to cavitation, expressed as P_{50} (Ψw in which 50% of hydraulic conductivity is lost) and P_{88}, which represents the point where plant death is irreversibly induced by hydraulic failure. Ethylene promoted stomatal closure and leaf abscission, which resulted in lower transpiration rates over time and more effective maintenance of water potential and hydraulic conductivity. Such modifications increased the plant survival time, with P_{50} and P_{88} being reached later and with less water content in the soil when compared to plants treated with silver thiosulfate. Plants treated with the ethylene inhibitor, in turn, kept their stomata open and, therefore, showed a higher photosynthetic rate over time. When the FC corresponded to 10% of the control, however, this situation changed and plants with ethylene inhibitor showed a sharp drop in the photosynthetic rate, as a result of the damage triggered by excessive transpiration. In fact, in this treatment, the plants reached P_{50} and P_{88} more quickly, with the early death of the plants occurring in the absence of ethylene. Thus, although the hormone did not change the values of P_{50} and P_{88}, the time and the soil water content to reach these points were different, highlighting the essential role of ethylene in the survival of Cerrado native plants exposed to drought.

Keywords: Mortality, Hydraulic failure, Cavitation, Ethylene, Forest death.

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Plant Physiology and its Contributions to Society IISIFV

Biochemical aspects of *Ocimum basilicum* L. submitted to fish farming water

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The use of fish farming water for vegetable irrigation is an alternative to mitigate the effects of the water deficiency of semiarid regions of Brazil, For example, it can be used to stimulate the cultivation of vegetables such as basil (*Ocimum basilicum L.*), which is widely consumed. However, in general, the water generated from this activity has a high salinity content. For this, research is needed to promote results on the behavior and salinity of this plant. Therefore, this work aimed to evaluate the effect of this effluent on the cultivation of *Ocimum basilicum* L. The experiment was a completely randomized design, plants grown in plastic bags for planting, with 24 repetitions, watered twice a day, with 30 ml of the effluent, for 28 days, without supplementary irrigation, carried out in a greenhouse to evaluate the pure effluent. and diluted: Control = 0.06 mS; T2 = 2.92 mS; T3 = 4.8 mS; T4 = 6.2mS; T5 = 7.1mS. Evaluated, hydrogen peroxide (H_2O_2), malondialdehyde (MDA), proline, and superoxide dismutase enzyme (SOD). All data were worked out statistically using Software R, with p-value =or> 0.05. Concerning MDA and H_2O_2, it was observed that the increase in MDA was not linked to H_2O_2. Possibly this higher concentration of MDA observed from 4.8 mS is due to other ROS, since the H_2O_2 content decreased due to the increase in salinity. No significant difference was observed between saline treatments in relation to SOD. The proline content did not differ statistically between saline treatments, however, the highest level of this osmoregulator was obtained in plants irrigated with a solution with 4.8 mS of conductivity, a treatment in which a higher level of MDA was detected. This fact may have occurred to stabilize plant homeostasis. With the research, we concluded that *O. basilicum* was sensitive to the salinity of the fish farming effluent, however up to a conductivity of 2.92 mS the plants can be irrigated with this type of effluent since the MDA levels were insufficient to cause lipid peroxidation of the cell membranes.

Keywords: Fish farming, Semiarid, Plant physiology, Salinity, Stress.

Acknowledgments: CNPq, UERN and LFBP.

Plant Physiology and its Contributions to Society IISIFV

Reuse of fish-farming wastewater in *Vigna unguiculata* (Fabaceae) cultivation: physiological and biochemical aspects

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Reusing wastewaters is fundamental for the rational and full use of available water resources. In this sense, it is necessary to develop alternatives that allow reusing fish farming wastewaters. Despite having considerable salinity, these wastewaters contain dissolved organic and inorganic compounds that can benefit plant nutrition. In addition, the cultivation of plants adapted to salinity opens perspectives for the cultivation of economically important plants, such as cowpea (*Vigna unguiculate* L.). Thus, this study focused on the physiological and biochemical adaptation mechanisms to salinity in *V. unguiculata* plants irrigated with diluted fish-farming wastewater. Two cowpea varieties (cultivar and landrace) were irrigated with waters at three electrical conductivity levels (T1 = 0.61; T2 = 2.5; and T3 = 5.0 dS m^{-1}) for 18 days, according physicochemical information of the effluent (T2 and T3 = K^+ 2.0, NA^+ 44.91, Cl^- 58.2, Ca^{2+} 15.10, Mg^{2+} 25.70, HCO_3^- 3.80) and supply water (T1= K^+ 0.25, NA^+ 4.44, Cl^- 2.4, Ca^{2+} 1.00, Mg^{2+} 0.90, HCO_3^- 3.40). The experiment was a completely randomized block design in a 3 x 2 factorial scheme (salinity levels x cowpea varieties), with three blocks and six replicates each. Relative water content (RWC) and lipid peroxidation concentration were evaluated. Also, the plant antioxidant defense system was evaluated by measuring ascorbate peroxidase (APX) and catalase (CAT) enzyme activities. In response, it was observed that the synchrony between the enzymatic activity and Reactive Oxygen Species (ROS) regulation and detoxification, in the plant cell under environmental stress situations, thereby ensuring the maintenance of the relative water content without increment of lipid peroxidation. The efficiency of the defense mechanism relies on synchrony between such enzyme activities toward successive elimination of reactive oxygen species and resulting in the assurance of some level of protection of the metabolism from oxidative damage. Results showed that the salinity levels did not affect cowpea, indicating that the plants were not stressed when irrigated with the effluent. Although salinity can cause physiological and biochemical changes in plants, fish-farming wastewater is rich in organic matter from fish food and excreta in addition to Ca^{2+} and Mg^{2+} contents which may have benefited the plant development. Therefore, reusing fish-farming wastewater can be an alternative for the irrigation of *V. unguiculata* plants.

Keywords: saline stress, plant development, antioxidant system, environment.

Acknowledgments: CAPES and UERN.

Plant Physiology and its Contributions to Society IISIFV

Is it possible to improve the water deficit tolerance in physalis seedlings by seed priming?

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Water deficit is the main abiotic stress to which the cultivated and uncultivated plants are subjected, especially in areas known as drylands. Developing tools that make it possible to increase the stress tolerance is one of the great current challenges. In this sense, the aim of this work was to evaluate the use of sodium nitroprusside, a nitric oxide donor, to improve the water deficit tolerance in physalis seedlings by seed priming. For this, the seeds were separated into two groups: (1) soaked in aqueous solution for two hours containing different concentrations of sodium nitroprusside (SNP): 0, 50, 100 and 200 µM; and (2) without any treatment (WT). The seeds were sown in a commercial substrate under well-watered conditions (WW, 100% of field capacity) and under water deficit (WD, 50% of field capacity), constituting the following treatments: WW WT; WW 0 µM SNP; WD ST; WD 0 µM SNP; WD 50 µM SNP; WD 100 µM SNP and WD 200 µM SNP. The maintenance of water availability conditions was performed using the gravimetric method, through daily weighings. Growth analyzes were performed at 25 days after sowing. There was no influence of the treatments evaluated for the shoot dry matter ($p = 0.0886$) and root dry matter ($p = 0.8271$). In seedlings under water deficit and that were pretreated with 50 and 100 µM of SNP, values of stem dry matter were observed equal to the seedlings in well-watered conditions. The leaf area of the seedlings was reduced with water deficit, however, the seed priming with SNP 100 µM was able to reverse these effects. Similar responses were observed for the variables of stem diameter and seedling height. The pretreatment of seeds with sodium nitroprusside is a promising tool for improving the water deficit tolerance in physalis seedlings.

Keywords: Drought stress, water deficit attenuation, nitric oxide donor, *Physalis angulata*.

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Plant Physiology and its Contributions to Society IISIFV

Physiological responses of *Alternanthera tenella* (Amaranthaceae) to cadmium and selenium co-exposure under *in vitro* conditions

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Cadmium (Cd) is an element that can be easily absorbed by plant roots and translocated to the aerial parts. It may inhibit plant growth through the reduction of photosynthetic rates. This element may interact with other mineral elements present in the soil, such as selenium (Se). Se can alleviate or potentialize Cd effects. Thus, the aim was to analyze the effects of Cd and Se co-exposure during *in vitro* cultivation of *Alternanthera tenella* plants, considering possible modulations (for better or worse) in the photosynthetic apparatus. Side shoots of *A. tenella* plants, previously established *in vitro*, were individualized and transferred to glass jars containing 25 mL Murashige and Skoog culture medium solidified with 6 g L^{-1} agar, supplemented with 15 g L^{-1} sucrose. The medium was supplemented with two selenium levels (0 and 16 µM Se) and four Cd levels (0, 50, 100, and 200 µM Cd), totalizing eight treatments. All plants remained photosynthetically active irrespective of the applied treatment. Clear positive L- and K bands were verified in plants grown with 200 µM Cd + 16 µM Se. These results can indicate a reduction in the connectivity between the reaction centers of photosystem II (PS II) and damages to the oxygen-evolving complex. Plants cultured with a co-exposure of 16 µM Se and 200 µM Cd, showed an increase (2.9 times higher) in the quantum yield energy dissipation (φD_0). In contrast, under the same conditions above-mentioned, a reduction of maximum quantum yield of primary photochemistry (φP_0) and quantum yield of electron transport (φE_0) (values 2.3 and 6.6 times lower than the other treatments' values), which shows low utilization of energy absorbed and photodamage. The overall performance index (PI_{total}), which measures the performance up until the final electron acceptors of photosystem I (PS I) evidenced the negative effects of co-exposure of 16 µM Se and 200 µM Cd (reduction of 120 times lower). The use of Se does not alleviate the stress induced by Cd, besides potentializing the stress of this heavy metal.

Keywords: chlorophyll *a* fluorescence, heavy metal, plant physiology, plant tissue culture.

Acknowledgments: CAPES and FAPES.

Plant Physiology and its Contributions to Society IISIFV

Zinc supplementation attenuates oxidative damage caused by water deficit in*Glycine max* L.

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Drought is one of the main abiotic stresses responsible for losses in soybean productivity. One of the effects of water deficit is the limitation of CO_2 assimilation by plants, causing an excessive reduction in the electron transport chain. This excessof reducing power favors the overproduction of reactive oxygen species (ROS), which promote cellular damage capable of leading to reductions in the plant's biomass and in the quality of grains. However, micronutrients such as zinc (Zn) are involved in processes such as the activation of enzymes in the antioxidant system, whichact incleaning these ROS. Thus, the aim was to evaluate the viability of supplementation with the micronutrient Zn in attenuating the harmful effects caused by water deficit in soybeans (*Glycine max* L.). For this, soybean seeds of cultivar Monsoy 5917 were sown in 5L pots containing soil and sand (2:1). After 30 days, the plants were submitted to treatments: control with water only; 300 mg Zn L^{-1} YaraVita® Zintrac™; 600 mg Zn L^{-1} YaraVita® Zintrac™; 300 mg Zn L^{-1} $ZnSO_4$. After 10 days of foliar application, a gradual water restriction was initiated, in part of the plants, until reaching 45% of the field capacity (CC). The other plants were maintained at 80% of CC. After 20 days of water suspension, completely expanded leaves were collected to quantifythe levels of H_2O_2 and malondealdehyde (MDA), a secondary product of lipid peroxidation. The design was completely randomized, using a 2x4 factorial scheme, with five replications. It was observed that in all concentrations and source of Zn, the irrigated plants had lower content of MDA and H_2O_2 if compared to those under deficit, except for those that were supplemented with 600 mg Zn L^{-1}, which did not differ from the irrigated ones. The different water conditions did not differ betweentheconcentrations of fertilizer and source of Zn with respect to the content of MDA. There was also no difference between the plants irrigated in H_2O_2 levels, however, in the water deficit the lowest level was in the concentration 600 mg Zn L^{-1} YaraVita® Zintrac™ and the highest in the concentrations of 300 mg Zn L^{-1} YaraVita® Zintrac™ and 300 mg Zn L^{-1} $ZnSO_4$. Therefore, the supply of 600 mg Zn L^{-1} YaraVita® Zintrac™, minimized the production of ROS, which did not reach sufficient levels to react with membrane lipids and promote lipid peroxidation, alleviating the oxidative damage caused by water deficit in plants of soybean.

Keywords: Hydrogen peroxide, malondialdehyde, soybean, drought.

Acknowledgments: UFLA, CNPq, FAPEMIG, CAPES and Yara Brasil Fertilizantes.

Plant Physiology and its Contributions to Society IISIFV

Gas exchanges and water relations in 'Valencia' orange tree under different citrus rootstocks

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Drought is one of the most threatening abiotic factors for citrus cultivation in the world. The use of rootstocks can contribute to the tolerance of the canopy variety to water deficit. This study aimed to evaluate the physiological responses of four citrus hybrid rootstocks with drought tolerance potential. The experiment was conducted on an anti aphid screen from Embrapa Cassava and Fruits, Cruz das Almas, Bahia, Brazil. Four citrus hybrid rootstocks were evaluated, ('LCR x TR - 001', 'TSKC x CTSW - 041', 'TSKC x (LCR x TR) - 059' and 'HTR – 069'), grafted with the orange tree canopy 'Valencia'. The seedlings were transplanted into plastic pots of 100 dm^3, previously divided into four compartments by anti-aphid screen and filled with soil at a density of 1.5 kg dm^{-3}. Each compartment represented an experimental plot with a plant of each hybrid. The treatments consisted of the combination of rootstocks in five water regimes in a 4x5 factorial scheme, with four replications in a completely randomized design. Water regimes were defined based on the leaf water potential (Ψ_L) before morning, being defined for each water treatment: (I) Control (CO): between -0.1 and -0.5 MPa; (II) Light Stress (MI): between -1.0 and -1.5 MPa; (III) Moderate Stress (MO) between - 2.5 and -3.5 MPa; (IV) Severe Stress (SE): less than -3.5 MPa; and (V) Rehydrated (RE): less than -3.5 MPa with subsequent rehydration of the plants for field capacity and analysis after 24 hours. Net photosynthesis rates per unit of leaf area (A), stomatal conductance to water vapor (g_s) and leaf transpiratory rate (E) were estimated with a portable analyzer, and the results obtained were subjected to Tukey's test variance analysis ($p \leq 0.05$). The gas exchange parameters were located below the range considered to be the limit for citrus and no significant differences were observed between the different rootstocks, SS was the most harmful to plants, with a reduction of 93.77% in A, 43.64 % in g_s and 84.43% in E, in relation to CO. In contrast, there were no significant differences between treatments with water restriction in g_s. In MI and MO there were no significant differences in gas exchange parameters even with Ψ_L variation, between -1.33 MPa and -3.01 MPa, respectively. Thus, the four hybrids evaluated have the same patterns of physiological responses when under limiting conditions of water in the soil at different intensities of stress, indicating a possible mechanism for preventing dehydration.

Keywords: Abiotic Stress, Drought, Photosynthesis, Stomatal Conductance, Transpiration.

Acknowledgments: Fundação de Amparo à Pesquisa do Estado da Bahia – FAPESB.

Plant Physiology and its Contributions to Society
IISIFV

Effect of light quality on the growth and synthesis of phenols and flavonoids of *Achillea millefolium* L. plants

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The *Achillea millefolium* L. is a perennial herb with important antibacterial, antifungal, antiinflammatory, antitumoral and antioxidant properties. Here we evaluated the effect of light quality on the growth and synthesis of phenols and flavonoids of *Achillea millefolium* L. plants. Plants were cultivated under either full light or colored shading nets (blue, red or black). Analyses were performed after eight weeks of shading and at two and four weeks after the removal of the nets. Total phenols and flavonoids were affected by the significant interaction between the factors shading by colored nets and harvest periods. However, there was no interaction between these factors for biomass accumulation. Plants grown under nets presented lower dry weight of leaves and flowers. Leaves shaded with red net decreased the biomass weight 1.3-fold compared to non-shaded plants, while the dry weight of plant leaves shaded with blue or black nets decreased 1.8-fold. In addition, plants shaded with red, blue or black nets decreased flower biomass 2-fold when compared to plants maintained in full light. In addition, the synthesis of total phenols and flavonoids decreased in the leaves and flowers of shaded plants, but in leaves increased after the shading nets were removed. The content of total flavonoids in shaded plants with black and blue nets was higher in flowers, while in the presence of full light and red nets was higher in leaves. Thus, these results demonstrate that the growth, the synthesis of phenols and flavonoids of *Achillea millefolium* L. plants respond differently to the quality of light.

Keywords: Growth, phenols, flavonoids, nets, *Achillea millefolium* L.

Acknowledgments: CAPES, CAVG and PPGFV-UFPel.

Plant Physiology and its Contributions to Society IISIFV

Phytotoxic effects of copper on seed germination and initial development of cowpea varieties

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The accumulation of heavy metals is a serious environmental problem that limits plant productivity and threatens human health. Copper is a heavy metal that acts as an essential micronutrient, being fundamental in several vital plant processes and that can become toxic at high levels. The present study aimed to evaluate the phytotoxic effect of copper sulfate ($CuSO_4$) on the seed germination and initial development of three cowpea varieties (BRS Potengi, BRS Imponente and BRS Itaim). The experiment was conducted under laboratory conditions. Seeds were disinfected, soaked and then distributed in Petri dishes containing cotton and filter paper. For the treatments, cotton and filter paper were moistened with distilled water (control) or with 20, 40, 60 and 80 µM $CuSO_4$. The experiment was followed for seven days and the seeds germinated in each treatment were counted daily. At the end of the experimental period, the root length, hypocotyl diameter and the dry weight of shoot and root were measured. Based on the data, the germination percentage and the germination speed, vigor and shoot and root tolerance indexes were calculated. The germination of the cowpea seeds was negatively influenced by the increasing levels of copper, however there was no inhibition of germination. There was a reduction of more than 20% in the germination speed index when the varieties were exposed to 80 µM $CuSO_4$ compared to the control. The variety BRS Imponente showed higher values of vigor index, root length and hypocotyl diameter in the presence of copper. The dry weight of shoot and root and the shoot tolerance index increased in the varieties BRS Potengi and BRS Itaim in response to the increase in copper concentration. The excess metal can be accumulated in roots in view to preserve photosynthetic sites from harmful effects of stress and higher root tolerance may be associated with better adaptability of the genotype to the stressful environment. In this study, BRS Imponente improves the root tolerance index when exposed to increasing levels of copper indicating higher tolerance to copper stress. The linear discriminant analysis shows that the three cowpea varieties present distinct responses to copper levels. In general, regard the data and indexes analyzed, the variety BRS Imponente showed better responses to increasing levels of copper. The result of the present study may be useful to understand the mechanisms involved in copper stress responses in initial plant development.

Keywords: Heavy metals, Tolerance index, Growth inhibition, Copper stress.

Acknowledgments: UFPI and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Foliar application of Zinc in soybean under drought stress

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Drought is the major limiting factor regarding crop yields and occurs frequently in tropical and subtropical regions, causing physiological damage to plants in agroecosystems. Micronutrients may act in drought alleviation by activation of certain physiological, biochemical and metabolic processes within the plant. Zinc (Zn), an essential micronutrient, is involved in cellular functions and processes, however its contributions for drought alleviation are not well-defined. In the present study, we aimed to evaluate the viability of supplementation with Zn applied via foliar acting for alleviating the deleterious effects caused by drought in soybean (*Glycine max* L.). Soybean plants *cv.* MONSOY® 5917 were cultivated in pots of 5 dm^3 containing mix of soil and sand (2:1) under greenhouse conditions and after 20 days, were applicate the four treatments: MOCK; 300 mg Zn L^{-1} YaraVita® Zintrac™; 600 mg Zn L^{-1} YaraVita® Zintrac™; 300 mg Zn L^{-1} $ZnSO_4$. 10 days after the foliar application, a part of the plants were submitted to gradual water restriction. For this, the total water content was reduced over 20 days, until reaching maximum stress, considering 45% of the water retention capacity (WRC) of soil. The other plants were maintained at 80% maximum WRC. The experiment was conducted in a completely randomized design, 4 x 2 factorial scheme, the water availability factors (irrigated and water deficit) and the dose/source of Zn (4) with five replicates, total of 8 treatments. As results, it was observed that for the number of leaves, total leaf area, root and shoot dry matter in soybean, there was a reduction in these parameters when the plants were exposed to water deficit in all treatments compared to irrigated treatment, for the number of leaves and total leaf area where there was no statistical difference between the control irrigated and control subjected to water deficit. At a concentration of 600 mg Zn L^{-1} in irrigated plants, it is possible to see an increase in total leaf area. For the number of leaves, it was possible to observe that in the irrigated treatments, the control had a lower number of leaves in comparison to the others. However, there was no statistical difference regarding the doses and sources of Zn. As a conclusion, for this experiment, there was no effect of the different concentrations and sources of zinc applied via leaf in soybean under drought stress for growth parameters.

Keywords: Plant nutrition, Micronutrient, Leaf area, Drought alleviation, *Glycine max L.*

Acknowledgments: CAPES, FAPEMIG, UFLA, CNPq and Yara Brasil Fertilizantes.

Plant Physiology and its Contributions to Society

Midday changes in fluorescence parameters of *Bertholletia excelsa* and *Dipteryx odorata* subjected to drought stress

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The water limitation affects plant growth, especially during the establishment of planting. Diurnal changes in the microclimate conditions (e.g. midday depression) can intensify the effects of drought stress. To evaluate how is the variation in the midday depression of fluorescence parameters on Amazon tree species (*Bertholletia excelsa* Bonpl. and *Dipteryx odorata* (Aubl). Willd.) under drought stress, we conducted for 35 days an experiment under controlled irrigation conditions. Ten plants per species received daily irrigation [well-watered (WW), control], while ten plants were subjected to water limitation by suspending irrigation [drought stress (DS) treatment]. We measured every seven days (8:00 h - morning and 12:00 h - midday) three parameters of chlorophyll *a* fluorescence provided by JIP-test: efficiency of photosystem II (F_v/F_m), performance index (PI_{abs}) and total performance index (PI_{total}). We calculated the variation in fluorescence parameters in the midday (time of greatest stress) in relation to morning through the formula $\Delta_{rel\%} = 100*[(Value_{12:00} - Value_{8:00})/ Value_{8:00})]$. For each species, we used unpaired t-tests or Mann-Whitney tests ($P < 0.05$) to compare WW and DS treatments with the progression of drought stress. *B. excelsa* and *D. odorata* submitted to drought stress, at the period of severe stress (35 days), exhibited reductions of 31% for F_v/F_m, 83% for PI_{abs} and 88% for PI_{total} measured in the morning. Similar reductions also occurred at midday. Significant midday changes occurred with the progression of drought stress, with the highest variation for DS plants. For *B. excelsa*, significant relative differences between treatments occurred at 28 days for PI_{total} (WW = 3%; DS = 47%) and, 35 days for F_v/F_m (WW = -4%; DS = -17%) and PIabs (WW = -25%; DS = -54%). Conversely, *D. odorata* showed significant and early differences between treatments at 14 days for all parameters: F_v/F_m (WW = -3%; DS = - 7%), PI_{abs} (WW = -12%; DS = -40%) and PI_{total} (WW = 28%; DS = -13%). *B. excelsa* and *D. odorata* exhibit variations in midday fluorescence parameters as affected by drought stress. The period of measurements (morning or midday) indicated similar effects of drought stress. The flux of energy around PSI seems to be more affected by drought stress than PSII. The decreasing on light use in response to drought stress can impair the establishment of these species on field planting.

Keywords: JIP-test, tree species, F_v/F_m, PI_{abs}, PItotal.

Acknowledgments: FAPEAM, UFAM, Viveiro Florestal and Laboratório de Silvicultura.

Plant Physiology and its Contributions to Society II SIFV

Correlation between leaf carbon isotope composition and instantaneous water use efficiency in coffee under field conditions

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The carbon isotope composition ($\delta^{13}C$) in the dry leaf mass can be considered an integrated indicator of photosynthetic capacity and stomatal behavior over time. Usually, this composition is also used to express the efficiency of water use. The objective was to determine the correlation between leaf carbon isotope composition ($\delta^{13}C$) and instantaneous water use efficiency in coffee. Leaf samples were collected from 42, 54 and 66 months old coffee trees grown in rainfed and irrigated systems. The leaves formed during the dry period were collected. Isotopic analysis were performed in the Centro de Isótopos Estáveis do Instituto de Biociências da Universidade Estadual Paulista, Campus de Botucatu-SP. The leaf carbon isotope composition ($\delta^{13}C$) was determined with the international standard Vienna-Pee Dee Belemnite – VPDB, using a continuous flow isotopic ratio mass spectrometer – CF-IRMS (Delta V Advantage Isotope Ratio MS – Thermo Scientific, Germany). Instantaneous water use efficiency was measured with an infrared gas analyzer (LI-6400XT Portable Photosynthesis System, LICOR, Lincoln, USA), from the photosynthesis/transpiration relationship. The results were analyzed using Spearman's Rho non-parametric correlation. Thesignificance level was established as p-values < 0.05. The spreadsheet software Excel® was used to perform the analyses. Spearman's Rho non-parametric correlation was significant and positive between water use efficiency and $\delta^{13}C$ indicating a monotonic relationship, that is, the higher the $\delta^{13}C$, the greater the water use efficiency, but not necessarily at a constant rate.

Keywords: gas exchange, non-parametric correlation, rainfed systems, irrigated systems.

Acknowledgments: CONSORCIO PESQUISA CAFÉ, INCT Café, CAPES, FAPEMIG, CNPq and FAPESP.

Plant Physiology and its Contributions to Society

Screening for tolerance to the salinity of sugarcane varieties: morphological and physiological responses

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Brazil is the world's largest producer of sugarcane (*Saccharum* spp.) and its cultivation has been expanding to semiarid regions. The success of this expansion depends, in part, on the planting of varieties that tolerate the adverse conditions of these places, such as salinity. Therefore, the aim was to evaluate photosynthetic and growth responses of 10 varieties (*Saccharum* spp.) and two species (*Saccharum officinarum* and *Saccharum spontaneum)* of sugarcane submitted to high salinity. For this, culms of the varieties: SP80 3280, RB85 5453, RB96 6928, RB85 5156, SP80 1842, SP80 1816, RB92 8064, RB86 7515, RB92 579, RB85 5536 and the species IM762-28 and IN84-82 were planted in citropotes (3.5 dm^3), under a completely randomized block design. Two concentrations of sodium chloride (NaCl) were tested: T0 [concentration found naturally in the soil, with electrical conductivity of 0.083 dS m^{-1} e T1 [soil enriched with 100 mM de NaCl, with 7.2 dS m^{-1}], considering n=5, amounting 120 plants. Were evaluated: number of leaves, culm height, plant height at 30 and 58 days; gas-exchange and the electron transport rate (ETR), at 45 days. The plants were collected at 58 days after planting, partitioned biomass and determined the dry mass of leaf, stem and root that were used to calculate the total dry mass. All varieties showed reductions in CO_2 assimilation (*A*), with the varieties SP80 3280, RB92 8064 and the species IM762-28 having the greatest falls due to salinity. Likewise, there was a loss in the accumulation of total biomass and reductions in growth for RB92 579 and IN82-84, demonstrating their sensitivity to stress. By the same token, variables such as stomatal conductance (g_s), ETR and transpiration (E) showed reductions for all varieties except for SP80 1842 which kept g_s and E under salinity conditions. The varieties, RB85 5156, SP80 1842, SP80 1816 and IM762-28 were not affected in the growth variables, which can be correlated with the maintenance of dry mass of leaves and stem under the condition of NaCl. Thus, the latter stand out for their lower sensitivity to stress, being varieties with the potential to be explored in the semi-arid region of Northeast Brazil, which has electrical conductivities greater than 4 dS m^{-1}, a condition that already causes losses in the production of this culture.

Keywords: *Saccharum* spp., NaCl, growing, gas exchange.

Acknowledgments: CAPES and CNPq.

Poster Presentations

LINE OF RESEARCH | Ecophysiology

Influence of sodium on gas exchange and allocation of biomass in high land rice lines

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Rice is of great socioeconomic importance as it is part of the diet of one third of the world population. Increases in rice production will be required, mainly considering the expected sharp increase in global population and the predicted future scenarios of climate change and limited expansion of agricultural land. In this scope, rice cultivation may be directed to areas with salty soils. The aim of the present study was to evaluate the effects of sodium chloride ($NaCl^+$) doses on the physiological aspects and on the biomass allocation of two upland and short-cycle lines of the Federal University of Lavras (UFLA) rice germplasm bank. The experiment was carried out in a greenhouse at UFLA with rice seeds sowed in Citropote containers with a volume of 4 liters and substrate in the composition 1: 2 (sandy:clay textures). The experiment was designed in completely randomized blocks, with 5 replicates and in a factorial scheme, with the two factor being: 2 rice lines, L1 (BRS ESMERALDA) and L2 (CMG 2085), and the 4 $NaCl^+$ concentrations (0; 3; 15; 45 mmol L^{-1}), 5 repetitions, totaling 40 plots. The evaluated characteristics were: liquid photosynthesis, transpiration, stomatal conduction, biomass allocation and grain production per plant. There was no interaction between the factors. The results obtained indicated that L2 was more efficient in the allocation of photoassimilates for filling the grains, obtaining a higher allocation and productivity per plant of 8.668 g compared to 6.962 g of L1, even with lower values in gas exchange. For the salt treatments, the concentration of 3 mmol L^{-1} of $NaCl^+$ was shown to be similar to the control treatment in terms of gas exchange, being higher in terms of allocation of photoassimilates and grain yield. Above this concentration there was a reduction in all variables evaluated. The higher salt content reduced all the variables evaluated. L2 was more promising, as it produced 19.68% more grains per plant than L1.

Keywords: Salinity, climate change, *Oryza sativa*.

Acknowledgments: CNPq, CAPES and UFLA.

Plant Physiology and its Contributions to Society IISIFV

Physiological changes by mepiquat chloride application in *Eucalyptus* clone

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Plant growth retardants (PGRs) are synthetic compounds capable of promoting various morphophysiological changes in plants. Among the various groups of plant regulators, gibberellin synthesis inhibitors deserve attention. The mepiquat chloride (MC) is the plant growth regulator that belongs to the quaternary ammonium compound MC (1,1-dimethylpiperidinium chloride) is an inhibitor of gibberellic acid (GA) mainly absorbed by chlorophyll tissues, transported by the xylem and redirected by the phloem. Several studies suggest that reduced levels of growth-promoting hormone gibberellin (GA) lead to increase resistance to water deficit. Trying to understand the drought tolerance mechanisms of *Eucalyptus* clones, the objective of this work was to evaluate the effects of different mepiquat chloride (MC) concentrations to Eucalyptus clones on physiological changes. Commercial clones of *E. grandis* x *E. urophylla* hybrid were planted in 20 L pots in a complete randomized block design with eight replications and four treatments. The treatments consisted of three concentrations of MC: 250, 500 and 1000 mg L^{-1} of MC. The control treatment consisted of a non-MC application (0 mg L^{-1} of MC). Evaluations of physiological parameters were carried out for 35 days after the MC application. Results indicated physiological changes after the MC application. MC application decreased leaf transpiration (E) and stomatal conductance (gs), improving intrinsic water use efficiency (WUEi) and increase in SPAD index of *Eucalyptus* clones after 35 days. The reduced leaf transpiration resulted increasing WUEi without affecting photosynthesis rate. The increase in SPAD values with increase in MC was probably due to by the increase in chlorophyll per unit of area. The increase in SPAD values indicates a better capacity to resist water deficit, due to the strong correlation among chlorophylls, photosynthesis rate. The E, WUEi and SPAD index improved when 250 and 500 mg L^{-1} MC concentration were applied. Our results suggest that MC application may promote drought resistance to *Eucalyptus* clones.

Keywords: Ecophysiology, growth retardants, gibberellin inhibitor, physiological.

Acknowledgments: CAPES, FABESP, UESB and UFLA.

Plant Physiology and its Contributions to Society
IISIFV

Systemic view of carbon and water balance in tropical trees

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Tropical trees cope with global carbon and water cycles by accounting for one third of global assimilation and transpiring more than twice the atmospheric water annually. Because trees coordinate carbon allocation and hydraulics with leaf physiology, we propose the use of a systemic approach of carbon and water balance to understand trees responses to environmental changes. We measured 20 water- and carbon related variables in the wood of 19 *Hymenaea courbaril* trees to build complex correlation networks. The ratio between CO_2 concentrations in the leaves and atmosphere (c_i/c_a, from tree-ring $\delta^{13}C$) is one of the main degree centrality in the network. Changes in c_i/c_a may not influence the basal area increment of trees as observed by other studies, but it is associated with changes in wood density due to carbon allocation in the cell walls. Trees finely coordinate c_i/c_a with cell-wall hemicelluloses by changing the proportion of xylose and mannose. Allocation in both monosaccharides occur at the expense of soluble sugars and starch in the wood suggesting a trade-off between growth and reserves formation. To support higher c_i/c_a, trees must invest in wider vessels for more efficient water transport. Surprisingly, the proportion of sapwood area, a key ecological trait, showed marginal relevance in the network. Instead, the usually unaccounted for number of tree rings in the sapwood showed high degree and eigenvector centralities highlighting its potential use as an integrative variable. In summary, the results reveal a fine tuning in trees carbon and water balance, which may explain some unresolved issues in the literature such as the absence of CO_2 effect on trees growth as measured by tree-ring widths, as well as new possibilities of measuring cell-wall composition of wood and the number of tree rings in the sapwood trees responses to environmental changes.

Keywords: Tree-rings, Leaf physiology, Wood density, Carbon allocation, Cell-wall monosaccharides, Non-structural carbohydrates.

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Plant Physiology and its Contributions to Society IISIFV

Photosynthesis in sun-tolerant and shade-tolerant *Paubrasilia echinata* ecotypes under drought and rehydration

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Drought is the most limiting environmental factor in photosynthesis. There are projections of rainfall reduction in the Brazilian Atlantic Forest biome between 30 and 35% for the Northeast region. However, little is known, but it is of great interest to know how plants sun-tolerant and plants shade-tolerant of this biome respond to drought. As a model in this study, two ecotypes with low taxonomic divergence of *P. echinata* were used. The small leaf ecotype is shade-tolerant and the medium leaf ecotype is sun tolerant in the in the initial growth phase. Juvenile plants of these two ecotypes were submitted to drought simulation - water suspension, followed by rain simulation - rehydration. A completely randomized design (CRD) was used, in a 2 x 2 factorial arrangement. Factor A two ecotypes (medium and small), and Factor B two water regimes (control and treated: water suspension - 17 days and rehydration - 36 days). The gas exchanges were performed on IRGA infrared gas analyzer, model LCpro-SD. Fluorescence used a portable fluorometer, model Handy-PEA. All measurements were between 8:00 and 10:00 am in leaves from the third node and fully expanded. Under drought, the shade-tolerant ecotype showed a greater decline in the values of net CO_2 assimilation (*A*), transpiration (*E*), stomatal conductance (*gs*) and water use efficiency (*WUE*) in relation to sun-tolerant ecotype. The decrease in photosynthetic rates in the two ecotypes were associated with disturbances in chlorophyll *a* fluorescence. Decreases in quantum yield on the acceptor side of photosystem I (ϕRo) and increase in energy dissipation (Di_0 / RC) have been associated with a low electron transport rate since photosystem II (PSII). This induced less use of light energy for photochemistry in the two ecotypes, however, more significantly in the shade-tolerant ecotype. In the rehydration phase, plants exposed to drought from the two ecotypes showed progressive recovery of most parameters of gas exchange and fluorescence of chlorophyll *a*, equaling the values of their controls after 36 days of rehydration. However, stomatal conductance, PSII performance index (PI_{ABS}) and electron transport performance index (PI_{TOTAL}) remained below those of their controls, being more pronounced in the shade-tolerant ecotype. The results indicate that the sun-tolerant ecotype has a better adjustment in photosynthetic mechanisms for drought tolerance than the shade-tolerant ecotype.

Keywords: Gas exchange, chlorophyll fluorescence, photosynthetic efficiency, Atlantic forest, brazilwood, drought tolerance.

Acknowledgments: CAPES.

Plant Physiology and its Contributions to Society

Intrinsic water-use efficiency of shade-tolerant and sun tolerant *Paubrasilia echinata* (Fabaceae: Caesalpinioideae) ecotypes in CO_2 levels, air temperature and humidity

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To understand how tropical native species will respond to future climate scenarios, a study was carried out using shade-tolerant (small leaf) and sun-tolerant (medium leaf) plants of *P. echinata* ecotypes. Brazilwood (*Paubrasilia echinata* Lam.) E. Gagnon, H. C. Lima & G. P. Lewis is a native leguminous species of Brazil's Atlantic forest. This study was carried out in air-conditioned greenhouses. To obtain and control an atmosphere with CO_2, we used open top chambers. Young plants (2 years old) of the small leaf and medium leaf ecotypes of *P. echinata* were used. Three climatic scenarios were simulated: current Atlantic forest (CAF), RCP 4.5 and RCP 8.5 in two levels of humidity in the substrate (80% and 40%). The CAF scenario was characterized by the normal weather conditions of Linhares-ES considering the C_a value of 400 ppm and the projections RCP 4.5 and RCP 8.5 projected due to the increase in air temperature in relation to CAF. The increase in the average air temperature in RCP 4.5 and RCP 8.5 was 2 ºC and 3.5 ºC, respectively. The relative humidity values were calculated using the values of the partial vapor pressure compensated for each projection. The C_a levels of these scenarios were 580 ppm in RCP 4.5 and 936 ppm in RCP 8.5. Gas exchanges were assessed using an Infrared Gas Analyzer. With the measures of the net CO_2 assimilation rate *(A)* and stomatal conductance *(gs)*, we calculated the intrinsic water use efficiency (iWUE = *A/gs*). Readings were taken between 8:00 am and 11:00 am, using an artificial light source with intensity of 500, 650, 800 and 900 µmol m^{-2} s^{-1} at 8:00, 9:00, 10:00 and 11:00 hours, respectively. The temperature of the block during the evaluation was controlled from the air temperature's average values of each environment at the evaluated time, using 25 ºC in CAF, 28 ºC in RCP 4.5 and 30 ºC in RCP 8.5. The C_a used in the environments were 400, 580 and 936 ppm in CAF, RCP 4.5 and RCP 8.5, respectively. *P. echinata* ecotypes can increase iWUE in scenarios with increased CO_2 and air temperature, at different levels of humidity in the air and in the substrate. The results corroborate the fact that C3 plants may be favored by increasing CO_2 at elevated temperature and reduced relative humidity, by increasing iWUE, regardless of humidity.

Keywords: Ecophysiological behavior, Atlantic forest of Brazil, Brazilwood, Representative Concentration Pathways, IPCC.

Acknowledgments: FAPES, UFES and LMEF.

Plant Physiology and its Contributions to Society IISIFV

Dry matter production in *Ceiba glasiovii* (Kuntze) K. (Malvaceae), a Caatinga tree species subjected to intermittent drought

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Plant species occurring in Caatinga have specific adaptative strategies that allow them to face long periods of drought. Several morphological modifications can be observed in response to water restriction, such as the reduction of growth and development rhythms. Evaluating biometric measures, like the accumulation of dry matter, is a way of determining such changes. This study aimed to evaluate the dry matter production during the initial growth of *Ceiba glaziovii* (Kuntze) K. Schum. seedlings under drought stress. The seedlings were subjected to three water treatments (Control - daily watering, S7 – watered every seven days, and TS – total irrigation suspension). There were no significative differences between control and S7 treatments in all parameters analyzed. On the other hand, TS vigorously reduced growth rates, promoting reductions in dry matter of leaves (LDM), roots (RDM) and total dry matter (TDM). Although this occurs, the R/S ratio and biomass partition were not altered, differing from patterns found in the literature, where seedlings exposed to water stress generally have a propensity to invest in root growth to the detriment of aboveground parts, aiming at a greater uptake of water from the soil in situations where it tends to become scarcer. Our results demonstrate that *C. glaziovii* do not change its distribution pattern of photoassimilates between shoot and root during the initial phase of development in drought conditions, suggesting that the different species have distinct morphological mechanisms to ensure survival in situation of water deficit.

Keywords: Barriguda, drought stress, plant adaptation, drought tolerance.

Acknowledgments: CAPES and UFS.

Plant Physiology and its Contributions to Society IISIFV

Efficiency of dimethyl sulfoxide as a chlorophyll extractor in *Opuntia ficus* and *Nopalea cochenillifera* cladodes

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In Brazil the palm has one of the largest planted areas in the world with the genera *Opuntia ficus* and *Nopallea cochenillifera* as the most explored. Palm photosynthesis follows the metabolism of the carbon fixation pathway known as Crassulacean Acid Metabolism (CAM). The determination of chlorophyll *a* (Chl *a*), allowed inferences about the efficiency of the photochemical phase of photosynthesis and may be useful in studies on the physiological behavior of CAM plants. Destructive pigment extraction methods require the use of organic solvents, the most common of which are 80% acetone and dimethyl sulfoxide (DMSO). DMSO has some advantages over acetone 80%, such as not having to crush the tissue and centrifuge the extract, as well as providing greater stability for the stored extracts. On the other hand, it has been shown that DMSO has low chlorophyll *b* (Chl *b*) extraction efficiency. The aim of this work was to test the applicability of DMSO as a chlorophyll extractor in *Opuntia ficus* and *Nopalea cochenillifera* at different time intervals. Samples of *Opuntia* and *Nopallea* were collected, four chlorophyll extraction time intervals (60min; 120min; 180min; 240min) (Factorial 2x4) were tested with five repetitions and the Scott-Knott test was used. The samples were taken from the cladodes, placed in test tubes covered with aluminum foil, 20 ml of DMSO were added to each tube, then the samples were placed in a water bath at 65°C. Subsequently, absorbance readings were taken on a spectrophotometer. The results of Chl *a*, presented superior values for the genus *Nopalea* when compared with an *Opuntia*. In relation to the extraction period or time of 240min, it has a higher Chl *a* value. The Gen. x Time interaction showed that the extraction period of (240min) increased the content of Chl *a* extracted for the genus *Opuntia* while for the genus *Nopalea* the times of (120min; 180min and 240min) did not show related differences. The results for Chl *b* extraction showed a variation coefficient above 80% in the *F* test and there was no significance for this variable. The results of total chlorophyll (*a* + *b*) show that only the extraction time (240min) has a significant value, having a superior effect of pigment extraction. Thus, the DMSO showed an efficient Chl *a* extractor and a low efficiency for Chl *b* for two palm genera, being necessary to increase the extraction times in order to verify the possibility of improving the results.

Keywords: dry soil, forage palm, DMSO, extraction time, spectrophotometer, pigments.

Acknowledgments: FAPES, INCAPER, IFES, UESC

Plant Physiology and its Contributions to Society IISIFV

Plants compensate for different soil history with functional trait changes resulting in similar outcomes

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Legacy effects are persistent effects caused on plants growing after the removal of a specific individual or species affecting their growth and development. Legacy effects are of particular concern for restoration ecology, especially regarding recovery of invaded soils and habitat. Two species of interest, one used in Cerrado restoration projects (*Diectomys fastigiata*) and the other an invasive species (*Urochloa eminii*) were grown in a greenhouse under different treatments in two phases. First phase treatments consisted of species grown alone in sterilized soil with soil *inoculi* from different origins (n = 16/treatment): native grassland soil, invaded grassland soil and firebreak sterilized soil. To investigate plant legacies, second phase consisted in dividing the pots from each treatment in the first phase, and planting the same species in half of the pots and the other species in the remaining half (n = 8/treatment). Functional traits such as aboveground biomass, leaf mass-area, specific root length and mycorrhizal colonization were measured. Plant legacies affect and are affected differently by each species. *Urochloa eminii* seems to be less affected by previous legacies, with minor changes in functional traits irrespective of inoculum origin. *Diectomys fastigiata* grows more in soils with *Urochloa* legacies, and self-legacy with invasive soil inoculum results in biomass outcomes similar to *Urochloa* legacies, with changes in other functional traits. Soil *inoculi* affect plant legacies. Our results points to the ability of plants being able to regulate changes in soil with changes in functional traits, leading to similar outcomes in terms of biomass production.

Keywords: Legacy effects, Plant-Soil Feedbacks, Invasive species, restoration ecology, soil inoculation.

Acknowledgments: CAPES, CNPq, FAPESP, Unicamp and IPEN.

Plant Physiology and its Contributions to Society IISIFV

Water stress memory in *Eugenia uniflora L.* plants

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Plant development occurs in different environments with multiple abiotic, chemical and physical factors that vary with time and location. The stress memory can lead to a faster acclimattion response and an increase in tolerance in an upcoming stress event. The study species, *Eugenia uniflora* L. is a tree of the Myrtaceae family, native to Brazil, occurring in the Cerrado, Mata Atlântica and Pampa biomes. In subtropical riverine forests, the species occurs in frequently flooded areas and due to the deep root system, it is also classified as drought tolerant. The aim of the present study was to investigate the effect of repeated water stress cycles on the physiological responses of *E. uniflora*. The experiments consisted of two consecutive cycles with 12 days of duration each and with three water treatments: control (C), saturation (S) and water deficit (D). After cycle 1, effects on plants under D treatment were observed in specific leaf area and plant water content. In plants that had a second water deficit cycle, differences in root length, specific leaf area and plant water content were observed. The results of this study suggest that *E. uniflora* plants that were subjected to isolated and repeated periods of water deficit showed reduced growth. However, plants subjected to repeated water saturation cycles showed similar growth to plants under control conditions. These results indicate that the species seems to be sensitive to drought, especially in situations of successive water deficit events. However, under conditions of soil water saturation, *E. uniflora* showed good growth, both in isolated situations and in successive events.

Keywords: drought, flood, pitanga, riverine forests, specific leaf área.

Acknowledgments: FAPERGS.

Plant Physiology and its Contributions to Society
IISIFV

Recurrent exposure to discontinuous hydration increases drought tolerance in *Tabebuia aurea* young plants through the recruitment of seed hydration memory

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In semiarid ecosystems, seeds and plants are frequently exposed to water shortage events, which implies the regular passage through drought stress throughout their life cycle. The aim of the present study was to determine whether the exposure to recurrent events of discontinuous hydration, from seed germination to initial development, increases *Tabebuia aurea* tolerance to drought stress, identifying the physiological, biochemical and morphoanatomical mechanisms involved in this process. Initially, seeds were subjected to 0, 1, 2 and 3 hydration and dehydration cycles. Seedlings were posteriorly, transferred to tissue bags and maintained in greenhouse conditions with continuous water supply during the acclimation period (60 days). Next, young plants from discontinuously hydrated seeds were randomly distributed in two experimental groups: 1) constant irrigation, in which plants were maintained in soil moistened to the field capacity for 30 days, and 2) water deficit cycles, in which plants were subjected to two periods of 10 days of water suspension followed by 5 consecutive days of reirrigation between each water deficit cycle. After those treatments, all plants were subjected to 30 days of total water suspension, in order to induce drought stress. Plant growth, stomatal anatomy, water relations and organic solutes concentration were evaluated, periodically. The passage through discontinuous hydration, from seed germination to initial development, induced the development of xeromorphic characters in *T. aurea* young plants, such as reduced stem length, mean foliar area, and stomatal size. In addition, stressed plants had an increase in proline and sugars content when subjected repeatedly to discontinuous hydration, which indicates that physiological responses of *T. aurea* plants towards drought stress tolerance are linked to events of hydration and dehydration that take place during germination in semiarid environments. Our data suggest that the exposure to recurrent events of loss and gain of water increases drought tolerance in *T. aurea* young plants through the recruitment of hydration memory in posterior phases of plant development, an important adaptative response to copy with water deficit in the Caatinga.

Keywords: drought tolerance, hydration memory, organic solutes, plant growth, water deficit.

Acknowledgments: CAPES and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Evaluation of carbon allocation in a biennial cycle of arabic coffee plants in the varginha mg region through the stable isotopic analysis

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Coffee production in Brazil is highly influenced by the biennial alternation in which there is a variation of years with high and low production. This alternation is due to the allocation and targeting of metabolic reserves for fruit production in years with high productivity and vegetative buds production that will generate new branches in years of low load potential. Unveiling the mechanisms of differential carbon investment in coffee trees is important for agroecological and socioeconomic issues, and the use of analytical methods such as stable isotopic analysis can be useful to improve the understanding of the physiological processes involved. Therefore, the aim was to evaluate the carbon allocation pattern in the different organs (leaves, branches and fruits) of coffee trees (*Coffea arabica* cv. Arara) in field conditions in the region of Varginha, south of the state of Minas Gerais, in two consecutive years (2017-2018) characterized by negative and positive bienniality, respectively. For that, analyzes of the carbon percentage (CP) and the carbon isotopic ratio ($\delta^{13}C$) were performed using continuous flow isotopic ratio mass spectrometry (CF-IRMS) at three points each year: January, June and October 2017 and January, May and October 2018. The results showed an average $\delta^{13}C$ value of -27.7 % (characteristic of C3 plants) with a variation coefficient of 3.8%, and an average PC value of 50.6% with a variation coefficient of 7.3%. There were no significant differences in $\delta^{13}C$ or CP between the two years evaluated and there was only statistical difference for $\delta^{13}C$ between the organs, showing a different carbon allocation pattern between source organs (leaves) and sink organs (branches and fruits), possibly due to carbon isotopic discrimination processes in the sources and isotopic enrichment processes of assimilates allocated in the sinks. The proposed methodology made it possible to identify carbon allocation patterns between coffee organs in field conditions, but not between biennial cycles in the Varginha - MG region.

Keywords: bienniality, CF-IRMS, source-sink relationship.

Acknowledgments: CAPES, UFLA and CIE.

Plant Physiology and its Contributions to Society IISIFV

Effects of water restriction on the foliar anatomy of poaceae with c3, c3 proto-kranz and c4 metabolisms

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Studies related to evolution, plants distribution and ecology aim to understand how climatic changes and abiotic stress affect plants with different photosynthetic metabolisms. The aim objective of this study was to determine the influence of water availability on leaf anatomy variations of C3, C3 proto-Kranz and C4 poaceae. In this research, three species representatives the carbon assimilatory pathways, *Oryza sativa*, *Homolepis isocalycia* and *Andropogon gayanus*, respectively, were submitted to three water conditions. The design was completely randomized in a 4x3 factorial scheme, considering twoo rice varieties, susceptible and the drought tolerant – Soberana and Douradão, respectively. The following variables were determined: distance and number of cells between vascular bundles (µm), area covered by vascular bundle sheath cells (BSC), area covered by mesophyll cells (M), total epidermis area (EA), thickness of the upper and lower epidermis on the adaxial (UE) and the abaxial (LE) face, area covered of the buliform cells (BCA), intercellular space area (ICS), xylem area (X) and phloem area (P). Was determined the percentage of buliform cells (pBCA), percentage of intercellular space (pICS), percentage of carbon assimilation area in the mesophyll cells (pPCA), percentage of carbon reduction area in the bundle sheath and ratio of carbon assimilation area in the mesophyll for carbon reduction area in the vascular bundle sheath (M:BSC). The data were submitted to analysis of variance (ANOVA) followed by the Tukey test ($P < 0.05$) using R Studio software. It was possible to verify that the more specific the leaf anatomy of the species is, as in the case of *A. gayanus* (C4), less anatomical variations it occur, regardless of the water condition. The foliar anatomical behavior of the intermediate species *H. isocalycia* resembled both C3 and C4 species in certain characteristics analyzed, such as the mesophyll area, number of cells, stomatal density, abaxial epidermal thickness, phloem area and intercellular space. When subjected to water deficit, anatomical rearrangement was similar to rice plants at the distance between vascular bundles and buliform cells area; and similar to C4 plants in the ratio of mesophyll cells to vascular bundle sheath cells (M: BSC).

Keywords: Plant ecophysiology, Intermediate metabolism, Water stress, Stress physiology, Transition metabolism.

Acknowledgments: FAPEMIG and UFLA.

Plant Physiology and its Contributions to Society
IISIFV

Phenology of seven species of *Manihot* established in the Recôncavo baiano

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The wild species of Manihot are of fundamental importance in the genetic improvement of the species *Manihot esculenta* Crantz, since they have a large reservoir of useful genes that can be transferred to the commercial species. However, the use of wild species for cassava breeding programs is still limited because they are not readily available to breeders, or because many of the species are not established outside their natural environment. Thus, it is necessary to continue a program of collection, identification and conservation of these species in field and laboratory collections, as well as the expansion of studies regarding the incorporation of useful genes in commercial cassava cultivars in the genetic improvement programs of the culture. In this sense, the objective was to understand the phenological behavior through the observation of the presence, absence and intensity of the vegetative (budding and leaf fall) and reproductive (flowering, fruiting and dispersion) phenophases of 76 individuals of seven wild species of Manihot from the biomes *caatinga* and *cerrado*. The experiment was conducted in the Recôncavo region of Bahia, more specifically, in the municipality of Cruz das Almas, a place where cassava has great socioeconomic importance, especially for family farms. The observations were made monthly between December 2018 and December 2019. To determine the intensity of each phenophase, the Fournier Intensity Index method (scale from 0 to 4, with an interval of 25% between classes) was used. After the observation period, the values of the monthly intensities of each of the phenophases separated by species were averaged, the interpretation was made based on the pattern and repetition of each event over the twelve months. The results obtained indicated that the vegetative phenophases showed a continuous and low intensity pattern, while the reproductive phenophases were concentrated in the dry season, more precisely in the months of November and December, where there is a reduction in precipitation and an increase in temperature. Thus, it is possible to verify that the occurrence of phenological factors showed a significant pattern, demonstrating good adaptation of the species evaluated to the region of Bahia Recôncavo.

Keywords: Ecophysiology, Phenophases, Flowering, Fournier index.

Acknowledgments: CNPq, Embrapa and UFRB.

Plant Physiology and its Contributions to Society

Elevated air [CO_2] improves photosynthetic performance and alters biomass accumulation and partitioning in drought-stressed coffee plants

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Coffee (*Coffea arabica* L.) is an important global commodity grown in tropical areas where increased drought severity and frequency are believed to become progressively important due to climate changes. Nonetheless, elevated air [CO_2] is thought to be able to mitigate heat and drought stresses. In this study, we tested how carbon assimilation and use are affected by elevated [CO_2] in combination with a progressive drought, and how this could impact shifts on biomass accumulation and partitioning. For that, we cultivated coffee plants in open top chambers under greenhouse conditions. Plants grown in 12-L pots were then submitted to ambient (386±20 ppm) or elevated (723±83 ppm) [CO_2] during approximately seven months, as well as to varying soil water availabilities (100, 50, 37.5, 25 or 20 % of soil field capacity). Our results demonstrate that elevated [CO_2] improved carbon assimilation rates (> 60 %) with unaltered stomatal conductance and no signs of photosynthetic downregulation. This was accompanied by increases in water-use efficiency, respiration rates and biomass accumulation regardless of watering, and decreased photorespiration rates and oxidative pressure under drought. Improved growth under elevated [CO_2] was more evident under drought than under full irrigation, and was unlikely to have been associated with global changes on hormonal pools, but rather with shifts on carbono fluxes. Finally, elevated [CO_2] promoted key allometric adjustments linked to drought tolerance, e.g., more biomass partitioning towards roots with greater root length. Collectively, our results offer novel and timely information on the mitigating ability of elevated [CO_2] on the photosynthetic performance and growth of coffee plants under drought conditions.

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Keywords: Allometric adjustments, rising [CO_2], drought stress, water-use-efficiency, hormonal pools.

Acknowledgments: CNPq, CAPES and FAPEMIG.

Plant Physiology and its Contributions to Society
IISIFV

Gas exchanges and carbohydrate content in plants *Mangifera indica* L. after the plan in the field

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Mangifera indica (L.) is popularly known as mango tree, being a fruiting tree of great economic importance in national and international agribusiness. Brazil is a country that has excellent climatic conditions for the cultivation of this plant, exporting around 30,000 tons per year. It is already known that during the cultivation of some fruit trees, for the formation of orchards, seedlings planting stress can result in decreased photosynthetic capacity; however, it is also known that some plants do not have the ability to acclimate or recover from that type of stress. Therefore, the present study aimed to evaluate the physiological responses of the mango tree, of the Palmer variety, after planting in the field. Physiological assessments consisted of analyzing gas exchange, and in the determination of total soluble carbohydrates (AST), sucrose (SAC), reducing sugars (ASR) and starch (AMI), in different experimental periods at 30, 150 and 300 days after planting (DPP). Initially, at 30 DPP, is observed low values net photosynthesis (*A*), efficiency intrinsic use of water (*A/gs)* and instantaneous carboxylation efficiency (*A/ci)*. However, to as we the increased planting time, the parameters values (*A, A/gs* e *A/ci*) increased exponentially, showing significant difference (*Skott-knott* $p<0.05$) between 30 and 300 DPP, with an expressive increase of 125% in the values *A*, 100% in *A/gs*, and approximately 80% in *A/ci*. With regard to the levels of AST, SAC, ASR and AMI, patterns involving these compounds are observed, which could predict, in a way, that in 30 DPP the plants were adjusting metabolically by reallocating carbon to meet the physiological demands of that specific period. Note that at 30 DPP, the content of SAC and ASR was higher than the values recorded at 150 and 300 DPP. Since, in an inversely nd parallel way, the AMI values increased significantly ($p< 0.05$) during the experiment. These changes, in turn, verified by means of gas exchange parameters and carbohydrate balance, show that the hose is a fruit tree that has physiological resources capable of promoting greater adaptability and use after transplantation.

Keywords: Photosynthesis, Sucrose, Starch and Acclimatization.

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Plant Physiology and its Contributions to Society
IISIFV

Effect of cadmium on gas exchange of *Talinum patens* cuttings

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Cadmium (Cd) is a heavy metal toxic to the health of humans, animals, plants and the environment. In plants, cadmium is a non-essential and highly toxic material, which can cause damage to photosynthetic devices, oxidative stress due to the production of reactive oxygen species, decreased CO_2 fixation, reduced stomatal conductance, changes in transpiration rates, among other problems. *Talinum patens* is a herbaceous plant known for its tolerance to certain levels of heavy metals and for its use as a phytoremediation species. The present study aimed to evaluate the effect of two different concentrations of cadmium on gas exchange parameters of *Talinum patens* cuttings, and to compare them with the control treatment. Cuttings from adult plants that grew in a greenhouse were obtained, and a hydroponics system was organized that consisted of two cuttings for each pot, that after a month of acclimatization in Hoagland solutions were subjected to three different treatments with five replicates each. The treatments were cadmium (0, 7 and 14 mg L^{-1}) added to the Hoagland solution. Analyzes of gas exchange were carried out, ten days after the treatments application. The parameters evaluated were photosynthesis (µmol CO_2 m^{-2} s^{-1}); stomatal conductance (mol H_2O m^{-2} s^{-1}) and transpiration (mmol H_2O m^{-2} s^{-1}). The data obtained were analyzed using a statistical software and the Scott-Knott test was applied, with $p < 0.05$. It was noted in each one of the three analyzes that there was no significant difference between the dosage of 7 mg L^{-1} of cadmium and the control treatment, however the dosage of 14 mg L^{-1} of cadmium showed significantly lower values when compared with the other treatments. The dosage of 14 mg $L^{-1}$of cadmium caused a reduction of 59% in the photosynthetic rate, 57.15% in stomatal conductance and 56.1% in transpiration, when compared to the control treatment. It is concluded that when using the dosage of 7 mg L^{-1} of cadmium there were no changes in the analyzed physiological parameters, which demonstrates a tolerance of *Talinum patens* in these concentrations, however the concentration of 14mg L^{-1} caused negative changes in the plant, which suggests the toxicity and the stress caused by the metal in these concentrations.

Keywords: IRGA, Ecophysiology, Photosynthesis, Heavy Metal.

Acknowledgments: CAPES and UNIFAL-MG.

Plant Physiology and its Contributions to Society
IISIFV

Can discontinuous hydration influence seed longevity?

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Seeds are dispersed in the environment after maturation. Thus, they undergo different abiotic factors in the soil that can influence their longevity, such as high temperatures and water availability. Therefore, the aim of this study was to evaluate whether the previous discontinued hydration could influence the longevity of Cereus *jamacaru* subsp. *jamacaru* seeds present in the soil seed bank. We submit the seeds to 0, 1, 2 and 3 hydration/dehydration cycles (HD cycles) to simulate discontinuous hydration. After that, we created an artificial soil seed bank in an area of Caatinga and we evaluated the germinative behavior (seedling emergence [SE] and T_{50}) at intervals of 0 (newly collected), 3, 6, 9, 12 and 15 months. In the newly collected seeds, we found a significant influence of the HD cycles in the SE ($F = 9.5180$; $df = 3$; $p < 0.0001$), with an increase of about 30% in the SE of the seeds that passed through two HD cycles when we compared to seeds that we not subjected to discontinuous hydration. Throughout the evaluation intervals, we noticed that seeds that did not undergo discontinuous hydration showed a drop in seed longevity, evidenced by a decrease in SE and an increase in T_{50}. However, seeds that have undergone cycles showed a significant increase in SE ($F = 39.0020$; $df = 3$; $p < 0.0001$) and a decrease in T_{50} ($F = 5.1950$; $df = 3$; $p = 0.0020$) in the evaluated intervals. We concluded that seeds of *C. jamacaru* subsp. *jamacaru* presents a benefit provided by discontinuous hydration in its germinative behavior both in the newly collected seeds and in those that we evaluated over time, showing an increase in the seed longevity. Therefore, this increase in seed longevity through discontinuous hydration can favor the establishment of the species in the environment, increasing its ecological success.

Keywords: Seed hydration memory, Cactaceae, seed germination, seedling emergence, viability.

Acknowledgments: CAPES.

Plant Physiology and its Contributions to Society
IISIFV

Effect of the maternal environment on the morphology and physiology of macaw palm fruits and seeds from two different populations

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Water availability and temperature are environmental traits that influence the mother plant performance, generating morphological and/or physiological changes in reproductive structures. Macaw palm (*Acrocomia aculeata* (Jacq.) Lodd. ex. Mart.) is widely distributed in Brazil, consequently its productivity is affected by climatic variations. Based on this, the aim of this study was to investigate fruits and seeds traits of macaw palm from two populations of different biomes in Minas Gerais (Cerrado and Atlantic Rainforest). Ripe fruits of macaw palm were collected in a natural environment in Cerrado (Mirabela) and Atlantic Forest (Brumadinho) in February 2017. The rainfall and temperature data for the sampling regions were obtained from the meteorological database available. The length, mass, and water content of fruits and seeds (n = 20); the content of proteins, carbohydrates and lipids, the percentage and speed of germination of the seeds, the viability and ABA content of the embryos were evaluated from material collected in both populations. A differentiated rainfall regime was found among the investigated populations, during the development of macaw palm fruits: the Cerrado's population was exposed to less precipitation (840 mm) and dry winter, while for the Atlantic Rainforest, the rain was well distributed and greater than 1.900 mm in the same period. Fruits from the Atlantic Rainforest had larger size and biomass, in addition to a thicker endocarp, than those from the Cerrado. Seeds of both biomes did not differ in size, dry biomass, and viability, however, higher water content was found in seeds of the Atlantic Rainforest. Seeds from Cerrado showed a lower concentration of ABA and, consequently, a higher percentage and speed of germination, in comparison with those from the Atlantic Forest. The content of lipids and carbohydrates did not differ between populations, however, the Atlantic Forest seeds showed higher protein content. These results suggest that greater water availability during the development of macaw palm fruits produced in the Atlantic Forest provided the formation of larger fruits, while the lower water availability experienced by the population of the Cerrado can contribute to a lower ABA content and, consequently, a lower dormancy level in the seeds of this population.

Keywords: *Acrocomia aculeata*, abscisic acid, Atlantic Forest, Cerrado, morphological aspects, water availability.

Acknowledgments: PPGBV/UFMG and FAPEMIG.

Poster Presentations

LINE OF RESEARCH | Metabolism and plant nutrition

Calcium in the enzymatic activation of the antioxidant system in *Annona emarginata* after mechanical damage

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Elevated levels of Ca^{2+} and reactive oxygen species (ROS) in the cytoplasm generate a cascade of signals activating kinases, and these are responsible for the expression of antioxidant enzymes, that it is involved in the ROS levels regulation in stress situation. Signal cascade coordinates intracellular responses in plants, and it allow long-distance signaling, which are important for the response to overcome stress. Was investigated influence of calcium concentrations on the antioxidant enzymes activity of *Annona emarginata* submitted to mechanical damage. *Annona emarginata* seedlings were grown in Hoagland & Arnon n° 2 nutrient solution, and it was modified to supply 4, 2 and 0 mM Ca^{2+}, without and with mechanical damage, which was performed 30 days after establishing the calcium variation. Level of hydrogen peroxide (H_2O_2) and lipid peroxidation and enzymatic activity of superoxide dismutase (SOD), catalase (CAT) and peroxidase (POD) were evaluated in five periods, at 30 minutes and 15, 30, 60 and 90 days after mechanical damage. Plants submitted to mechanical damage, regardless of calcium concentration, showed a higher H_2O_2 concentration, however, without causing damage to membranes observed by lipid peroxidation. These results suggest that the enzymes SOD, CAT and POD were efficient in ROS neutralizing, avoiding membrane damage and that *Annona emarginata* in the absence of calcium supply maintained the enzymatic defense system functioning.

Keywords: enzymatic activation, stress response, pruning, calcium deficiency, signalizing pathway, enzymatic activity.

Acknowledgments: CNPq and CAPES.

Plant Physiology and its Contributions to Society
IISIFV

Use of iron ore tailings for the cultivation of agricultural species

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The rupture of the Fundão's dam (Minas Gerais, Brazil) released a large amount of iron ore tailings, which raised concerns about possible impacts on local agricultural activity. Given this scenario, this study evaluated the physiological performance and the accumulation of metals by four species of great relevance in the region, two graniferous (bean and maize) and two forage (brachiaria and crotalaria), cultivated in tailings and in soil. The bioextraction capacity of each species was also evaluated as indicated by the bioaccumulation factor (BF). The tailings showed higher levels of Fe, Mn and Na than the soil. The productivity of bean, crotalaria and maize in the tailings did not differ from that in soil. Bachiaria plants had reduced growth when grown in tailings, which can be attributed to the characteristics of the root system of this species. In general, photosynthetic pigments and Fv/Fm did not differ between treatments. With the exception of brachiaria, Fe and Mn were the main metals in higher concentrations in the aerial part of plants grown in the tailings, reflecting the high levels of these elements in this substrate. The concentrations of metals detected in bean and maize grains were within the limits allowed for human consumption. Brachiaria can be indicated to restore pastures in the region affected by the tailings as it represents a low risk for metal biomagnification in the food chain. Crotalaria and maize showed high concentrations of Fe and Mn and FB > 1 for Mn, Zn and Cu, and thus are indicated as promising for phytoextraction. Nonetheless, caution should be exercised in the use of the aerial part of these plants for animal feed without further study.

Keywords: Bioaccumulation factor, biomagnification, phytoextraction, food security, bioextraction capacity.

Acknowledgments: CAPES and CNPq.

Plant Physiology and its Contributions to Society
IISIFV

Initial growth and metabolism of *Peltophorum dubium* (Fabaceae) cultivated under different nitrogen sources and manganese concentrations

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Mining activity can suppress vegetation, cause the removal of organic matter, the loss of soil nutrients and impose restrictions on the growth of tree plant species. Generally, iron ore tailings, as the one from the Fundão dam's rupture (Mariana, MG, Brazil), are compacted and exhibit an imbalance of essential mineral elements, with low macronutrients and high micronutrients concentrations, such as nitrogen (N) and manganese (Mn), respectively. Previous studies have indicated that the chemical imbalance of the substrate in the area impacted by the Fundão dam's rupture is the main limiting factor of the native tree species' initial growth. Besides, nitrogen fertilization could guarantee the best plants performance in recovery programs of the affected area. However, a source of N can cause acidification of the rhizosphere, compromise the absorption of calcium (Ca), magnesium (Mg) and potassium (K) and increase the availability of Mn for plants, accentuating the symptoms of manganese toxicity. In this way, this study investigated the interaction between different N sources and Mn doses in the initial development of *Peltophorum dubium* seedlings, a native tree species of Atlantic Forest. For this, growth and photosynthetic parameters were evaluated to propose fertilization strategies for the area affected by iron ore tailings. Manganese concentration, similar to that found in the Fundão's tailings (25 mg L^{-1}), did not affect the growth of *P. dubium* when nitrate was used as the only N source. On the other hand, ammoniacal fertilization, especially when combined with a high Mn concentration (50 mg L^{-1}) caused the substrate acidification and lower total biomass accumulation, in relation to other N sources. Moreover, this treatment promoted Mn translocation to the shoot and reduced the potential quantum yield of chlorophyll a. In conclusion, manganese concentrations present in the Fundão's tailings did not compromise the initial growth of *P. dubium* and this species can be used in the reforestation of the affected area, especially if nitrate is used as the only N source.

Keywords: mineral nutrition, photosynthesis, plant growth, iron ore tailings, Atlantic Forest, tree species.

Acknowledgments: CAPES and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Growth of *Physalis angulata* L. under molybdenum doses

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The molybdenum ion (Mo) is involved in several biochemical processes and has fundamental importance in the incorporation of nitrogen, contributing to plant growth and development. Solutions increased with Mo, as a management strategy, can offer benefits in the cultivation of plants such as *Physalis angulata*, whose fruits have nutraceutical properties and the management of cultivation has not yet been fully defined. The aim of this work was to evaluate the growth of P. angulata plants in response to different doses of molybdenum. The study was carried out at the Experimental Unit Horto Florestal of the State University of Feira de Santana (UEFS), Feira de Santana, Bahia, under hydroponic cultivation in a randomized design with twelve replicates and five doses of Mo (0, 0.005, 0.01, 0.015 and 0.02 mg dm^{-3} of $H_2MoO * 4H_2O$). The shoot (cm) and root length (cm) and the number of leaves were evaluated. The dry matter (DM) was obtained from the fractions of the leaves, stems and roots and used to determine the total dry matter (TDM) and root to root ratio (Root:Soot). The data were subjected to analysis of variance using the F test and analysis of regression ($p < 0.05$). The growth parameters were not significant. Gains were observed in the DM of leaves, stems and roots of 28, 149 and 32%, respectively and a positive increase in the TDM, when the doses of Mo were high (0.015 and 0.02 mg dm^{-3}). In all treatments, plants prioritized investment in the shoot part at the expense o froots, however a higher Root:shoot ratio was observed in the treatment without or with low ion dose. These results indicate that the highest doses of Mo provided in P. angulata greater increases in dry matter. This response maybe justified by the participation of Mo ion on enzymatic activity of nitrate reductase, found in the leaves and roots of plants and, consequently, by intensifying nitrogen metabolism, being an alternative to increase the potential of cultivation of this species.

Keywords: Fisalis, micronutrients, hydroponics.

Acknowledgments: CAPES, UEFS and PPPG.

Plant Physiology and its Contributions to Society IISIFV

Can vegetative and reproductive stadiums affect yield and chemical profile of *Xylopia aromatica* essential oil?

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Xylopia aromatica (Lam.) Mart. (Annonaceae) is a tree species, commonly called the monkey pepper. This tree is widely distributed in the cerrado (Brazilian savanna) and semideciduous forests. The species plays an important role in the restoration of degraded areas; besides specialized metabolic pathways of this medicinal and aromatic plant play a key role in the production of essential oil. Chemical studies revealed that the main components for *Xylopia aromatica* were α-pinene, β-pinene, limonene, cadinene, germacrene D, bicyclogermacrene, globulol and spathulenol. These phytoconstituents exhibit potential antioxidant, anti-inflammatory, antiproliferative, antimicrobial and antifungal activities, which has aroused the pharmaceutical industry interest. These components also serve as a defensive mechanism for plants acclimation to overcome environmental stresses. The plant age and stage of development are known to affect essential oil production; consequently, the present study aimed to characterize the yield and chemical profile of essential oil extracted from *X. aromatica* leaves in both vegetative and reproductive stages. Therefore, twenty individuals of *X. aromatica* were evaluated in Cerrado remnants in the region of Botucatu, state of São Paulo, i.e. 10 in the vegetative stage (without the presence of fruit development) and 10 in the reproductive stage (with fruit development). For the essential oil extraction, the hydrodistillation took 2 hours by using the Clevenger type apparatus, and then the chemical profile was analysed by gas chromatography-flame ionization detector (GC-FID) and GC-mass spectrometry (GC–MS). Results detected higher essential oil yield in the reproductive stadium. The cluster analysis sought to base on the substance's relative percentage by distributing 20 individuals into four chemical profiles; thus, clusters I and IV mostly grouped individuals into reproductive stage, while clusters II and III into vegetative stage. Finally, the development stadium affected essential oil yield, but chemical profile was not entirely influenced by, since three individuals revealed a higher genetic interaction with the developmental stadiums.

Keywords: specialized metabolism, terpene, Annonaceae.

Acknowledgments: CAPES and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Elevated CO_2 could change NO^{3-}/NH^{4+} ratio in fertilizing tobacco plants

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Many studies point out that as the atmospheric CO_2 concentration increases, the NO_3^- assimilation decreases, leading to a decrease in the proportion of nitrogenous organic compounds (NOC) in the plant. Thus, it has been suggested that the increased absorption of NH_4^+ could compensate for the low assimilation of NO_3^-. However, this would require understanding how NH_4^+ toxicity can be overcome, as well as finding the synthesis of sufficient C skeletons for both growth demands and NOC. Therefore, the objective was to assess whether high [CO_2] can alter the preferred source of inorganic N (NO_3^-/NH_4^+) in tobacco plants. For this, plants (*Nicotiana tabacum*) were germinated in MS culture medium and transferred to the growth chamber with a 12-hour photoperiod, 300 µmol m^{-2} s^{-1}, and 380 µmol mol^{-1} ($_LCO_2$). Under these conditions, the plants were acclimatized for 21 days and received weekly 5 fertilizations with complete nutrient solution (CS; control) from Hoagland & Arnon and modified to contain only NO_3^- (N-NO_3^-) or NH_4^+ (N-NH_4^+) as exclusive N source. 45 days after transfer, the CO_2 was adjusted to 760 µmol mol^{-1} ($_ECO_2$), where the plants remained for another 5 days. For evaluations, plants were collected at 45 ($_LCO_2$) and 50 days ($_ECO_2$) after transferring to the growth chamber. The starch, sucrose, and reducing sugars (RS) concentrations in leaves and roots were determined. Under CS, the transition to $_ECO_2$ determined an increase in the concentrations of starch in the leaves (81%) and roots (48%), as well as in the RS in the leaves (56%), while decreasing the sucrose concentration on leaves (-57%). In turn, under N-NO_3^- the $_ECO_2$ decreased the concentrations of starch (-34%) and sucrose (-34%) in the leaves, and of RS (-57%) in the roots, while there was increased RS (32%) in the leaves and sucrose (256%) in the roots. Under N-NH_4^+, $_ECO_2$ resulted in higher concentrations of starch (35%), sucrose (160%) and RS (162%) in the leaves, and still sucrose (77%) and AR (25%) in the roots, while only a decrease in starch (-49%) in the roots. Together, these data point to a considerable gain in the number of carbon skeletons available for the synthesis of NOC and structural carbohydrates in tobacco plants under $_ECO_2$ fertilized exclusively with NH_4^+, which presupposes a paradigm shift in nitrogen fertilization as the continuous emission of CO_2 increases its concentration on the atm.

Keywords: High CO_2, Nitrogen Source, Carbohydrate Metabolism, Ammonium Benefits.

Acknowledgments: CAPES, CNPq and UFLA.

Poster Presentations

LINE OF RESEARCH | Plant growth and development

Physiological modulation of seedlings of *Passiflora edulis* Sims. submitted to gibberellin biosinthesis inhibitor

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The sensibility of *Passiflora edulis* Sims. to extreme climate changing, resctrict the initial stablishment and production yield. In many species, the control of gibberellin levels is a important tool to abiotic stress tolerance. By this way, the objetive of this study was to verify if the restriction of gibberellin biosynthesis in *Passiflora edulis* Sims. seedlings could optimize the water relations and foliar gas exchanges. The trial was conducted at greenhouse, with seedlings cultivated in poliethyle tubes (290 cm^3), using a experimental radomly design, with five concentrations of an gibberellin biosynthesis inhibitor (paclobutrazol, 0, 40, 80, 120, 160 mg L^{-1}), applied via substrate at 32 days after seed emergence (DAE). At 90 days after treatment, it was analysed the leaf water potential (Ψ_{wf}), relative water content (RWC) at predawn and at midday, stomathal conductance (gs) and CO_2 assimilation rate (*A*). The gibberellin inhibition changed the phisiological patterns of passion fruit seedlings when evaluated the gas exchange and water relations, with exception of RWC at predawn. There was na increasing to Ψ_{wf} at predawn and midday and RWC at midday in seedlings submitted to gibberellin restriction in relation to witness. The optimization of water status induced by gibberellin biosynthesis is related to celular elasticity coeficient, higher pressure potential and maintainance of celular turgity. It was verified to gs and *A* there were a similar effect. By this way, the restriction of a gibberellin biosynthesis capacity alters the metabolism of *Passiflora edulis* Sims.

Keywords: Yellow passion fruit, water relations, leaf gas exchange.

Acknowledgments: CAPES

Plant Physiology and its Contributions to Society IISIFV

Mathematical model for estimating the volume of coffee fruits

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CO_2 assimilation (*A*) is a parameter strongly associated with crop productivity. Although leaves are the most important photosynthetic organ, it is well known that fruits can also act as photosynthetically active organs during part of the development. Thus, the estimation of *A* in fruits has been calculated for several crops considering the units as area or dry matter. However, volume is a functional characteristic related to fruit growth, therefore, the calculation of this parameter offers an alternative measure to study the in situ variation of gas exchange during fruit development. The direct method for calculating volume can be a limiting factor for experimentation, since based on the Archimedes principle it is necessary to remove the fruit from the plant, making it impossible to assess the volume of the same fruit over time. Therefore, a mathematical model applied to coffee fruits was tested, considering it as an ellipsoid. The robustness of the model was validated by comparison with the conventional method for calculating volume. In this way, 569 fruits in various phenological stages were evaluated in the field, being measured length diameter (X axis in the Cartesian plane = a), width (Z axis = c) and height (Y axis = b) in mm, and were applied in the following equation: $\int_{-a}^{a} Ax * dx = \frac{\pi bc}{a^2}\int_{-a}^{a} (a^2 - x^2) * dx = 2\,\frac{\pi bc}{a^2}\left(a^2x - \frac{x^3}{3}\right)|_0^a = \frac{2xbc}{a^2}\left(a^3 - \frac{x^3}{3}\right) = \frac{3}{4}\pi abc$ After *in situ* measurements, each fruit was identified with a number and cut from the branch to calculate the volume in a conventional manner. The efficiency of the model was assessed by linear regression and by comparing the data obtained with the t Student test for independent samples. It was found a positive linear relationship between the two methods, the t Student's test (α = 0.05) showed that both coefficients are significant; therefore, the model is explained with the equation y = 0.9518x + 0.0118. There was a high correlation (r = 0.9917) and excellent prediction due to the high determination coefficient (R^2 = 0.9835). Thus, based on the root of the mean square error of (RMSE, 0.0391), it can be affirmed that the two models considered to measure the volume of the fruits do not present significant differences between them and that this model is suitable for estimating the volume of fruits of coffee.

Keywords: integrals, conventional method, Archimedes' Principle

Acknowledgments: CAPES and UFLA.

Plant Physiology and its Contributions to Society

Effect of grafting and rootstock methods on tomato gas exchange

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Grafted-transplants consist on two distinct plants joined through tissue regeneration, allowing their development as a single plant. Consequently, a strategic use of scion rootstock combinations can provide grafted seedlings with resistance to soil-related phytosanitary problems, enhance tolerance to salinity and temperature variability, increase the efficiency of water and nutrient uptake, promote physiological performance, maximize yield, and improve fruit quality. Thus, the objective of this study was to evaluate gas exchange of a commercial tomato cultivar (cv. Giuliana) grafted onto the genotype RVTC-66 (*Solanum lycopersicum* var. cerasiforme) using the cleft and approach grafting methods. An experiment was conducted in a randomized block design with a two factorial design (two rootstocks and two grafting methods) with four replications. Plots consisted on four plants. Rootstock treatments were considered seedlings of commercial cultivar Giuliana grafted onto the rootstock RVTC-66 and non-grafted. Grafting methods were cleft and approach grafting. At 21 days after grafting, when seedlings had 5-6 leaves completely expanded, they were transplanted to 10 dm^3low density polyethylene pots, containing substrate based on biostabilized pine bark. Plants were kept in a greenhouse, being supported with aid of vertical stakes, in which one main stem per plant was maintained. Net CO_2 assimilation rate (A_{net}, µmol CO_2 m^{-2} s^{-1}), internal CO_2 concentration in leaves (Ci, µmol CO_2 mol^{-1} air), transpiration rate (E_t, mmol steam m^{-2} s^{-1}) and stomatal conductance (gs, mol m^{-2} s^{-1}) were determined using a portable photosynthesis measurement system (IRGA, Infrared Gas Analyzer, Li-COR, LI6400XT), with 1000 µmol photons m^{-2} s^{-1}, 400 µmol mol^{-1} CO_2 and ΔCO_2 + ΔH_2O less than 1%. Water use efficiency [(WUE, µmol CO_2 (mmol $H_2O)^{-1}$] was estimated by the relationship between A_{net} and E_t. Gas exchange evaluations were performed biweekly after flowering. Data were tested for normality and homogeneity of residual variances by Lilliefors and Bartlett tests, respectively, and then subjected to analysis of individual and joint variance. When the F test was significant ($P \leq 0.05$), the means were subjected to Student's t-test comparison at 5% probability of error. Grafting methods had no significant effect on photosynthetic parameters of tomato cultivar Giuliana. Rootstocks had significant effect for A_{net} and WUE. The use of RVTC-66 as rootstock led to an increment on A_{net} and WUE of 17% and 21% compared to non-grafted transplants, respectively. The grafting methods studied had no effect on the gas exchange of Giuliana tomato cultivar grafted onto RVTC-66. However, the RVTC-66 rootstock provided an increase in photosynthetic efficiency and water use efficiency.

Keywords: *Solanum lycopersicum*, Net CO_2 assimilation rate, RVTC-66, water use efficiency.

Plant Physiology and its Contributions to Society
IISIFV

Seedlings growth of *Urochloa brizantha* cv. Marandu under different temperatures

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Initial seedling growth is directly influenced by temperature conditions, this is one of the main factors for the field establishment. Studies about relating the temperature fluctuations are important for a better understanding of the mechanism of responses in seedling growth. Thus, the objective in this work was to verify the influence of different temperatures on the initial seedling growth of *U. brizantha* (Hochst. ex A. Rich.) Stapf cv. Marandu. Were used nine lots of seed of *U. brizantha* cv. Marandu. For the characterization of the lots, the evaluations of the water content and germination test were performed at 21 days. The normal seedlings were obtained seven days after sowing on two germitest® paper, covered with a third sheet, subsequently the roll shaped papers were kept in *Biochemical Oxigen Demand* (BOD) germinators, at constant temperatures of: 20, 25, 30, 35ºC and alternated 20-35ºC, under photoperiod of 12 h of light and 12 h of dark. At the end of this period, seedling growth was determined by image analysis using the GroundEye equipment®, version S800. The analysis of the images was performed automatically, with corrections of failures in the identification of the parts of the seedlings by the software, and the mean values of seedlings characteristics were measured: root length (CR), length of hypocotyl (CH), total seedling length (CT) and the ratio of the length of the hypocotyl to the length of the root (CH/CR). The water content of the seeds varied from 10.81 to 12.05%. All lots had the same germinative potential and did not differ significantly from each other. In general, all the variables studied were significantly influenced by the constant temperature of 20ºC, with the lowest results obtained in this treatment, on the other hand, greater lengths were verified at constant temperatures of 30 and 35ºC. Thus, it can be concluded that the temperature influences the initial seedling growth, so implantation of pastures with cv. Marandu is indicated for environments that present annual average temperatures that vary between 30 and 35ºC.

Keywords: Forage, Physiological potential, Seedling size, Image analysis.

Acknowledgments: CAPES, FAPEMIG and UFLA.

Plant Physiology and its Contributions to Society
IISIFV

Variation in nitrate reductase activity in seedlings of *Annona emarginata* (Schltdl.) H. Rainer 'Terra- Fria' variety according to the circadian rhythm

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Annona emerginata is a native tree species of great importance, since is used as a commercial rootstock to graft for instance, some species of atemoya; besides having higher biological potential. In plants, nitrate reductase is an enzyme that is mainly responsible for nitrogen assimilation, but this enzyme is affected by several changes in the environment, such as the time of the day, which is still unclear described in Anonas. The present study therefore aimed to assess how circadian rhythms affect nitrate reductase activity in seedlings of *Annona emarginata* (Schltdl.) H. Rainer 'Terra-fria' variety. The Coordination of Sustainable Rural Development (CDRS) in São Bento do Sapucaí provided the seedlings, which were kept in a greenhouse at the Department of Botany, UNESP, Botucatu, where leaf and air temperatures varied from 19ºC to 31ºC. Samples were collected over six different periods of the day (at 02am, 06am, 10am, 14pm, 18pm, 22pm) with four repetitions of one plant at a time. Therefore, the nitrate reductase activity followed the method proposed by Mulder et al. (1969). Results showed an increase in enzyme concentration to high levels during the beginning of the light phase (at 06am), with the peak at 10am; and a decrease in concentration to low levels during the dark phase (i.e., at 10pm and 2am). There is an interdependence in order to produce nitrate reductase, since this enzyme needs carbohydrate metabolism and, consequently, nitrogen substances, such as chlorophyll. Moreover, nitrate assimilation mainly occurs during the light phase, since photosynthetic electrons are responsible for nitrate reduction. In the dark phase, this enzyme is also present but smaller proportions, the reducing power of this period therefore comes from the oxidation of organic compounds. As a result, the circadian rhythm affects nitrate reductase activity in seedlings of *Annona emarginata* 'Terra-fria' variety.

Keywords: enzyme, circadian variation, native, arboreal.

Acknowledgments: CAPES and CDRS.

Plant Physiology and its Contributions to Society
IISIFV

Changes in chlorophyll fluorescence parameters in *Hancornia speciosa* Gomes during *in vitro* cultivation under LEDs

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Hancornia speciosa Gomes is a species of pharmaceutical importance, used in traditional medicine in the treatment of tuberculosis, diabetes and hypertension. However, studies evaluating physiological behavior *in vitro* are still scarce. Thus, the objective was to evaluate the impact of light emitting diodes (LEDs) on the photosynthetic apparatus of *H. speciosa*. Seeds were grown *in vitro* in MS medium, under the qualities of light blue (400-490 nm), red (600-700 nm), blue / red (1: 1), white (400-700nm) and white (400-700nm) with 1/3 of UV-B light, flow density of photosynthetic photons at 100 ± 5 µmol m^{-2} s^{-1} and photoperiod of 16 hours. After 75 days of cultivation, analyzes of the fluorescence characteristics of chlorophyll a were performed, being the photosynthetic performance index (PIABS), the maximum quantum yield of primary photochemistry (PhiPo), the quantum yield of energy dissipation in the form of heat (PhiDo) and specific flow of energy dissipation at the level of the antenna chlorophylls (Dio / RC). It was found that the different LEDs influenced the photosynthetic apparatus of *H. speciosa*, seedlings under red light showed a reduction in PhiPo and PIABS, not showing an efficient behavior for the photosynthetic apparatus, possibly due to the increase in energy dissipation in the form of heat (PhiDo and DIO / RC), being a seedling strategy, in order to reduce the formation of reactive oxygen species, thus indicating the compromise of the photosynthetic apparatus. In contrast, the white / UV-B, white and blue / red (1: 1) spectral environments increased PhiPo and PIABS and reduced the rates of energy dissipation in the form of heat, indicating less pressure on photosystem II and greater physiological performance compared to seedlings under red light. Therefore, the chlorophyll a fluorescence parameters indicate that the use of white / UV-B, white and blue / red LEDs (1: 1) induce better physiological performance of *H. speciosa* seedlings grown *in vitro*.

Keywords: Mangaba, Cerrado, Light quality, Photosynthetic apparatus; Plant tissue culture.

Acknowledgments: Laboratório de Cultura de Tecidos, Instituto Federal Goiano and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Vegetative propagation of Uvaia (*Eugenia pyriformis* Cambess) by cuttings

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Uvaia is a fruit plant of Cerrado region with commercial purposes for the ice cream, juice, jam and wine production. It is also food for the local fauna. The species has a great plantlets production challenge due to the lack of seeds and genetic dysfunction. The aim of this study was to develop a seedling production protocol for the species with asexual propagation of cuttings using indole-3-butyric acid (IBA). There is a lack of researches in the literature that report about the asexual propagation of uvaia. To start the experiment, a pre-test was carried out to define the substrate humidity, ambient temperature, type of cuttings, photoperiod and management of the irrigation shift. It was executed in growth room and consisted of ten treatments: two types of cuttings (herbaceous and semi hardwood) submitted to five concentrations of IBA (0, 2000, 4000, 6000 and 8000 ppm). Herbaceous and semi-hardwood cuttings were collected from uvaia and the disinfection with sodium hypochlorite (0.5%) was performed. Then, they were cutted into cuttings of 6-7 cm. The cuttings were placed in two lines with five units in the mini clonal garden. The room was acclimated to 25°C with a twelve-hour photoperiod. The relative humidity was maintained around 90 – 95%. The final evaluation was made after 90 days after implantation and the parameters of survival percentage, rooting percentage, number of roots, root length, number and length of shoots evaluated. All types of cuttings did not show any rooting. The semi-hardwood cuttings showed better survival and the highest average (6%) was with IBA 4000 ppm that presented 100% of living shoots. The treatments with surviving cuttings were herbaceous with 0 ppm of IBA (2%), semi hardwood with 2000 (2%), 4000 (6%), 6000 (2%), and 8000 (4%) ppm of IBA. The results confirmed the difficulty to carry out the asexual propagation for the species.

Keywords: Rooting, auxin, IBA, mini clonal garden, herbaceous, semi hard-woody.

Acknowledgments: IFTM and FAPEMIG.

Plant Physiology and its Contributions to Society IISIFV

Restriction of the growth of *Passiflora setacea* seedlings

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Passiflora setacea is an important species used as rootstock for comercial *Passiflora* canopy as *P. edulis* and *P. alata*, however, the morphological compatiblity between diameters restrict this technique. The aim of this study was evaluate if the gibberellin biossynthesis restriction, induced by paclobutrazole affect the morphological characteristics of *Passiflora setacea* seedlings to be used as rootstock. The trial was conducted at greenhouse, in State University of Southwest of Bahia (UESB), Vitória da Conquista *Campus*. It was led in an entirely randomized design, with five treatments (concentrations of paclobutrazole 0, 40, 80, 120 e 160 mg L^{-1}) and five repetitions, and the plot consisted of 24 seedlings. The seedlings were maintained at a polyethylene tubes, and to 50 days after seed emergence it were imersed in paclobutrazole aqueous solutions until substrate saturation was reach. At 35 days after this treatment, it was measured a morphological parameters of shoot and roots. The data were submitted to variance homogeneity (Cochran) and normality (Lilliefors) test, F test and variance analysis of regression ($R^2 \geq 50\%$). The gibberellin biosynthesis restriction altered the morphology of *P. setacea* seedling, raising the leaf number and root volume. It was observed a tendency of increasing in basal and medium shoot diameters, leaf, shoot and root fresh and dry weight, associated to paclobutrazole concentrations between 60 to 90 mg L^{-1}. The restriction of gibberellin biosynthesis induced by paclobutrazole increase the seedling quality and benefit the compatibility between *P. setacea* rootstock and comercial *Passiflora* canopy.

Keywords: Vegetative propagation, inhibitor of gibberellin biosynthesis, passion fruit.

Acknowledgments: UESB and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Correlations between growth traits of stem cuttings arabica coffee seedlings treated with thiamethoxan

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The success in coffee production depends, among other factors, on the quality of the seedlings produced. A viable alternative to produce vigorous seedlings and rapid multiplication of promising progenies and/or hybrids is the rooting of stem cuttings. Thus, the objective of the present work is to evaluate the vegetative growth of cloned coffee plants treated with thiamethoxan. The cuttings were obtained by the end of January 2020 from plants of the Mundo Novo cultivar. After a process of disinfestation (10 minutes in a 10% sodium hypochlorite solution), the cuttings were treated with IBA (4000 ppm) to induce the rooting process and then they were inserted in a 50 cm^3 tube containing vermiculite as substrate. The experiment was conducted in a greenhouse with fogging and a 5 g L^{-1} dose of sucrose were applied on the cuttings every 15 days. At 60 days the seedlings were arranged into a randomized blocks design experiment, with 5 blocks, containing three treatments: T1 (control), T2 (2.5 g L^{-1} of thiamethoxan), T3 (5 g L^{-1} of thiamethoxan). Each treatment contained 5 plants per experimental plot. At 90 days of experiment the seedlings were transplanted to polyethylene bags and the following parameters were analyzed: plant height (PH), stem diameter (SD) and number of new leaves (NNL). In possession of the data, Pearson correlations were performed between all the parameters. Both T1 and T3 treatment did not show significant correlations for thiamethoxan and transplantation at 60 days. However, T2 showed satisfactory values of correlation considering the period of experiment, with the results of 0.65 between PH/SD, 0.59 between PH/NNL and 0.74 between SD/NNL. Positive and higher values of correlation between plant height and stem diameter are important growth parameters to obtain success on the subsequent performance on the field, however evaluations with more days of experiment can provide results more interesting since the coffee seedlings achieve a higher growth at 180 days.

Keywords: Rooting vigor, Cloning process, Vegetative propagation.

Acknowledgments: CAPES, UFLA, INOVACAFÉ and INCT.

Plant Physiology and its Contributions to Society
IISIFV

Initial vegetative growth of arabica coffee cv. Catuaí IAC 144 submitted to foliar gibberellin inhibitor application

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The modulation of sink-source relations associated to gibberellin biosynthesis is a hotspot in scenario of plant physiology, mainly that related to seedling quality. The objective of this study was to verify if seedling quality of Arabica coffee is affected by gibberellin biosynthesis restriction induced by mepiquat chloride. The trial was conducted in a greenhouse, at Universidade Estadual do Sudoeste da Bahia (UESB), in December/2019 to April/2020. Seedlings of Arabica coffee cv. 'Catuaí Vermelho IAC 144', with one pair of developted leaves were organized in a experimental design constituted by completely random in a 5x4 factorial arrangement (five Sponsor® cummulative concentrations (0, 200, 400, 600 e 800 mg L^{-1}), with four replicates. The plant regulator was applied utilizing a CO_2 backpackspraying (200 L ha^{-1}). The evaluations were realized at 15, 30, 45 e 60 days after third application. Morphogological charachteristics, root volume (RV) and leaf gas exchage were measured and the data were submitted to variancy homogeneity test, normal distibution test, F test and variance analysis of regression ($R^2 \geq 50\%$), by means of SAEG 9.1 software. It was defined a linear tendency with decreases to relationship between stem lenght and restriction of gibberellin biosynthesis; a quadratic models was delineated to relationship beteween gibberellin biosynthesis and stem diameter, number of leaves, net photosynthesis rate and stomathal conductance. In the relation ship the SPAD index, there was a reduction of this parameter in the seedlings submitted to the gibberellin biosynthesis inhibitor in relation to the control, while the RV showed a beneficial increase in all treatments, with the highest RV being at 200 mg L^{-1}. The use of the growth pregulator in the range of 200 to 400 mg of ai L-1 provided greater efficiency, inhibiting the growth of the plant in height and redirecting these photoassimilates for the increase in the root volume, in addition, it provided a better active photosynthetic rate and stomatal conductance.

Keywords: *Coffea arabica*, growth regulator, Sponsor®

Acknowledgments: CNPq, LFV and UESB.

Plant Physiology and its Contributions to Society
IISIFV

Cloning of arabica coffee hybrid under application of antioxidant molecules and AIB

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The cloning of arabica coffee hybrid resistant in pest, disease, drought-tolerant and high yield potential can maximize arabica coffee production. However, coffee can show resistance to rooting, requiring the use of root stimulants. The indole butyric acid (IBA) favors rooting process, since it stimulates cell division and elongation. Ascorbic acid (AAC) and melatonin (MEL) acts as antioxidants for phenols in the presence of molecular oxygen after cutting the minicut. Thereby, the objective was to evaluate the rooting and quality of root using IBA, AAC and MEL in arabica coffee hybrids. The experiment was carried out in a greenhouse with 80% shade located in Plant Physiology sector of Universidade Federal de Lavras, MG. A randomized block design was adopted with 5 stimulant treatments (E1 = control, E2 = IBA 1000 ppm; E3 = AAC 80 ppm, E4 = E2 + E3 and E5 = MEL 1000 ppm) and four blocks and 12 piles per experimental plot, and 100 cm^3 tubes were used. The hybrid 19 from Empresa de Pesquisa Agropecuária de Minas Gerais (EPAMIG) was used. The substrate adopted was composed of substrate, micronutrients and washed sand. After 100 days of setting up the experiment, the following variables were collected: percentage of rooted cuttings (PRC), root volume (RV), root area (RA) and average root length (ARL). It was observed that the rooting occurred in all treatments, and there were no differences regarding PRC by the Scott Knott test at 5%. It could be seen that the RV and RA were lower when the hybrid was submitted to treatments E3 and E4. The ARL was higher when E2 treatment was applied. The application of melatonin and IBA did not influence the parameters analyzed in relation to the control treatment. The cuttings of hybrid 19 showed rooting capacity independent of the application of the treatments and therefore, it is concluded that the propagation per cut of this hybrid can be carried out without application of antioxidants and IBA.

Keywords: *Coffea arabica*, root quality, melatonin, ascorbic acid.

Acknowledgments: CONSÓRCIO PESQUISA CAFÉ, CAPES, UFLA, EPAMIG, INCT CAFÉ, FAPEMIG and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Flowering in cassava seedlings induced by gibberellin biosynthesis inhibitor

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The plant juvenility is associated to gibberellin biosynthesis that determine a physiological immaturity to reach a reproductive phase. The aim of this study is verified if a cassava flowering is affected by inhibition of gibberellin biosynthesis. The trial was conducted with mini-cuttings, BRS Novo Horizonte variety. After rooting, the plantlets were transplanted to polyethylene tubes, containing commercial substrate and maintained at greenhouse with 20% of light restriction. After eight days of transplanting, it was realized an immersion in aqueous solutions of paclobutrazol, an inhibitor of gibberellin biosynthesis, during one minute until reach substrate saturation. The trial was organized in a randomized block design, with four concentrations of paclobutrazol (50, 100, 150 e 200 mg i.a. L^{-1}; Cultar 250 SC) and a control plants, and four blocks. The experimental parcel was constituted by 20 tubes, and it was evaluated the percentage of plantlets with flowers, at 35 days after treatment. The data was submitted to variance homogeneity test, normal distribution test, F test and a variance analyze of regression (p=0.05). The relationship between flowering percentage and paclobutrazol concentration was defined by a quadratic model reaching a maximum value of 22.9% at 129.6 mg L^{-1}in comparison to control ones. The gibberellin biosynthesis inhibition and a stress conditioned by paclobutrazol were associated with a flowering, however, more evidences about mechanism that involves this plant regulator and cassava flowering must be clarified.

Keywords: plantlet, paclobutrazol, *Manihot esculenta* Crantz.

Acknowledgments: CAPES, UESB and LMPV.

Plant Physiology and its Contributions to Society IISIFV

Impact of levels of salts and sucrose on the content of carbohydrates and proteins in leaves of *Cattleya walqueriana*

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To overcome the reproductive challenges of the species, which has a high ornamental value with low germination in nature, it is extremely important to multiply the species *in vitro* to conserve native Cerrado species of the genus *Catlleya*. The objective was to evaluate the impact of the levels of salts and sucrose on the content of carbohydrates and protein in leaves of *Cattleya walkeriana* grown *in vitro*. For that, seeds of *C. walkeriana* were grown *in vitro* for 120 days, afterwards the seedlings were seeded and divided into different treatments with a completely randomized design (DIC). The treatments were tested with medium (Murashige and Skoog, 1962) and sucrose being: T1- MS100% / 30g; T2- MS100% / 15g T3 MS100% / 5g; T4 MS50% / 30g; T5 MS50% / 15g; T6 MS50% / 5g. All treatments contained 5 replicates / flasks containing four seedlings in each. The treatments were maintained in a growth room with PAR of 50 µmol m^{-2} s^{-1} of photons and photoperiod of 16h and temperature adjusted to 25 ± 3 C. Analyzes were performed after 120 days of cultivation. Evaluated after the content of protein, starch and reducing sugars (AR), sucrose and total soluble (AST). The highest total protein content was found in treatment T4, intermediate in treatments T1, T2 and T3 and lower for T5 and T6. Regarding carbohydrates, it was observed that for the AR content, the highest values were found in treatment T6 followed by T5. Intermediate and similar values were verified in treatments T3 and T4. Lower values were verified in treatments T2 and T1, the latter being the one with the lowest value. The sucrose content exhibited a behavior similar to that of RA, therefore, it was found that the highest values occurred in treatments T5 and T6, followed by T3 and T4, with the lowest values for treatments T1 and T2. In relation to AST, there was a separation into two groups, with treatments T3, T5 and T6 having the highest values of this variable. Based on the statistical data, we concluded that the starch content was higher and similar in the T5 and T6 treatments. Intermediate and similar values were verified in treatments T2 and T4. The lower values were verified in the T3 and T1 treatments, the last one having the lowest value. Therefore, it is noted that the treatments T5 and T6 with 50% of Salts and 15 and 5g of sucrose that provided plants with low aerial development, respectively accumulate more carbohydrates *in vitro*. However, they have less protein.

Keywords: Proteins, Carbohydrates, Species conservation.

Acknowledgments: CAPES, IF Goiano Campus – Rio Verde - Go, Prefeitura de Rio Verde – GO and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Peach carbohydrates variation during phenological cycles

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The physiological processes involved in the peach trees breaking dormancy can be related to several factors intrinsic and extrinsic to plants, among which the flow of carbohydrates and the translocation of reserves in a short distance. The carbohydrate storage is necessary to support the development of plants during periods of stress, dormancy, at the beginning of vegetative development and in the fruiting stage. The goal of the present study was to evaluate the carbohydrates concentration of 'BRS Rubimel' peach, grown in subtropical conditions, during the annual crop cycle. The experiment was carried out at São Paulo State University, Faculty of Agronomy at UNESP, in Botucatu/SP (22º51'55"S and 48º26'22"W, at an altitude of 740 m). The climate of the area is classified as Cwa, that is, humid subtropical climate (mesothermic). The two-year-old peach trees were cultivated at 6,0 x 4,0 m spacing. The experimental design was in randomized blocks with 4 plants per plot and 4 replications. The treatments corresponded to the times of leaves and branches samples were collected, during the phenological cycle, corresponding to the months of January, February, March, April, May, July, August, September, October, November and December. For the roots the samples were collected in January, April, August, November and December. The fruits were harvested in November at the concentration of production. Four fruits were collected per plant, when they reached the minimum content of soluble solids of 10º Brix. The results presented that the carbohydrates concentration varied in the different organs according to the evaluation cycle, and the starch concentrations in the roots were higher than the branches from August to December, highlighting the August month with the highest concentration. However, the concentration of starch in branches was higher than the roots in April. The carbohydrate most stored in the organs of peach 'BRS Rubimel' was starch.

Keywords: *Prunus persica* L. Bastch, phtoassimilates, starch.

Acknowledgments: CAPES and CNPq.

Plant Physiology and its Contributions to Society

Seed germination and shoot induction *in vitro* in *Tabebuia roseoalba* (Ridl.) Sandwith (Bignoniaceae)

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Tabebuia roseoalba (Bignoniaceae), popularly known as Ipê-branco, is a tree species that has medicinal potential and great ornamental value, being widely used in urban afforestation and for plant recomposition of degraded areas due to its exuberant flowering. In addition, this species is native from Cerrado, and its seeds present a low germination rate in natural environment. Thus, the objective of this study was to evaluate the percentage of seed germination and to establish a protocol for induction of *in vitro* shoots for *T. roseoalba* via direct organogenesis. For *in vitro* establishment, a germination test was performed with seeds without wings, disinfected, and inoculated in MS culture medium supplemented with different concentrations (0.5, 1, and 2 mg L^{-1}) of gibberellic acid (GA_3). To induce the shoots, the explants consisted of nodal segments containing a pair of axillary buds, without the leaves in MS culture medium supplemented with different cytokinins: 6-benzylaminopurine (BAP), kinetin (KIN), thidiazuron (TDZ), and isopentenyladenine (2iP); in concentrations 1.0, 2.0, 4.0, and 8.0 mg L^{-1}). For *in vitro* germination of *T. roseoalba*, the best results were found for the use of MS culture medium supplemented with 0.5 mg L^{-1} of GA_3, presenting a germination rate above 80%. Despite the low number of shoots, BAP was better than TDZ, KIN and 2iP for induction of shoots, regardless of the concentration used, providing a multiplication rate of 1.5 times. It was concluded that 0.5 mg L^{-1} of GA_3 can improve *T. roseoalba* germination *in vitro* and BAP can enhance its shoot multiplication rate.

Keywords: Conservation, Micropropagation, Ipê-branco, Cerrado.

Acknowledgments: CAPES, FAPEMIG, UFLA, UFSJ and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Essential oil of *Vanillosmopsis arborea* as a possible post emergence bioherbicide for *Oryza sativa* and *Senna occidentalis*

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Synthetic herbicides are generally used for weeding control. However, they can cause damage to the environment and human health. Therefore, the use of bioherbicides is an alternative for weeds control. They are composed by natural products from the secondary metabolism, which can affect the growth of target plants by modifying physiological processes, such as photosynthesis. *Vanillosmopsis arborea* Baker, commonly known as "Candeeiro", is an endemic plant that occurs in Chapada do Araripe, Crato-CE, Brazil. It has already been reported that essential oil has a potential in suppressing seed germination, although, its action is not known in the post-emergence. Preliminary studies with bioherbicides include the use of target species, such as *Oryza sativa* L. (rice) and *Senna occidentalis* (L.) Link ("mata pasto", an weed plant). This work aimed to evaluate the bioherbicide potential of *V. arborea* essential oil in the post-emergence of *S. occidentalis* and *O. sativa*. The essential oil of *V. arborea* was extracted from their wood through hydro-distillation in a Clevenger type apparatus, and subsequently diluted to a concentration of 0.5% with deionized water at 40ºC. The experiments for the two species were conducted independently in a greenhouse. It was used 2 treatments (essential oil of *V. arborea* and water as a control) with 7 replicates, and 2 plants in each replicate. The seeds were sown in pots containing soil and sand (2:1). It was sprayed 4mL for each treatment after 45 and 120 days of the emergence of rice seedlings and "mata pasto", respectively. The variables evaluated were photosynthetic rate and dry matter of the shoot and root. The photosynthetic rate of *S. occidentalis* plants were significantly affected by the essential oil of *V. arborea*, reducing about 88% of this parameter. However, for *O. sativa* the reduction in the photosynthetic rate (24%) was not significant. For dry mass of shoot and root, there was no significant difference in treatments for any of the target species. These results indicate that *V. arborea*'s essential oil may be efficient as a bioherbicide, since it affects the photosynthesis parameters of *S. occidentalis* plants. However, during the evaluation period, there is no significant reduction in dry mass of the observed plants. In that sense, it is required further studies to determine the effectiveness of this product as a bioherbicide.

Keywords: Allelopathy, photosynthesis, weed, "mata pasto", rice.

Acknowledgment: CAPES and UFLA.

Plant Physiology and its Contributions to Society
IISIFV

Seasonal variation of ecophysiological, biochemical and phytochemical attributes of *Garcinia brasiliensis* leaf extract

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The environmental stimuli received by plants may influence plant metabolism and can also redirect metabolic routes, affecting the production of plant secondary metabolites. The species *Garcinia brasiliensis* Mart. (Clusiaceae) has attracted the interest of science due to the production of compounds of pharmaceutical interest. Thus, the objective of this work was to identify the seasonal influence on the ecophysiological, biochemical and phytochemical parameters of leaves of *Garcinia brasiliensis*. Evaluations were carried out on six-year-old adult plants, with four replications, over four months (May, August, November and February) corresponding the middle of each of the four seasons. The evaluations were performed in the middle third of the canopy, in fully expanded leaves from the four cardinal points of the canopy. The photosynthetic rate, content of carbohydrates, proteins, phenolic compounds and the antioxidant activity of the methanolic extract of leaves of *G. brasiliensis* were evaluated. The photosynthetic rate and the production of primary metabolites were higher in November, the month with the highest rainfall, while the highest antioxidant activity of the methanolic extract and the content of phenolic compounds occurred in February, the month with the highest temperatures and radiation. The primary metabolism is accelerated in November, while the secondary metabolism in February was related to thermal stress due to high temperatures, which increased the amount of total phenolic compounds and the antioxidant capacity to eliminate excessive reactive oxygen species to copy with the stress conditions.

Keywords: Bacupari, photosynthesis, DPPH, phenolic compounds, primary and secondary metabolism.

Acknowledgments: CAPES (Financial Code 001), FAPEMIG, CNPq and UNIFAL-MG.

Plant Physiology and its Contributions to Society IISIFV

Coffea arabica rootstock compatibility for the production of *Meloidogyne paranaensis* resistant seedlings

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Bearing in mind that the area contaminated by *Meloidogyne paranaensis* has been increasing in the main coffee growing regions, and that it is an extremely harmful nematode to coffee farming, arises the need to investigate effective and low-cost techniques of immediate recommendation. Therefore, grafting techniques using resistant rootstocks can be an alternative for producing coffee seedlings to be implanted in infested areas. Facing that, the aim of this work is to evaluate the vegetative compatibility between the *M. paranaenses* resistant rootstock (Hibrid 28: Catuaí Vermelho x Amphillo 2-161) and a high economic value cultivar, though highly susceptible (Catuaí Vermelho IAC 144). The experiment was conducted in a greenhouse through a randomized block design of six grafting combinations, which were, non grafted Catuaí and genotype 28 seedlings (144 and 28), self-grafting of these materials (144/144 and 28/28), Catuaí grafting in genotype 28 and genotype 28 grafted in Catuaí (144/28 and 28/144) and 8 repetitions, each plot consisting of one plant per pot. The percentage of the seedlings' grafting success was calculated according to the number of successfully grafted seedlings. 350 days past the grafting process, the following morphological variables were evaluated: height (cm), stem diameter (mm), total leaf area (cm^2) and plagiotropic branches length (cm). Dry mass accumulation on aerial part and roots were also quantified. It was observed that all combinations presented grafting success percentages close to 100%, demonstrating no incompatibility symptoms regarding the evaluated growth parameters. No significant differences of leaves' fresh and dry mass were observed in all treatments. However, regarding stems' fresh and dry mass, the lowest values were found in non-grafted 144, self-grafted 144/144 and 144/28 grafted seedlings. In contrast, there were found no differences among the treatments regarding root's fresh mass, although the root's dry mass quantification showed that non grafted 28, self-grafted 28/28, 144/28 and 28/144 grafted seedlings presented the lowest values. It is concluded that there is a compatibility between Catuaí Vermelho IAC 144 and genotype 28, since the grafted seedlings followed the aerial part's growth pattern of their respective grafts.

Keywords: Coffee, grafting, galls nematodes, growth.

Acknowledgments: CONSÓRCIO PESQUISA CAFÉ, CAPES, UFLA, EPAMIG, INCT CAFÉ, FAPEMIG and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Gibberellin biosynthesis inhibitor of yellow passion fruit seedling quality

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The optimization of the propagation material of *Passiflora edulis* Sims. it is a growing demand aiming at the formation of more uniform orchards and, consequently, the increase in productivity. Restricting high levels of gibberellin biosynthesis induces the acclimatization of seedlings by directing the drain of photoassimilates to the roots, increasing tolerance to biotic and abiotic stresses. The objective of this study was verify if the gibberellin biosynthesis inhibitor can change the quality pattern of yellow passion fruit seedlings. The trial was conducted in greenhouse, with seedlings cultivated in poliethylene tubes containing a comercial substrate. At 54 days after seeding, the treatments were applied by means seedling imersion until reach to substrate level in aqueous solutions of a gibberellin biosynthesis inhibitor (paclobutrazole at concentrations of 0, 40, 80, 120 e 160 mg L^{-1}). The experimental radomly design was applied, with four replicates and 20 plots. Each plot was contituted by 54 seedlings, with four central ones utilized to evaluations. At 45 days after regulator applications it was evaluated the shoot/root ratio, Dickson Quality Index (DQI) and robustness index (RI). The data were submitted to F test and variance analysis of regression. The inhibition of gibberellin biosynthesis was associated to decreases of shoot/root index, higher DQI and decrease of RI. The restriction of gibberellin biosynthesis improved the shortened seedlings and, consequently, increased quality. By this way, the restrinction of gibberellin biosynthesis can modulate and optimize the propagation of passion fruit.

Keywords: *Passiflora edulis* Sims., Dickson quality index, growth regulator.

Acknowledgments: CNPq

Plant Physiology and its Contributions to Society IISIFV

Changes in physicochemical properties of starch during the growth of cassava plant

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Starch constitutes the carbohydrate reserve of many plants and is found in the leaves (chloroplasts) and in the reserve organelles (amyloplasts). It is a biopolymer composed of amylose and amylopectin, which are glucose units having different with repeating structures. Physicochemical properties of starches determine their suitability for certain end uses, with a relationship between the molecular structure of starch and its functional properties. The objective of this study was to evaluate the growth parameters of cassava plant together with the evaluation of the structural and physicochemical characteristics of starch obtained from cassava roots harvested at different plant growth periods (3, 5, 7, 9 and 11 months after planting). At each evaluation period, four plants per plot were collected, and they are evaluated for the number of roots per plant, length and diameter of roots, dry matter, starch and agriculture yield. Starches extracted from roots at each harvest time were analyzed for morphology X-ray pattern, crystallinity, phosphorus, amylose, resistant starch, pasting and thermal properties. All the production parameters of cassava plant increased during the first months of growth, with maximum yield, dry matter, and starch accumulation observed at 9 months after planting. Cassava starch showed different physicochemical properties during different growth periods. The shape of the starch granules did not change during the growth of the plant, with a unimodal distribution of granule size and increase in the mean diameter occurring at the end of tuberization. Amylose content and crystallinity decreased during plant development. The phosphorus content in cassava starch increased with plant growth, leading to in-creasing swelling power. The pulp properties showed that cassava starches extracted from plants at 7 or 11 MAP have lower stability to heat and agitation and higher syneresis, when compared with those obtained from plants at 9 MAP. Thus, results showed that the management practices for production of cassava optimizes industrial production of unmodified starches and that the time of harvest of cassava changes the physicochemical characteristics of the starches, and it is possible to obtain cassava starches with specific characteristics valued for industry application through the staggered harvest of plants between 270 and 330 days after planting.

Keywords: *Manihot esculenta*, vegetative cycle, starch, viscosity.

Acknowledgments: FAPESP and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Vegetative Propagation of *Pyrus Calleryana* roodstock by cutting

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The pear tree is a temperate fruit belonging to the genus *Pyrus* L., Rosaceae family. The pear tree seedlings are obtained mainly through the grafting technique and, above all, the use of rootstocks from seeds is employed, causing high variability among the plants and high vigor of the rootstocks, unlike the asexual propagation that ensures the maintenance of the genetic identity of the mother plant and reduction of vigor, allowing greater thickening of the orchard and ease in cultural treatments. In Brazil, the most used rootstock are *Pyrus calleryana* Dcne and *Pyrus betulaefolia* Bunge. Despite the advantages of using rootstocks propagated by stache, the rooting rates are still low. Thus, the aim of this study was to evaluate the rooting of *P. calleryana* cuttings submitted to different concentrations of rooting inducing growth regulator and two root growth promoting products. The experiment was conducted in the experimental orchard of the Federal University of Lavras, Minas Gerais, Brazil, located at 21º14'S, 45º00'W and 841 m altitude, Cwa climate. Woody cuttings approximately 15 centimeters long and 5-10 milimeters in diameter were collected in the winter from *P. calleryana* matrix plants with 7 years old. The experimental design adopted was the entirely randomized one, containing 10 treatments (witness, 7 concentrations of IndolButyric Acid -IBA-, Carbo and Radifarm) with 4 repetitions, with 20 cuttings per plot. The cuttings were planted in sand boxes under shaded roof and irrigated daily. The evaluations were carried out 120 days after planting. The mortality rate, percentage of chalky cuttings, rooting and number of roots per cut were evaluated. The cuttings submitted to concentrations of 500 and 750 ppm had the highest mortality rate (100%). Those submitted to 2000 ppm IBA and Carbo concentrations presented the lowest rate (73.5% and 56.3%, respectively). Regarding callus formation, cuttings submitted to 250, 500 and 750 ppm concentrations presented the lowest rates (33.8%, 30.3% and 5%, respectively). The cuttings submitted to a concentration of 1000 ppm of IBA and the witness had the highest rate of callus formation (74.8% and 80%, respectively). Regarding the rooting rate and the number of roots per cutting there was no difference between treatments. In view of the above, it is concluded that the treatments adopted are not satisfactory for the production of *P. Calleryana* rootstocks by piling from the collection of woody cuttings in winter.

Keywords: pear, rooting, asexual propagation, growth regulator, rooting promoters, winter.

Acknowledgments: CAPES, UFLA, FNDE, PET and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Could the essential oil of *Vanillosmopsis arborea* Baker inhibit germination and the initial growth about *Lactuca sativa* L.?

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Essential oils are produced by the secondary metabolism of plants, resulting from a mixture of metabolites. These products perform some functions in the environment capable of interfering in the germination and establishment of other species. This ability is called allelopathy. Towards safer methods for the environment, essential oils have been studied in the control of spontaneous species. The Candeeiro (*Vanillosmopsis arborea* Baker), an endemic species in the Chapada do Araripe, Crato, CE, Brazil, produces an essential oil that has been the focus of studies about the allelochemical potential of their constituents. Among the target plants of allelopathy studies, the *Lactuca sativa* L. is considered a model due to its rapid germination and its sensitivity to allelochemicals. Thus, the present work aimed to verify the capacity of *V. arborea* essential oil to inhibit the germination and growth of *L. sativa*. Seeds of *L. sativa* were obtained from commercial seeds, while the weed material was collected *in situ* in Chapada do Araripe. In order to extract the essential oil, the Candeeiro was submitted to a hydro-distillation process in a Clevenger apparatus. After that, it was diluted with deionized hot water (40ºC) at concentrations of 0.01, 0.0625, 0.125, 0.5, 0.75%. The solutions were used to moist the germination paper where the *L. sativa* seeds were sown. The Petri dishes contained the seeds were kept in a BOD Incubator (Bio-Oxygen Demand) at a temperature of 25°C and photoperiod of 12 hours. The biotest was conducted in six treatments (five oil concentrations plus the control) and five repetitions with 25 seeds each. The variables analyzed were Germination percentage (GP), Germination Speed Index (GSI) and size of roots and stem. All variables were significantly affected by treatments. The GP was inhibited with the increase in oil concentration, so that the treatment with 0.75% oil-concentration resulted in the most significant for reduction of germination. Similarly, the GSI was little affected by low concentrations (0.06 and 0.125%) while high concentrations (0.75%) influenced more negatively this variable. The highest concentrations (0.50 and 0.75%) also caused reduction in the stem and root of lettuce seedlings when compared to the control. Therefore, it should be concluded that the essential oil of the *V. arborea* tree is capable of inhibiting germination and initial growth of *L. sativa*, with 0.75% oil-concentration being the most effective treatment tested.

Keywords: Secondary metabolism, allelopathy, seed, seedling, candeeiro.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Sound frequencies as a sustainable alternative in weed control

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Weed resistance is recurrent in the evolutionary process. However, agricultural practices have enhanced these resistant biotypes through selection pressure, induced by the indiscriminate use of pesticides. The objective of the present work is to present a new approach for the effective control of these plants, using sound frequencies in seeds and plants in order to make them unfeasible. In the first experiment, seeds of the species *Bidens pilosa* and *Digitaria insularis* were cleaned with 50% sodium hypochlorite for 10 minutes, and exposed to treatment with a 300 Hertz sound frequency at different exposure times (zero, one and two hours). In the second experiment, only the species *Bidens pilosa* was used. The seeds were treated with a 300 hertz frequency in different times of exposure (zero or two hours) and, when the seedling formed, a new exposure was made to the 300 hertz frequency and exposure times (zero, one hour or two hours). The experiment was set up in 25 ml cups with soil. The design was completely randomized, in a 2x3 factorial scheme. The parameters of initial development and germination measured were: germination speed index, germination percentage, shoot and root length in the first experiment, and germination percentage, first pair of leaves, normal seedlings, shoot and root length in the second. Exposure in seeds for two hours influenced the root system in both species, however the response was divergent between them: while the species *Bidens pilosa* showed an increase in root length of 30.96%, the species *Digitaria insularis* had a decrease of 29.36%. This treatment also caused a decrease of up to 35% in the germination percentage and 36.63% in the germination speed index of the *Bidens pilosa* species. The initial treatment for two hours at a 300 hertz frequency associated with a new exposure for one hour at the seedling stage proved to be the most efficient in the control for the species *B. pilosa*, as it was the treatment that significantly reduced all the analyzed parameters, which corroborates the hypothesis that specific sound frequencies, at certain exposure times, may make part of these seeds unfeasible. In view of the results obtained, it is worth emphasizing the need for further studies in this area, since in initial experiments they showed great potential.

Keywords: Mechanosensitivity, Spontaneous plants, Agrochemicals.

Acknowledgments: UFSJ

Plant Physiology and its Contributions to Society IISIFV

Gibberellin biosynthesis inhibitor in pepper plants

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Peppers belong to the family Solanaceae, genus Capsicum are characterized agronomically as olerícola culture. They can be used as raw material for the food, pharmaceutical and cosmetic industries, as well as in ornamentation. For ornamental use, they should show some important morphological characteristics such as vivid foliage and small height. Paclobutrazol (PBZ) interferes with the mechanisms related to the action of giberelins, mainly by inhibiting plant growth. Thus, the objective of this study was to evaluate whether the effect of gibereline biosynthesis inhibitor affects gas exchange in ornamental plants of capsicum baccatum and capsicum annuum species. The trial was conducted at Universidade Estadual do Sudoeste da Bahia (UESB), Vitória da Conquista-BA. Seeds of cv. Chapéu de Bispo (*C. baccatum*) and Vulcão (C. *annuum*), were submitted to gibberellin biosynthesis inhibitor and organized in a completely randomized design, with a factorial skeme (2X4,) constituted by 4 PBZ concentrations (0; 25; 50 e 75 mg a.i.per plant). The application of the growth regulator PBZ was performed when the peppers reached between 10 and 15 cm in length, using the commercial product Cultar 250 SC® (250 g a.i. L -1 of paclobutrazol). It was evaluated the leaf net photosynthesis rate (A), transpiration rate (E), stomathal conductance (g_s), CO_2 internal concentration of leaf (Ci), leaf temperature, water use efficiency (A/E) and efficiency of carboxilation (A/Ci). Regression models were defined based on significance, by the "F" test at 5% and 1% probability. Pbz reduced gas exchange in peppers, being higher observed in the volcano species. It was observed that different concentrations of pbz resulted in reduction of the rates of liquid photosynthesis, leaf transpiration and stomatal conductance. Whereas for the concentration of 75 mg of PBZ causes water use efficiency (WUE) reduction, whereas 50 mg of PBZ causes transpiration reduction. The plants submitted to gibberellin biosynthesis inhibitor reduced the leaf gas exchange of *C. baccatum* cv. Chapéu de Bispo and *C. annuum* cv. Vulcão.

Keywords: Paclobutrazol, gas exchange, Growth.

Acknowledgments: UESB

Plant Physiology and its Contributions to Society IISIFV

Effect of effluent generated on the glass industry on *Ocimum basilicum L.* germination

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Water is one of the most consumed resources by agriculture. And in the Northeastern semi-arid, this fact becomes even more serious, as the rainy season is short and due to high temperatures, part of this water is lost through evaporation (BARROS et al., 2015). With this, a plausible alternative for better management of this resource, would be the use of industrial effluents, such as that of the glass industry, which uses water in various processes. This effluent can be used to grow vegetables such as basil (*Ocimum basilicum* L.), which is widely consumed in salads and as an ingredient in sauces and has antimicrobial and antioxidant activity. Given the importance of water reuse and the need to know if this effluent can be used for irrigation in vegetables, the objective of this work was to analyze the germination of basil seeds soaked with the effluent from the glass industry. Basil seeds were subjected to four treatments: T1 (distilled water); T2 (2% glyphosate); T3 (treated wastewater) and T4 (untreated wastewater). The experimental design was completely randomized, with 4 treatments and 4 repetitions. Each repetition consisted of 25 seeds, making a total of 100 seeds per treatment. Residual water from the glass industry was treated with aluminum sulfate and sodium hydroxide by collaborators of the Chemistry Laboratory at the same university. The variables analyzed were germination (%), average germination time, number of germinated seeds, root length, relative growth index, germination index and emergence speed index. The results obtained indicated that the treated effluent (T3) presented a efficiency similar to that of water (T1), regarding the number of seeds, average germination time, length of hypocotyl + radicle. It also promoted a result superior to the untreated effluent (T4), in relation to the relative growth index and germination index. The divergence in the results found in T3 and T4 may have occurred due to the difference between these effluents, where the treated effluent has less turbidity, less glass particles and neutral pH, while the untreated one has a pH between 12 and 13 (basic). Therefore, the treated effluent proved to be a viable alternative for the irrigation of basil, avoiding the disposal of this residual water, as well as increasing the availability of water for other activities.

Keywords: Industrial effluent, glass, germination, basil.

Acknowledgments: CNPq and UERN.

Plant Physiology and its Contributions to Society IISIFV

Development and selection of tomato genotypes F_2BC1 with processing characteristics and drought tolerant

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The species *Solanum pennellii* access LA 716 should serve as a genetic source of characters that confer drought tolerance, allowing to obtain more efficient cultivars in the use of natural resources. Thus, in order to obtain genotypes with a commercial pattern and tolerant to stress, it is necessary to cross the cultivated tomato with wild access, followed by backcrosses for *Solanum lycopersicum* and selections. The objective was to select tomato genotypes of the second generation of the first backcross (F_1BC_1) with characteristics for processing and drought tolerant. The hybrid F_1 Redenção × LA 716 was backcrosses with the parent Redenção, in order to obtain the population F_1BC1 [(Redenção × LA 716) × Redenção]. The second-generation genotypes of first backcrossing (F_2BC_1) were obtain from the self-fertilization of F_1BC_1 plants. From segregating populations, 60 genotypes were evaluated. Federer's augmented blocks experimental design was adopted, in which the controls (LA-716 and Redenção genotypes) are equivalent to the common treatments and the segregating genotypes to the regular treatments. The experiment was set up in a greenhouse with average temperature of 24.80 ^oC ± 0.78 and relative humidity averaged of 77.83% ± 0.98. Seedlings were transplanted to 10 dm^3 pots after presenting 4-5 defined leaves. The pots containing commercial substrate. The plants were irrigated equally until 15 days after transplanting. Since then, no more irrigation was provided. Leaf relative water content (RWC) was measured at 16 days after induction of water stress. The expression used was RWC = [(FW - DW)/(SW - DW)] x 100, where FW is the fresh weight, SW is the weight after hydrating the leaf discs in water for 24 hours and DW is the weight dry mass. Additionally, the wilt of the plants based on the leaf aspect was evaluated by rating scale: 5- 0% wilted leaves; 4- 0 to 30% wilted leaves; 3- $\geq$ 30% wilted leaves and all with green color; 2- $\geq$ 30% wilted leaves and with the beginning of drying; and 1- completely dry leaves. The genotypes F_2BC_1 were selected by principal component analysis (PCA). The Wilt and RWC characteristics were inversely proportional. In PCAthe genotypes were divided into four groups, highlighting IP16 and IP29, belonging to the same group as LA716. The LA 716 access has a high potential to donate genes for tolerance to water stress in tomatoes. The genotypes F_2BC_1 IP16 and IP29 are promising for advances in obtaining background lines for processing and drought tolerant.

Keywords: *Solanum lycopersicum*, *Solanum pennellii*, breeding, water stress.

Acknowledgments: CNPq.

Plant Physiology and its Contributions to Society

Growth of the aerial part and root of *Cattleya loddigesii* cultivated *in vitro* under different concentrations of sucrose and sealing systems

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The *in vitro* cultivation of orchids is an alternative for *ex situ* conservation, as well as the commercial production of seedlings. In this way, the ideal concentration of organic products used in the enrichment of the culture medium and the sealing of the flasks directly influence the success of *in vitro* propagation. The objective of this work was to evaluate the growth of the aerial part and roots in *Cattleya loddigesii*, under different concentrations of sucrose and flasks sealing systems. In this sense, seedlings of *C. loddigesii* germinated *in vitro* were inoculated in 30 mm^3 flasks, with 10 mL of MS basal medium, using 0,6% of agar as a gelling agent, combined with different sucrose concentrations (0, 5, 10, 15 or 20 g L^{-1}), without the addition of growth regulators. The flasks were sealed with polyethylene caps or cotton plugs (allows greater gas exchange). The orchids remained in a growth room under a 40 W fluorescent lamp, with quantified light at 30 µmol m^{-2} s^{-1} and a temperature of 25 °C. The explants remained incubated for a total of 60 days, with images captured, before and after 60 days of incubation, evaluations were performed using the ImageJ software. Different concentrations of sucrose in the culture medium did not significantly alter the growth of the aerial part, however, at the concentration of 5 g L^{-1}, the growth was greater in orchids grown in tubes with cotton plug. As for the roots, orchids grown in flasks with cotton lids showed greater growth compared to those grown in flasks with plastic plug, with the highest averages observed in concentrations of 5, 10 and 15 g L^{-1}. It is concluded that the root growth, essential organ for the success in the cultivation of orchids, was greater in flasks with cotton plugs in culture medium with 5 to 15 g L^{-1} of sucrose, being possible a decrease in the costs in the process of micropropagation of orchids, since traditional *in vitro* cultivation uses totally closed flasks and 30 g L^{-1} of sucrose.

Keywords: Micropropagation, Orchid, Nutrient medium, Energy source, Tube sealing.

Acknowledgments: IFSULDEMINAS - Campus Machado.

Plant Physiology and its Contributions to Society IISIFV

Gibberellin biosynthesis restriction of *Tabebuia roseoalba* seedlings

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The aim of this is study aimed to verify if the gibberellin biosynthesis inhibition of seedlings affect the morphohysiology of *Tabebuia roseoalba* (Ridl.) Sandwith at initial vegetative growth. Seedlings were planted in polyethylene tubes (180 cm^3) with a substrate composed by pinus bark and vermiculite and maintained at a greenhouse with 50% light restriction, at Universidade Estadual do Sudoeste da Bahia (Uesb). At 30 days after planting, it was applied the gibberellin biosynthesis inhibition treatment through imersion in an aquesous solution of paclobutrazole (PBZ, 0, 250, 500, 750 and 1000 mg L^{-1}). After treatment, seedlings were transplanted to pots (8 L), and arranged in a completely ramdomized design, constituted by five treatments and four replicates. At 30 days, after regulator application, the shoot morphology, water status and leaf gas exchange were evluated The data were submitted to homogeneity and normality test, F test and analyse of regression ($P \leq 0.05$), by means of SAEG software version 9.1. To plants submitted to gibberellin restriction, the shoot morphology, leaf stomathal conductance and water potential was the same to verified to control ones. Higher Spad index was verified only for plants submitted to major levels of gibberellin biosynthesis. The net photosynthesis was increased (46%) in plants submitted to 750 mgL^{-1} of paclobutrazol. The gibberellin biosynthesis restriction of *Tabebuia roseoalba* (Ridl.) Sandwith seedlings not cause alteration in shoot morphology at initial vegetative growth.

Keywords: Paclobutrazol, Regulator, *rustification*, leaf gas exchanges.

Acknowledgments: CAPES, FAPESB, LFV and UESB.

Plant Physiology and its Contributions to Society
IISIFV

Genotypic variation in photosynthetic capacity of sugarcane

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Sugarcane (*Saccharum* spp.) is one of the main alternatives for the bioenergy sector due to its great potential for phytomass production, being photosynthesis a key process related to conversion of the sunlight energy intercepted by the plants into phytomass. The aim of this study was to investigate the photosynthesis of nine sugarcane varieties launched between 1948 and 2006, as well as the species *Saccharum officinarum*, *S. spontaneum* and *S. robustum*. In plants grown under greenhouse conditions, CO_2 response curves of photosynthesis were performed and key photosynthetic traits and their heritabilities estimated. *In vitro* activities of ribulose-1,5- bisphosphate carboxylase/oxygenase (Rubisco) and phosphoenolpyruvate carboxylase (PEPC) were also evaluated. Although photosynthesis have varied significantly among the genotypes, there was no correlation between photosynthesis on leaf area basis and plant phytomass. On the other hand, photosynthesis was correlated positively with photosystem II operating efficiency, non photochemical quenching, stomatal conductance, and PEPC and Rubisco activities, which presented broad sense heritability varying from 0.74 (non-photochemical quenching) to 0.97 (photosynthesis). Overall, our results indicate that higher photosynthetic rates in sugarcane complex are due to high photochemical activity, low stomatal limitation and high carboxylation activity. This study revealed a significant natural genotypic variation in photosynthetic capacity, a pathway to be explored by breeding programs for increasing sugarcane yield.

Keywords: *Saccharum* spp., photosynthesis, yield, breeding.

Acknowledgements: CAPES, Fapesp and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Initial development of Jambu (*Spilanthes oleracea* L.) on low tunnel with colored shade screens and open field in Nova Mutum - MT, Brazil

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Jambu (*Spilanthes oleracea* L.) of the family Asteraceae, with outstanding ethnobotanical potential. The leaves and flowers are used for different categories of uses by man: food, medicinal, cosmetic and ornamental. In this sense, the objective of this work was to evaluate the initial development cycle of S. oleracea from cultivation in low tunnel using different screens and their interference in diameter, height and number of leave, in order to identify the interference of the use of low tunnel screens in these characteristics in Nova Mutum. The experimental design was a randomized block in a factorial ordered in subdivided plots, with six environments, with three replications. The environments used were: open field and five low tunnels covered with different screens, one red 35%, silver 35%, black 35%, white TNT with 15 g m² and 47 g m² organza. The environmental conditions of the experiment were analyzed in each environment. The analyzed variables were number of leaves (NF), stem length (CC) and stem diameter (DC) for 15 days after transplantation. Data were submitted to analysis of variance and regression analysis by AgroEstat and Tukey's test ($P<0.05$). As response variables, the influence of low tunnel screens in relation to height, leaf length was analyzed. The results showed that the variables analyzed did not show significantly different results between the different screens surveyed. In relation to were number of leaves (NF), stem length (CC) and stem diameter (DC) of S. oleracea from cultivation in low tunnel using different screens. These parameters did not show influence of the variation of the analyzed treatments. In our next studies it will be evaluated the total development cycle.

Keywords: (*Spilanthes oleracea* L.), Medicinal plants. Low Tunnel.

Acknowledgments: UNEMAT, CAPES and FAPEMAT.

Plant Physiology and its Contributions to Society IISIFV

Does molybdenum and cobalt foliar spray mitigate nitrogen deficiency?

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The passion fruit [*Passiflora edulis* Sims. f. *flavicarpa* Degener] is a fruit species that has high economic demand in the national and international scenario. Knowledge about the nutritional balance has become necessary to work around the limitations on the nutritional levels required during the formation of seedlings. The objective of this study was to evaluate the interaction between the mineral elements molybdenum (Mo) and cobalt (Co), essential and beneficial, respectively, applied via leaf, in seedlings of passion fruit cultivated and different availabilities of the mineral element nitrogen (N), using a nutrient solution. Our hypothesis tested the benefits (stress mitigate) of Mo and Co foliar spray under different N availability (N%) during the initial phenological stage of plant growth. The essential mineral elements were supplied with the Hoagland and Arnon nº 01 nutrient solution, which is deprived of NH_4^+. The treatments employed were N availability different (25%, 50%, and 100% N) combined with the absence/presence of Co and Mo spray. The experimental design used was completely randomized, with 06 treatments (17 replicates of 01 plant each per treatment). The data of plant growth (plant height, plant length, stem diameter, and leaf area) were subjected to analysis of variance (ANOVA) and of the treatment means were grouped by Scott-Knott method ($P<0.05$). From the results, Co and Mo spray reduced the discrepancies between the plant height and plant length under different N availabilities. These results can be associated with molybdo-flavoenzyme necessary to obtain the biological function required to plant development. Therefore, we conclude that the foliar application of Mo and Co combined under different N availability benefits plant growth during the initial phenological stage of plant growth of *P. edulis* in the seedlings nursery.

Keywords: Abiotic stress, Beneficial mineral elements, Essential mineral elements, Hydroponic, Passiflora, Plant nutrition.

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Plant Physiology and its Contributions to Society
IISIFV

Growth of *Passiflora cincinnata* seedlings under gibberellin biosynthesis inhibition

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An important factor that determine the high levels fruit production of *Passiflora cincinnata* Mast. is the quality of seedlings. The aim of this study was verify if the application of a gibberellin biosynthesis inhibitor affect the *P. cincinnata* Mast. seedling quality. The trial was conducted in a greenhouse with 50% of light restriciton, where the seedlings were maintained in poliethylene tubes and the propagation was done by seeds. At 30 days after seed emergence the gibberellin biosynthesis inhibitor was applied by means immersion in paclobutrazol aqueous solution, until reach substrate saturation. A randomly casualized design was defined constituted by four paclobutrazol concentration (commercial product Cultar 250 SC: 40, 80, 120 and 160 mg i.a. L^{-1}), and a treatment without application of gibberellin biosynthesis inhibitor, with 4 replicates. Length of stem and basal diameter was measured at 7, 21 and 35 days after treatment (DAT). The data was submitted to variance homogeneity and normal distribuition, F test and variance analysis of regressions (5% of probability). There was no effect of gibberellin biosynthesis inhibitor to stem length at 7 DAT and to diameter at 21 DAT. The stem length of seedling at 21 and 35 DAT decrease linearly as the concentration of gibberellin biosynthesis inhibitor increase. There was a tendency to linear reduction of basal diameter at 21 DAT, however, the main effect occured at 35 DAT, when was defined a quadratic model. Major diameter of plants submitted to paclobutrazol, in comparison to control ones, were verified up to 103 mg L^{-1}, however at higher concentrations there were reductions of this characteristic. The basal diameter increasing to the detriment of stem length is a desirable parameter to vigour and resistance of seedlings to field condition. By this way, the shoot growth of *P. cincinnata* Mast. is restricted by application of gibberellin biosynthesis inhibitor, characterizing the optimization of seedling quality.

Keywords: Gibberellin biosynthesis inhibition, *Passiflora cincinnata* Mast., paclobutrazol, growth regulator.

Acknowledgments: FAPESB, UESB and LFV.

Plant Physiology and its Contributions to Society
IISIFV

Impact of levels of salts and sucrose on growth and morphogenesis of *Cattleya walkeriana* grown *in vitro*

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The low efficiency in the propagation of orchids of the genus Cattleya puts these species at risk of extinction, since it generates a great extractivism of its natural environment, for illegal trade. In order to overcome these challenges faced by producers and, at the same time, conserve and preserve species of the genus *Cattleya*, the objective of this work was to develop a large-scale propagation protocol *in vitro* for the species *C. walkeriana*, varying the levels of sais and sucrose of the culture medium. To start this study, seeds of *C. walkeriana* were grown *in vitro* for 120 days, aiming to obtain seedlings with an aerial part of approximately 2 cm. Subsequently, the seedlings were grown in different treatments in a completely randomized design (DIC). The treatments were: T1- MS 100% / 30g of sucrose; T2- 100% MS / 15g sucrose; T3 MS100% / 5g sucrose; T4 MS50% / 30g sucrose; T5 MS50% / 15g sucrose; T6 MS50%. All treatments contained 5 repetitions, where each flask containing four seedlings was considered a repetition. The treatments were maintained in a growth room at an intensity of 50 µmol m^{-2} s^{-1} of photons and a photoperiod of 16h and temperature adjusted to 25 ± 3 °C. Analyzes were performed after 120 days of cultivation. The number of leaves and shoots, total fresh weight, length and diameter of the largest root and number of roots were evaluated. After analyzing the data it was found that for the number of leaves there were no differences between the different treatments. The total fresh weight was higher in the T1, T2 and T4 treatments, followed by the T3 and T5 treatments, thus leaving the lowest value for the T6 treatment. The number of shoots was higher only in the T6 treatments, the others showed similar values. The number of roots was higher in treatments T1, T2 and T4 in relation to the other treatments that did not differ from each other. The diameter of the largest root showed statistically similar values among all treatments. On the other hand, the length of the largest root suffered from the treatments, where the highest values for treatments T1 and T4 and the lowest for treatment T6 can be observed. In view of the above, it is concluded that the cultivation of *C. walkeriana in vitro* can be carried out according to treatments T2 and T4 without compromising its growth, considering that in these cultivation conditions, the seedlings showed values of total fresh mass and number roots similar to those of the control treatment, T1.

Key words: Growth, Development, Roots, Plant tissue culture, Plant Physiology.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Phenology and development of *Pavonia malacophylla* (Link & Otto) Garcke (Malvaceae) conditioned by the environment in an ecological reserve area in Minas Gerais, Brazil

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Plant development is greatly limited by the amount of sunlight available and is negatively influenced by herbivory. Shrubby plants with beautiful flowers and ornamental and invasive potential can be used in urban and rural areas to attract and maintain pollinators, an important focus nowadays due to pollinators decline. But these species can also compete in natural areas with originally established species and alter the community, using distinct places to grow. Considering this, our objective was to investigate whether phenology, damage caused by herbivores and morphological characteristics are modified by sun light intensity. We observed *Pavonia malacophylla* (Link & Otto) Garcke (Malvaceae), a native species common in an urban ecological reserve of Cerrado in Patrocínio city, Minas Gerais, from April 2008 to March 2019. The place presents hot-rainy summer (October-March) and cold-dry winter (April-September). We evaluated 30 adult plants, 15 from sunny and 15 from shaded areas. Our results indicate *P. malacophylla* is an evergreen species, with seasonal phenological pattern greatly influenced by rainfall with annual and regular flowering. The phenological events had similar presentation time, except for leaf fall and ripe fruit. Foliar herbivory was similar in both sunny and shaded plants, but floral herbivory was more intense and long lasting in sunny plants. Leaf spread occurs during all over the year, most intensely in sunny plants and during the rainy season. Ripe leaves are present throughout the year, as well as leaf herbivory. Just the plants from sunny areas had distinct leaf herbivory depending on the height of the canopy, with more damage on the upper extract than on the middle and lower extracts. In sunny and shaded areas floral buds, flowers and fruits had peak of development in winter. Fruit maturation was faster in sunny (July) than in shaded areas (August). *Pavonia malacophylla* presented larger stem diameter and number of branches in sunny plants, but the species proved to be tolerant to shade as it compensates for the lower solar intensity with greater leaf area and taller plants. We conclude that *P. malacophylla* can grow and thrives in different luminous incidences, indicating it can be used in urban ornamentation and in rural properties as its long flowering is interesting for the maintenance of floral visitors.

Keywords: Mauve, Cerrado, Brazilian savanna, shading, herbivory, temporal variation.

Acknowledgments: Fundação Comunitária, Cultural e Educacional, Patrocínio, MG, for permiting the use of the ecological reserve. The study received no funding.

Plant Physiology and its Contributions to Society

Germination of conditioned seeds of *Handroanthus heptaphyllus* in iron mining tailings

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Iron mining activities, despite being an important sector for the economy of Brazil, end up causing negative impacts such as the degradation of vegetation cover and the contamination of the surrounding areas with heavy metals. Techniques such as reforestation with native species aim to recover these areas, however germination and seedling establishment are the most sensitive stages of plant development, and the presence of heavy metals interferes with proper growth and development. The speed and uniformity of germination are desirable characteristics, and for this, physiological preconditioning techniques (priming) are widely used. Nitric oxide (NO) and hydrogen peroxide (H_2O_2) are molecules that participate in plant physiological processes, including germination and interact to alleviate the negative influence of abiotic stress, in this case by heavy metals. Thus, this work has the objective of evaluating the germinative aspects (accumulated germination and the germination speed index) of the seeds of *Handroanthus heptaphyllus*, in soil and in iron mining tailings from Brumadinho-MG, whose treatments are: control (without priming), H_2O, NO (200µM), H_2O_2 (100µM) and a combination of NO+H_2O_2 (in the same doses), containing 5 repetitions per treatment each with 20 seeds. The germination experiment were followed for 10 days. Regarding cumulative germination, the conditioning treatments in the soil showed a germination values above 85%, however in the tailings, the tratament with H_2O, H_2O_2, and NO+H_2O_2 showed values above 65% of germination, the control, and the NO was below 50%, for the germination speed index, the tailings treatments showed a lower speed compared to the soil, but the conditions provided a higher germination speed in the tailings in the H_2O and NO+H_2O_2 treatments. It was possible to observe that the tailings affected the germination of *H. heptaphyllus*. However, treatments with the interaction of NO and H_2O_2 managed to promote a percentage and speed of germination. NO and H_2O_2 are known molecules capable of inducing seed germination, even in stressful situations. Therefore, these priming treatments are efficient to promote the establishment of seedlings in environments contaminated by tailings from iron miners.

Keywords: Brumadinho, Hydrogen peroxide, Nitric oxide, Priming.

Acknowledgments: FAPEMIG, UFLA and LCDP.

Plant Physiology and its Contributions to Society IISIFV

Responses of photosystem II and I photochemistry in leaves of *Piper nigrum* L. (Piperaceae) to 6-benzylaminopurine during *in vitro* culture

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Techniques of *in vitro* culture allow the large-scale multiplication of several plant species with commercial value, such as *Piper nigrum* (known as black pepper). During *in vitro* culture, the employment of cytokinins may be necessary to optimize the induction of adventitious shoots. The 6-benzylaminopurine (BAP) is a synthetic cytokinins often used in micropropagation protocols; however, its exposure may alter the physiological status of shoots. The aim was to analyze the effects of BAP concentrations on the photosynthetic apparatus performance of *P. nigrum* during *in vitro* propagation. Previously *in-vitro*-established *P. nigrum* plants were transferred to Murashige and Skoog (MS) medium solidified with 6 g L^{-1} agar and containing 0, 5, 10, or 20 µM BAP. At 65 days of BAP exposure, chlorophyll *a* fluorescence was performed on 14 plants using a portable Handy-PEA fluorimeter. The resulting data were submitted to analysis of variance (ANOVA), and the averages were compared using the Scott-Knott test at 5 % probability level. All samples presented similar initial fluorescence (F_0) values (average of 726.3). Plants also showed alterations in the efficiency of the energy fluxes per cross-section (CS) as a function of BAP concentrations. Under BAP exposure, irrespective of its concentrations, plants presented a ~7% decrease in absorption (ABS/CS) and trapping (TR_0/CS), as well as a 15% reduction in energy transport flux (ET_0/CS), but no changes were observed in the energy dissipation flux (DI_0/CS). The parameters related to the quantum yield of primary photochemistry (φP_0) and the potential quantum efficiency (F_V/F_0) of photosystem II (PS II) did not show any differences among the treatments (averages of 0.7 and 2.6, respectively). The density of active reaction centers per CS (RC/CS) was also similar in all plants. Nevertheless, increments in the I-step fluorescence level (V_I) were verified under BAP exposure (3% higher). In contrast, a significant reduction of maximum fluorescence (F_M) was observed (6.2% lower) in plants cultured with BAP. These results can indicate declines in the efficiency/probability of electron movement from PSII to the photosystem I (PSI) acceptor side, as well as a decrease in PSI activity. The use of BAP can induce physiological disorders from the intersystem to the PSI (lower functionality) of *P. nigrum* plants during *in vitro* propagation.

Keywords: black pepper, chlorophyll *a* fluorescence, cytokinin, plant tissue culture.

Acknowledgments: CAPES and FAPES.

Poster Presentations

LINE OF RESEARCH | Plant-water relations

Net CO_2 assimilation rate of Intra and interspecific hybrids of tomatoes submitted to water deficit

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Crosses should be performed aiming at incorporating stress resistance genes in tomato plants. The objective was to exploring intra and interspecific hybrids of tomatoes for tolerance to water deficit, based on net CO_2 assimilation. The genotypes Santa Clara I 5300, Redenção (both *Solaum lycopercisum*), LA 716 (*Solanum penneellii*) and RVTC 66 (*Solanum lycopersicum* var. *Cersasiforme*) were used; and five hybrids F_1, Santa Clara × RVTC 66, Santa Clara × LA 716, Redenção × RVTC 66, Redenção × LA 716 and RVTC 66 × LA 716. A randomized block design was used, containing three replicates with six plants each. The experiment was set up in a greenhouse with average temperature of 24.80 ^oC ± 0.78 and relative humidity averaged of 77.83% ± 0.98. Seedlings were transplanted to 10 dm^3 pots after presenting 4-5 defined and fully expanded leaves. The pots containing commercial substrate based on bio-stabilized pine bark. The plants were irrigated without distinction until 25 days after transplanting, using micro-drippers. Since then, five levels of water supply were adopted, 0, 20, 40, 60, 80 and 100% (control) of the water requirement. In the condition of 100% supply, a maximum water tension in the soil of 25 kPa was adopted. Net CO_2 assimilation rate (A_{net}, µmol CO_2 m^{-2} s^{-1}) was determined after 15 days using a portable photosynthesis measurement system (IRGA, Infrared Gas Analyzer, Li-COR, LI6400XT), with 1000 µmol photons m^{-2} s^{-1}, 400 µmol mol^{-1} CO_2 and $\Delta CO_2 + \Delta H_2O$ less than 1%. With less water supply (0, 25 and 50% of the required water), access LA 716 has the highest Anet, followed by its progenies F_1 Redenção × LA 716 and RVTC 66 × LA 716. The LA 716 access has a high potential to donate genes for tolerance to water stress in tomatoes. The descendants of this wild access inherit characteristics of resistance to water stress.

Keywords: *Solanum lycopersicum*, *Solanum pennellii*, drought resistance, gas exchange.

Acknowledgments: CNPq and CAPES.

Plant Physiology and its Contributions to Society
IISIFV

Exploring the genetic variability of tomatoes for tolerance to water deficit

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Some genotypes of wild tomatoes have morphological characteristics such as size and density of stomata that confer tolerance to abiotic stresses. The objective was to identify, in the genetic variability of tomato, plants with greater tolerance to water deficit. Were evaluated seven wild tomato species genotypes were assessed namely: *S. pimpinellifolium* access AF 26970, *S. galapagense* access LA 1401, *S. peruvianum* access AF 19684, *S. chilense* acess LA 1967, *S. habrochaites* var. *hirsutum* access PI 127826, *S. habrochaites* var. *glabratum* access PI134417 and *S. pennellii* access LA 716; three *S. lycopersicum* var. *cerasiforme* genotypes, accesses RVTC 03, RVTC 20 and RVTC 66; four commercial lines *S. lycopersicum*, Santa Cruz Kada, Santa Clara I 5300, BRS Tospodoro and Redenção; and two commercial hybrids F_1, Giuliana and Milagros. The experiment was set up in a greenhouse with an average temperature of 24.80 ^{o}C ± 0.78 and relative humidity averaged of 77.83% ± 0.98. Seedlings were transplanted to 10 dm^3 pots after presenting 4-5 defined and fully expanded leaves. The pots contained commercial substrate based on bio-stabilized pine bark. A randomized block design was used, containing three replicates with eight plants each. The plants were irrigated without distinction until 28 days after transplanting, using micro-drippers to standardize the development of the plants. Since then, two levels of water supply were adopted, 50% (wat er stress) and 100% (control) of the water requirement. In the condition of 100% supply, a maximum water tension in the soil of 25 kPa was adopted. Net CO_2 assimilation rate (A_{net}, µmol CO_2 m^{-2} s^{-1}), transpiration rate (E_t, mmol H_2O m^{-2} s^{-1}) and stomatal conductance (gs, mol m^{-2} s^{-1}) were determined after 15 days using a portable photosynthesis measurement system (IRGA, Infrared Gas Analyzer, Li-COR, LI6400XT), with 1000 µmol photons m^{-2} s^{-1}, 400 µmol mol^{-1} CO_2 and $\Delta CO_2 + \Delta H_2O$ less than 1%. Water use efficiency [(WUE, µmol CO_2 (mmol H_2O)$^{-1}$] was estimated by the relationship between A_{net} and E_t. The genotypes Giuliana F_1, Milagros F_1, Santa Cruz Kada, Santa Clara and BRS Tospodoro were the most affected by the 50% reduction in water supply. LA 716 access when in the condition of 100% water supply was generally inferior to the other genotypes. However, when supplied only 50% of the required water had the highest A_{net} and WUE. The LA 716 access has a high potential to donate genes for tolerance to water stress in tomatoes.

Keywords: *Solanum lycopersicum*, *Solanum pennellii*, drought resistance, gas exchange.

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Plant Physiology and its Contributions to Society

Are drought tolerance and resistance related to carbohydrate remobilization in sugarcane?

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Brazil is the world's largest producer of sugarcane (*Saccharum* spp.), The first producer and exporter of sugar and the second largest producer and exporter of ethanol. However, the water deficit causes losses of up to 60% in production causing economic losses. Photosynthesis products are important for plant maintenance and growth. Therefore, this work aimed to evaluate the carbohydrate metabolism in two sugarcane varieties submitted to drought and to analyze its relationship with the strategies of tolerance and resistance to water stress. The experiment was conducted in a greenhouse, with two varieties of sugarcane (RB85 5536-drought sensitive and RB86 7515-drought tolerant) planted in 3.8 liter pots. After 91 of the planting, the seedlings were submitted to the following treatments: (i) irrigated and (ii) water deficit (WD), imposed with the suspension of irrigation for 8 days, followed by rehydration. Two collections were made, the first in the period of maximum stress (M), 8 days after water restriction and the second 4 days after rehydration. Growth analysis was carried out weekly, daytime CO_2 assimilation (*A*), water potential (ψ_w), water relative content (WRC) and determination of macromolecules (Total soluble sugars, reducing sugars, sucrose, starch and total protein) in M and in REC (recovered) in leaf, stem and root tissues. Water déficit maximum stress of the variety RB86 7515 had a larger stem diameter than the treatment with water deficiency in recovery, in addition to that it also presented a greater accumulation of dry mass in the root, less accumulation of starch, reducing sugars and glucose in the leaf and stem. The representative values of the water potential for maximum M and WD are -0.2 and – 0.1. These results suggest that the variety RB86 7515, was more tolerant to drought, than the variety RB85 5536 when submitted to water deficiency, because after its rehydration it presented better recovery.

Keywords: Water stress, tolerance strategies, biochemistry, *Saccharum* ssp., Photosynthesis.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Poster Presentations

LINE OF RESEARCH | Plants' Molecular Biology

In silico identification of ALMT genes of *Saccharum* spp

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The "Goiás" state is the second largest sugarcane producer in Brazil, and it is in "*cerrado*" biome, in which soils have high acidity and high availability of Al^{3+}. Therefore, there are huge costs regarding soil management and preparation in order to increase base saturation and pH, culminating with the unavailability of Al^{3+}. One of the mechanisms of plant tolerance to Al^{3+} is related to malate efflux proteins, which are encoded by the ALMT gene family (Al-activated malate transporters) in plants such as corn, sorghum, setaria and rice. The malate, when exudated, promotes the chelation of Al^{3+} ions and consequently forms stable complexes in rhizosphere. However, genes of ALMT family have not yet been identified in sugarcane (*Saccharum* spp). Therefore, we conducted an "*in silico*" study to identify genes of the ALMT family using a public sugarcane database, made available by CIRAD. Therefore, we searched for ALMT protein sequences of arabidopsis at UNIPROT. By using Arabidopsis protein sequences retrieved, we've used the Phytozome database to carry out a systematic search for orthologous genes of rice, sorghum, corn and setaria. Subsequently, we've used the sorghum proteins sequences to carry out a new search at CIRAD database and then we retrieved some sugarcane sequences. It was possible to retrieve 7 sugarcane gene sequences which, after alignment and construction of the phylogenetic tree, we've concluded to belong to the ALMT family.

Keywords: aluminum, tolerance, abiotic stress, membrane proteins.

Acknowledgments: CAPES, IF Goiano and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Understanding *Coffea arabica* terpenome in genome-wide coexpression modules

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Plant specialized metabolites play key roles in several physiological, developmental and evolutionary processes. Terpenoids represent the most abundant and structurally diverse plant specialized metabolites, known to be involved in plant chemical communication, defence and several other functions. Terpene synthases (TPS) and prenyl transferases (PT) form a unique set of enzymes (TERzymes) that are able to catalyze complex chemical reactions required for terpene biosynthesis. Currently, there is a lack of information about the regulatory mechanisms and correlations between these specialized metabolites at the omics level in coffee. We used the recently released *Coffea arabica* genome as a reference to perform a coexpression network analysis for 72 illumina RNA-Seq libraries from coffee leaves, fruits, roots, stems and seeds. We identified networks of gene modules whose expression patterns were highly correlated. A total of 4969 genes are in coexpression modules, which were distributed in eight modules (2860, 885, 683, 200, 171, 76, 48 and 46 genes). We identified two PT in two modules, and four TPS in three coexpression modules using the TERZYME prediction server. Prenyl transferases were identified in modules 1 and 2. We found two TPS-b (monoterpene synthases) and two TPS-a (sesquiterpene synthases). Module 1 have one TPS-b and one TPS-a, module 3 has one TPS-b, and module 5 has one TPS-a. The occurrence of TERzymes in our integrated omics-level coexpression modules provides novel insights into the potential regulatory mechanisms of terpenoids and prenyl transferases, and helps the identification of key genes for further studies on the molecular biology of specialized metabolism in coffee trees.

Keywords: gene coexpression, plant specialized metabolism, terpenoids, *Coffea arabica*.

Acknowledgments: FAPESP (2016/10896-0), CNPq and CAPES.

Poster Presentations

LINE OF RESEARCH | Production physiology

Influence of respiratory activity on the postharvest of 'Golden' papaya and 'Monterei' strawberry: comparison between a climacteric and a non-climacteric fruit

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Papaya is a climacteric respiratory pattern, and is an increase in the rate of respiration, accompanied by an autocalitic production of ethylene during the ripening process. The strawberry is a non-climacteric pattern and has a high respiratory rate, and must be harvested at the height of its ripening process, as it does not complete the ripening cycle after harvest. The objective was to explore the influence of respiratory activity on papaya and strawberry postharvest. 'Golden' papaya fruits were used in stage 0. The papayas were stored in a chamber with temperature control (25°C ± 1°C) and relative humidity (85% ± 5%), the 'Monterei' strawberry fruits in three ripening stages: green, intermediate and ripe were obtained from a producer in the region of Santa Maria de Jetibá (ES) and stored at (2°C ± 1°C). The firmness was determined by means of resistance to penetration with a texturometer, titratable acidity (TA) by titration with 0.1N NaOH and the content of ascorbic acid (AA) by titulometry. Mitochondria isolated by differential and sequential centrifugations were used to measure respiration using O_2 consumption using the polarographic method, the evaluations were carried out at three stages of ripening. Papaya fruits showed a firmness of 15.2; 7.4; 5.3N and 0.07%, 0.06% and 0.02% citric acid, AA content varied from 37.5, 101.5 and 183.3 mg.100g.PF^{-1}in the green, intermediate and mature, respectively. The participation of the breathing pathways cytochrome c oxidase (COX) and alternative oxidase (AOX) showed that in the green stadium most of the consumption of O_2 was related to the activity of COX, with AOX having little participation. During the ripening process it was noticed an increase in the share of AOX in the ripe fruits in relation to the green and intermediate fruits. Strawberry pseudofruits in the green, intermediate and ripe stages, respectively, showed firmness of 3.8, 2.8 and 1.1N and AT of 25.4%, 22.1% and 13.4% citric acid, the content AA ranged from 0.8, 1.6 and 1.7 mg.100g.PF^{-1}. The highest consumption of O_2 was found in green papaya fruits due to COX action, while AOX activity is low. Mitochondria isolated from papaya showed an increase in the share of AOX in ripe fruits. Papaya fruits had a higher AA content and lower TA in the ripe stage, the same occurred with strawberries. Strawberry mitochondria have a greater share of the AOX pathway in intermediate fruits.

Keywords: Isolated mitochondria, COX, AOX, ripening process.

Acknowledgments: UENF, FAPERJ, LMGV and Plant Physiology.

Plant Physiology and its Contributions to Society IISIFV

Partition of biomass and harvest index of vegetable soybean genotypes

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Vegetable soybeans, or edamame, are common soybeans with special characteristics, such as sweet taste and higher content of vitamins and proteins, with the beans harvested still green. Currently, there are several cultivars developed by Embrapa Soja, which are being studied in various regions of the country. Vegetable soybean presents itself as an alternative for the diversification of agriculture in small farms in the Recôncavo of Bahia region, including the possibility of being a substitute for the tobacco crop, which for many years has sustained family farming in that region. Thus, it is important to study the potential of different genotypes of vegetable soybean and their ability to adapt to the agroclimatic conditions of other regions different that of their origin. For this reason, the objective of this work was to evaluate the dry biomass partition and the ability to transform dry matter into grains, through the harvest index, by four vegetable soybean genotypes grown in the Recôncavo of Bahia. The study was carried out in the experimental field of the Center for Agricultural, Environmental and Biological Sciences of the Federal University of Recôncavo of Bahia. The experiment followed a randomized block design with four genotypes (JLM 17, BR 94, BRS 267 and BRS 258) and seven replications. The collection of material for assessment of dry biomass partition started 21 days after emergency, in fifteen-day intervals, until harvest of vegetable soy (stage R6). The harvest index was determined by the relation between the accumulated mass of fresh matter or biological product from the last collection to the productivity of immature grains or economic production. The data were submitted to joint variance analysis and the means compared by the Tukey test at 5% probability. In the first year, genotypes BR 94 and BRS 267 had the highest values of harvest index. In the second year, BRS 267 had the highest harvest index, indicating that it was the most efficient, in converting synthesized products into an economic product, in the edaphoclimatic conditions of the Recôncavo of Bahia. At 63 days after emergence, the genotypes BR 94 and BRS 267, in the two agricultural years, showed superiority in the accumulation of dry matter of pods in relation to the others, which gives a greater precocity to these genotypes. In the conditions of the Recôncavo of Bahia, the BRS 267 and the BR 94 genotypes can be indicated as the most adapted.

Keywords: adaptation, dry matter, edamame, yield.

Acknowledgments: UFRB, CCAAB, Embrapa Soja and MaPENeo.

Plant Physiology and its Contributions to Society IISIFV

Stresscan – Building a system for monitoring plant leaf temperature

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Plants are complex organisms with behavior and dynamic responses, that interact with environment all the time. For a better understanding of plant physiology and your application in agriculture it is necessary to study more deeply plant physiological time series data. Data on climatic variables, soil and plants being sent continuously at regular time intervals can possible form large time series databases. Recent academic discoveries show that it is essential for agricultural management connection systems with low cost sensors and microprocessors, capable of measuring not only specific points but also patterns or signatures of each collected variable. Thus, decision making is supported by real-time data, making the use of resources more efficient. The objective of this work was to create a system of physiological monitoring of plants, formed by a station of sensors that communicate with the user through a digital platform. The experiment has been carried out at an experimental unit in Conchal - SP, in February 2018. An area of 2 square meters, with soybean plants between the v4 and v5 stadiums, was monitored by 2 sensor stations for 28 days. The soybean plants showed no signs of any nutritional stress, and the measured soil moisture was 80% during data collection. Data was collected on temperature and humidity of air and soil and leaf temperature of plants where we used an infrared temperature sensor. According to research, leaf temperature is a reliable indicator of stress in plants, so it was used as a physiological reference of the plant. The sensor station was developed using measurement technology based on the Atmega® system and a processing system coupled to a computer system. The transmission of data from the station was done via 3G internet and the power supply of the station was made by a solar photovoltaic plate. The system allows to farmers make decisions about irrigation or in case of hydroponic grows, management of water temperature. The results showed that sensors station are capable to collect and send the data to the cloud, where it was stored and analyzed. The measurement of leaf temperature data over the 28-day period shows the power of this data in revealing a pattern of variation in leaf temperature in response to the environment. The measurement of time series of leaf temperature data in plants can be a diagnostic tool for stress, thus providing an important tool for the efficient management of resources in agriculture.

Keywords: Agriculture, plant stress, sensors, internet of things.

Acknowledgments: FAPESP.

Plant Physiology and its Contributions to Society IISIFV

Growth and production of inoculated and non-inoculated soybeans under different magnesium doses

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Soybean is one of the most important Brazilian commodities, and probably the most important source of vegetable protein, which gives it global relevance, and is grown worldwide. Nutrient availability is one of the restrictions to soybean cultivation, with Mg deficiency being a common mineral problem in tropical and subtropical soils, as in Brazil. Therefore, in the present study, we evaluated the effects of different doses of Mg on the growth and nodulation of soybean plants inoculated and not inoculated with bacteria of the genus *Rizhobium*. Seeds of cultivar Monsoy 6410IPRO were sown, and half of the seeds were inoculated with 1 mL per seed of *rhizobium* strain BR 29/SEMIA5019 and the other half was not inoculated. Plants with 35 day old were submitted to treatments: 0, 1.7 and 3.4 mM of magnesium, totaling 6 treatments (6 plants per treatment). The experiment was carried out until production and the number of nodules, number of green beans, number of grains, leaf dry weight, root dry weight, stem dry weight and total leaf area were analyzed. The number of nodules was significantly lower in non-inoculated plants, however, nodulation was not affected by magnesium concentrations. Nodulation affects the absorption of nitrogen by the plant, that is, the more active nodules, the greater the amount of nitrogen acquired by the plant. As nitrogen is an essential nutrient that is present in amino acids, proteins, enzymes and in chlorophyll, the growth and development of soybeans can be affected by its lower absorption. Thus, a lower leaves dry weight and stem dry weight was observed in plants not inoculated under 0 mM of magnesium. A smaller total leaf area and root dry weight were observed in plants not inoculated under 0 mM magnesium and inoculated under 0 mM and 1.7 mM magnesium. However, the production of green beans and number of grains was significantly negatively affected only in plants not inoculated under 0 mM of magnesium. It is concluded with this work that the interaction between non-nodulation and magnesium deficiency negatively affects the production of soybean plants, and an important point to be taken into account is that if the plant is properly nourished or supplemented with magnesium, the lack of nodulation does not affects the production negatively.

Keywords: Mineral nutrition, nodulation, magnesium deficiency, *Glycine Max,* field crops.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Plant Physiology and its Contributions to Society

Physiological responses, nutritional status, and grain yield of cowpea under cropping systems

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Leguminosae are an important plant family for food security and reduction of poverty around the globe. In this sense, cowpea (*Vigna unguiculata* (L.) Walp.) is one of the most important Leguminosae to provide protein in Brazil, especially in North and Northeast regions. Traditional soil preparation used in producers' areas of cowpea in Brazil negatively affects chemical and physical attributes of the soil. For this reason, farmers have been adopting conservationist and sustainable approaches, such as no-tillage farming. Moreover, liming is not a routine practice in this areas even though a stimulating plant growth and roots development. Because of this we decided to evaluate physiological parameters, nutritional leaf content and grain yield of cowpea under two cropping systems (tillage or no-tillage) and without or with liming (1 ton ha^{-1}), arranged in a 2x2 factorial scheme, with four blocks, in a randomized block design. The experiment was developed at the experimental field of the Universidade Federal do Tocantins, Gurupi *campus*, using BRS Novaera cultivar during 2018 off-season period, in a Dystrophic Yellow Oxisol, under irrigation. We evaluated here (*i*) physiological parameters: internal CO_2 concentration (C_i), transpiration (E), stomatal conductance (g_s) and net CO_2 assimilation (A); (*ii*) nutritional traits: foliar contents of N, P, K, Ca, and Mg; and (*iii*) grain yield. The statistical analysis was performed using the ExpDes.pt package of R software. The g_s, C_i, and E were higher in no-tillage treatment, while A was higher without liming. The physiological parameters values are close to those obtained in other studies with cowpea. Levels of Ca and Mg was higher in no-tillage treatment, whereas P was increased in treatment with liming. Nutritional contents are within the range previously reported by other studies. Regarding grain yield, there was interaction between soil correction and cropping systems, which were better in no-tillage farming without liming. Cowpea grain yield was the expected to this crop regardless treatments. The no-tillage system provides an increase in gas exchange, leaf nutritional contents and grain yield. The liming increases foliar P content with no changes in cowpea yield.

Keywords: *Vigna unguiculata* (L.) Walp., Cerrado, gas exchange, soil correction.

Acknowledgments: CAPES, IFTO and UFT.

Plant Physiology and its Contributions to Society IISIFV

Altitude effects on yield components of diploid potato (*Solanum tuberosum*, Phureja Group) cultivars in Colombia

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Colombia has the greatest diversity of diploid potato genotypes from the Phureja Group, which are grown along a wide altitudinal range. The objective of the present study was to assess the impact of contrasting altitudinal environments in the Colombian highlands where potato is cultivated, upon yield components of several improved potato cultivars belonging to the Phureja Group. Trials took place in the Sumapaz province in Cundinamarca (Colombia). The experiment was set under a complete two-factor arrangement in generalized blocks design; The first factor evaluated was cultivar, with 5 levels corresponding to c.v. Criolla Colombia, Criolla Dorada, Criolla Ocarina, Paola and Violeta; The second factor was the location, with 3 levels according to their altitude: High (3200 m.a.s.l), intermediate (2700 m.a.s.l) and low (2300 m.a.s.l). The experimental plots where set simultaneously and nearby locations, managed under equal agronomic settings. Yield components evaluated included; total yield, percentage of first and second category tubers and the number of tubers per plant. Significant statistical effects were found among the independent factors as well as the interaction cultivar and location. Higher altitude resulted in higher proportions of bigger tubers and higher yields among all cultivars. Low altitude locations resulted in limitation to yield for c.v Criolla Ocarina, Paola y Violeta, while high and middle altitude favoured yield in all cultivars. The cultivars which showed less variability in response to the location where Criolla Colombia y Criolla Dorada, where the latest cultivar showed the most stable response and the greatest potential for production, of less but bigger tubers among all altitudes. In contrast, Criolla Ocarina was produced a greater amount of tubers with more homogenous size distribution. Paola is a promising cultivar for industrial use due to its morphotype, and together with Violeta they achieved the highest yield on both high and intermediate locations, and on all locations produced a greater amount of large-sized tubers. Ambient temperature is one of the main inducing factors that regulates the tuberization process in potatoes. The observed temperature differences by altitude (Average temperature. Low: 10.1°C; Middle: 13.1° C; High: 15.5°C), allows to concluded that it's a factor to take into account when establishing diploid potato crops (Group Phureja), as it directly influences productivity, with a differential response per cultivar.

Keywords: Altitudinal gradient, ambient temperature, genotype-environment interaction, improved cultivars.

Acknowledgments: Universidad Nacional de Colombia, Sede Bogotá.

Plant Physiology and its Contributions to Society

Aqueous extract of *Leucaena leucocephala* decreases the germinative capacity of seeds of *Handroanthus albus*

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In the leaves and fruits of *Leucaena leucocephala*, an exotic tree with potential for invasion in Brazil, a non-protein amino acid is found that has the potential to influence the germination of native species, the mimosina. The objective of this work was to study the allelopathic effect of fruit extract with *Leucaena leucocephala* seeds on the germination of *Handroanthus albus* seeds. *L. leucocephala* fruits were collected for the production of aqueous extract and these diluted in distilled water to obtain five treatments, comprising the control group (0% of the extract), 25%, 50%, 75% and 100% that were applied to *H. albus* seeds after being sown in expanded polystyrene trays, filled with peat based substrate. At the end of the test, the percentage, speed, average time, relative frequency and germination synchronization were calculated. The data were submitted to regression analysis and adjusted to the level of 5% probability. The germination percentage decreased due to the increase in the concentration of the applied extracts, following the equation "y = -0.252x + 58.3 R^2 =0.71" proposed by the regression analysis, the germination speed decreased due to the increase in the concentration of the applied extracts, following the equation "y = -0.1984x + 42.7 R^2 =0.63 " proposed by the regression analysis, the average germination time increased due to the increase in the concentration of the applied extracts, following the equation "y = -0.0085x + 9.95 R^2=0.42" proposed by the regression analysis, while the index synchronization did not change due to the treatments applied. The relative frequency of germination presented polymodal behavior for all treatments. Based on the conditions in which the experiment was conducted, it was concluded that the aqueous extract of fruits of *L. leucocephala*, negatively influences the emergence of *Handroanthus albus*.

Keywords: Mimosin, allelochemical, allelopathy, invasive plant, biological invasion.

Acknowledgments: UNOESTE.

Plant Physiology and its Contributions to Society IISIFV

Optimal harvest stage of banana cultivars according with physiological maturity

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Banana is a typical climacteric fruit with rapid deterioration, which reinforces the importance of being harvested at an appropriate maturity. There is a general agreement that bananas must be harvested while they are still green and unripe. However, the criteria for harvesting bananas in Brazil can be quite subjective, since the particularities of each cultivar are not been taken into further consideration. Quality attributes of fruits such as pH, titratable acidity, soluble solids, maturity indices, firmness, skin colour and sugar content should support choosing the choice of the most appropriate stage to harvest bananas. Therefore, this study aimed to identify the optimal harvest stage of different cultivars according to five fruit diameters. The experiment was carried out at experimental farm (FCA/UNESP) located at 22º44'28" S, 48º34'37" W at an altitude of 740 m. All fruits were harvested in grade 1 (E1) of the green skin colour in the respective diameters. Afterwards, they were taken to the fruit culture laboratory, where they remained under room temperature and relative humidity (± 21-23ºC and ± 55-65% RH), until reaching the grade 6 (E6) of yellow skin colour. Through a randomized block design with 4 replicates, the following variables were evaluated: pH, titratable acidity, soluble solids, maturity index, firmness, fruit peel colour and sugar content on the cultivars Prata-Anã, Maçã, FHIA 18, Grand Naine and Nanicão IAC 2001. Fruits from the second bunch of banana bundle were harvested when they reached the diameters of 32, 34, 36, 38 and 40 mm. A significant interaction occurred between cultivars and fruit diameters at harvest for all measured variables, that way each cultivar presented singularity with regards to the evaluated variables, according to fruit diameter at harvest. By considering the quality parameters, the fruits of 'FHIA 18' should be with 34, 36 or 38 mm in diameters at harvest. 'Grand Naine' should be with 38 or 40 mm in diameters at harvest, because of the high maturity indices observed. 'Maçã' and 'Nanicão IAC 2001' should be with 38 mm in diameter at harvest, due to the high sugar content and adequate maturity indices in 'Macã' and high soluble solids contents and maturity indices in 'Nanicão IAC 2001'. The fruits of 'Prata-anã' should be harvested with 34 or 36 mm in diameters at harvest to obtain high contents of sugar, soluble solids and maturity indices in ripe fruits.

Keywords: *Musa* spp, physicochemical quality, fruit diameter.

Acknowledgments: CAPES and CNPq.

Plant Physiology and its Contributions to Society
IISIFV

Physical-chemical characterization of Sour Orange (*Citrus aurantium* L.) accessions

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Brazil is the world's largest producer of oranges and the largest exporter of orange juice. However, few varieties of this fruit concentrate almost all of the country's production. Sour orange is part of the Brazilian culture and culinary, due to its traditional use in the homemade production of sweets and in the preparation of teas with medicinal properties. It is commonly found in domestic orchards in several regions of the country, however, it is a species which needs further studies and explored commercially, because it has a potential for use. Thus, this study aimed to evaluate the physical and chemical characteristics of fruits from three accessions of *Citrus aurantium* L. in the central region of Minas Gerais. The fruits were obtained from domestic orchards in the cities of Sete Lagoas-MG, Paraopeba-MG and Curvelo-MG and the chosen plants were nominated access 1, 2 and 3 respectively. The accessions were obtained via seminiferous propagation and had an average of 3.5 meters in height, without any type of cultural treatment. The physical analyzes included: longitudinal (LD) and transversal (TD) diameters, fruit mass, number of seeds and orange segment, flavedo, albedo and pulp yield, fruit format (LD/TD), albedo thickness, flavedo color and pulp color. Chemical analyzes included, total titratable acidity (TTA), soluble solids (SS), pH, ratio SS/TTA. A completely randomized design with three treatments, four replications and five fruits per experimental unit was used. The data obtained were subjected to analysis of variance and comparison of means by the Tukey test ($p < 0.05$). Regarding the physical parameters, it was possible to observe a significant difference between accessions for: fruit mass, flavedo yield, transversal diameter, fruit format and number of seeds, in which access 3 stood out with the highest averages, with 226.75g, 30.25%, 77.00 mm, 0.96 LD/TD and 23 seeds/fruit respectively. According to chemical parameters, there was no significant difference between the accessions, whose results showed low acidity, on average 0.12% citric acid for the three accessions, and an SS content average of 10.16 ^{o}Brix and ratio SS/TTA 86.33 with values similar to commercial varieties. With these results it was possible to obtain a parameter of final quality of the fruits and conclude that there was variability between the accessions of sour orange and this variability allows a versatility of use and enjoyment of the fruits.

Keywords: Seville orange, albedo, fruit processing, fruit growing, brix.

Acknowledgments: UFSJ, UFLA and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Morpho-physiological, nutritional, and agronomic characterization of wheat cultivars with different cycles in the Cerrado conditions

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Common wheat (*Triticum aestivum* L.) is an important annual crop, being one of the world's three most-produced cereal. Currently, Brazil produces less than half of demanded wheat quantity for internal consumption, hence depending on the importation of this commodity. The first step to increase wheat production in Brazil is testing and characterizing cultivars in different growth conditions, and here we characterized wheat cultivars by morpho-physiological, nutritional, and agronomic approaches in an edaphoclimatic condition of Cerrado. The study was conducted at Universidade Federal do Tocantins, Gurupi *campus*, with wheat cultivars presenting different life cycles (BRS254 and BRS394 with short cycle (SC) and Mestre and Sintonia with medium cycle (MC)), grown in pots (ten replicates) containing Red Yellow Oxisol, during 2018-2019 crop season. We evaluated 41 (*i*) morpho-physiological, (*ii*) nutritional, and (*iii*) agronomic traits. Statistical analysis was performed using the R software, ggplot2 package, for principal component analysis (PCA), and ExpDes package, for descriptive statistics. PCA outputs for all traits delineated two major groups, which together explained over 50% of the total variation. The main factors to influence such variability was cultivar and their cycle type. The groups comprised 16 traits, being 6 for SC plants and 10 for MC. Higher values of ear length (EL), N utilization efficiency, stomatal conductance (g_s), and transpiration (E) at reproductive stage, Zn in grains, and grains per ear (GE) were presented in SC plants; while root length and dry mass, root:shoot ratio, shoot dry mass, number of tillers (NT), internal CO_2 concentration (C_i), net CO_2 assimilation (A), g_s, and E at vegetative stage, and water use efficiency at reproductive stage, were higher in MC plants. Regarding grain yield, there is no difference between cultivars despite the contrasting responses in the agronomic traits that compose this important trait, as EL, GE, NT, and thousand grain mass. Most of the nutritional variation is not related to the cycle type, being an intrinsic trait of each cultivar in response to the environment. On the other hand, alterations in carbon partitioning justify the difference in cultivars that are not detected in grain yield. These responses suggest that there may be adverse ways to compensate differences in light demand (day degrees) in these cultivars, maintaining similar fitting and yield under Cerrado environmental conditions.

Keywords: *Triticum aestivum* L., Cerrado, crop cycle, gas exchange, nutritional status.

Acknowledgments: CAPES and UFT.

Poster Presentations

LINE OF RESEARCH | Seed physiology

Germination and antioxidant enzymes activity in seeds of sunflower (*Helianthus annus*) stored under different oxygen availability

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The storage conditions of seeds is a suitable practice to avoid damage and to preserve their integrity after harvest. Different ways to grant their quality and vigor are used nowadays, but humidity, temperature and oxygen are highly controlled in all of them. Aiming to preserve low metabolic activities, this technique prevent the seed germination and damages caused by a high ROS formation during the respiratory metabolism. The aim of this work was to evaluate the effects of different oxygen availability in the storage of sunflower seeds. Fresh and previously stored *Helianthus annuus* (sunflower) seeds were subjected to storage under normal oxygen conditions and anoxia during 120 days. Germination, viability (with tetrazolium salt test), enzymatic antioxidant system and the content of H_2O_2 and MDA (malondialdehyde, an extension of lipid peroxidation) were evaluated each 60 days. Germination was severely affected along the experiment, lower rates of germination are exhibited at 60 and 120 days after the beginning of the experiment. At the initial analyzes, seed germination is greater than 60% in all conditions but this rate decrease, above all, in the seeds stored under anoxia. Germination of seeds that are previously stored showed the lowest germination, these seeds decreased up to 40% at 60 and 120 days in comparison to initial germination evaluation. Although tetrazolium test showed that seeds under all conditions are physiologically viable, they did not show high physiological commitment that indicate unfeasibility. The levels of MDA increased after storage of 120 days while H_2O_2 levels did not change with storage. The enzymatic activity changed along the experiment, superoxide dismutase (SOD) activity increased at 60 days of storage under normal oxygen conditions, while catalase (CAT) increasing occured at 120 days. These results demonstrate that even seeds stored at lower oxygen conditions, a condition where metabolism are maintained at lower levels, can keep the ROS generation, causing several damages and leading to lower germination.

Keywords: Anoxia, hypoxia, ROS, oxidative stress, seed deterioration.

Acknowledgments: CAPES, UFLA and LCDP.

Plant Physiology and its Contributions to Society IISIFV

Physiological quality and enzymatic activity of corn seeds under water stress

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The increase of some antioxidant enzymes has been observed in plants combating the oxidative alteration induced by several types of stress conditions. The maintenance of a high antioxidant capacity to eliminate Reactive Oxygen Species is associated with the increased tolerance of plants to these environmental stresses. In view of the above, the objective of this research was to evaluate the physiological quality and antioxidant enzymes activity of corn seeds and seedlings under water stress conditions. For this, corn seeds of 91 line were submitted, during flowering, to two conditions: without water restriction and with water restriction. The physiological quality of these seeds was verified by the tests: germination rate, first germination count, accelerated aging test, emergence speed index and emergence rate. The quantification of lipid peroxidation and the enzymatic activity of the enzyme superoxide dismutase (SOD), catalase (CAT) and ascorbate proxidase (APX) were also evaluated, using the seeds and seedlings from the germination test. The tests results for physiological quality, according to the variance analysis, were not significant, except for the first germination count test. The lipid peroxidation quantification, which determines the amount of damage caused to the membranes, was statistically different between treatments. Stressed seeds presented a higher lipid peroxidation than the non-stressed seeds and this behavior perpetuates on the remaining seedlings of these seeds. For the SOD enzyme, similar activity was observed for the seeds regardless of the level of stress, however, for the seedlings from these seeds, it was higher in the treatment with water restriction. The enzymatic activity was statistically equal for seeds submitted to both treatments, for CAT and APX enzyme. As for the seedlings, this pattern of activity remained for CAT, however for APX, seedlings obtained from seeds produced under the water stress had higher activity than those that did not suffer water restriction. The corn seeds production under water stress caused damage to the membranes, leading to variation in the enzymatic patterns of the enzymes SOD and APX, although this difference was not observed in the physiological quality of these seeds.

Keywords: stress conditions, antioxidant enzyme, membrane damage Elisa.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Plant Physiology and its Contributions to Society

Physiological responses of crambe (*Crambe abyssinica* Hochst) seed to different levels of osmotic potential

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Crambe (*Crambe abyssinica* H.) is an oilseed known for its ability to acclimate to different edaphoclimatic conditions. During its germination there is a conversion of lipids by isocitrate lyase (ICL) and malate synthase (MSy) in the glyoxylate cycle. Under low osmotic potentials, a reduction in soaking and enzymatic activity of seeds may occur. Thereby, the aim was to evaluate the response of crambe seeds to different osmotic potentials during germination, ICL and MSy activity and the role of enzymatic antioxidant system in tolerating these stressful conditions. The experiment was conducted in CRD design using PEG6000 to provide the osmotic potentials of 0, -0.2, - 0.4, -0.6 and -0.8 MPa, totaling 5 treatments with 5 repetitions and 50 seeds each. After moistening with PEG solutions, seeds were maintained at 25º C, 12 hours photoperiod for 8 days. Collections were performed at 2, 4, 6 and 8 days after sowing and the following parameters were evaluated: total germination (%), water content, hydrogen peroxide (H_2O_2) and malondialdehyde (MDA - an extension of lipid peroxidation) content, activity of enzymatic antioxidant system (SOD, CAT and APX) and MSy and ICL activity. The water content and the germination percentage reduced along with osmotic potential decrease, with no germination in the -0.8 MPa treatment. Regarding the H_2O_2 content, the highest levels were found in the -0.6 MPa treatment in all periods analyzed. On days 2 and 4, the control treatment was similar to -0.2 MPa treatment and had a greater H_2O_2 accumulation in comparison to -0.6 and -0.8 MPa treatments. On the other hand, on days 6 and 8, the -0.6 and -0.8 MPa treatments showed greater H_2O_2 accumulation when compared to the control. MDA levels were significantly higher in sown seeds at the most negative osmotic potential and the lowest damage rate was found in control treatment. The activity of SOD, CAT, APX, ICL and MSy was statistically higher in control and -0.2 MPa, with greater activity on the 4th day evaluated. Therefore, it's concluded that more negative osmotic potentials promote the reduction of crambe seeds' imbibition and consequently the germination and also reducing the activity of ICL and MSy. In addition, although the germination process of oilseeds culminates in greater production of H_2O_2, it acts in signaling and seeds germination. Once germination is delayed and the antioxidant system activity is reduced, oxidative damage and loss of viability of these seeds are generated.

Keywords: oilseeds, abiotic stress, glyoxylate cycle, enzymatic activity, polyethylene glycol, germination.

Acknowledgments: FAPEMIG, CAPES, CNPq, UFLA and UFSJ.

Plant Physiology and its Contributions to Society IISIFV

Can Thompson Atemoya seeds tolerate desiccation and storage?

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The seeds of Atemoya (*Annona x atemoya* Mabb.) are used to produce rootstock of the hybrid itself; however, there is a paucity of literature on classification, desiccation and storage tolerance among most species of the Annonaceae family. The present study aimed to evaluate whether atemoya seeds are capable of tolerating desiccation and storage. The selected seeds presented an initial moisture content of 38% and viability of 64.5%, they were then subjected to drying until reaching initial, 30%, 20%, 10% and 5% moisture content; and stored for 0, 30, 60, 90, 150 days on a lab stand (at a temperature range of 20 and 29ºC). After each storage period, tetrazolium and germination tests were performed to determine seed viability by using 4 repetitions of 25 seeds per treatment. For the germination test, seeds were placed in a germination chamber set under different temperatures and photoperiods, that is, 6 h of light at 30°C and 18 hours of darkness at 20°C. The initial moisture content in seeds presented from 60 to 65% germination during zero, 30, 60, 90 and 150 days of storage; however, the germination percentage in seeds with 30% moisture content was between 75 and 69%, while seeds with 20% moisture content varied from 77 to 62% germination, whereas seeds with 10% moisture contente presented a range between 61 and 63% germination and, finally, the germination oscillated between 43 and 39% in seeds with 5% moisture content; the storage periods were the same for all moisture contents nonetheless. Data were subjected to analysis of variance and means were compared by the Tukey's test at 5% probability. Results detected that seeds tolerated drying up to 10% moisture content and stored at ambient temperature for up to 150 days; consequently, an indicative of its desiccation tolerance. This study deepens the understanding of atemoya seeds to desiccation tolerance and storage; enabling appropriate management practices and seedling production scheduling in nursery without compromising the physiological quality of the seeds.

Keywords: Orthodox seeds, Physiology of germination, Seeds moisture content.

Acknowledgments: UNESP-IBB and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Delinting methods using sulfuric acid timing and different neutralizers on cotton seed physiological quality

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Delinting is considered an essential step for removing the remained fiber on cotton seed tegument, how this process is executed affects directly seed physiological quality, also the type of neutralizer will be important to lower pH and maintain seed quality. The object of this study was to determine the physiological quality of cotton seeds delinted in different sulfuric acid timing, and neutralized with different bases. The experimental design was randomized in a factorial of 3 x 4 (Sulfuric acid timing x Neutralizers), with four replicates. Cotton seeds cultivar DP1746B2RF were delinted with sulfuric acid 98% (1L/7kg) at 2, 4 and 10 minutes, washed in running water for one minute, and neutralized with CaO, $Ca(OH)_2$, $CaCO_3$, (PRNT 134%) and NaOH (pure) for one minute, the proportion of water and neutralizer was 1:1, then the seeds were dried in a circulating air oven at 40°C for two hours. The seed quality assessments were germination, percentage of Big (> 12 cm), Medium (8 > 12 cm) and Small (4 > 8 cm) seedlings, and pH. The best seed germination (90%), happened when the seeds were delinted for four minutes neutralized with $Ca(OH)_2$. The greater percentage of big seedlings was in seeds delinted for 2 minutes and neutralized with CaO (28%); medium seedlings were higher in seeds delinted for 4 minutes, neutralized with CaO (41%) and $Ca(OH)_2$ (40%). Small seedlings were above 40% in seeds delinted for 2 and 10 minutes neutralized with $Ca(OH)_2$ and $CaCO_3$. The pH in each type of neutralizer decreased according to the increase of sulfuric acid timing, but neutralizers $Ca(OH)_2$ and NaOH had this decrease slower than the others. In conclusion, cotton seeds delinted for 2 minutes neutralized with CaO and, seeds delinted for 4 minutes neutralized with $Ca(OH)_2$ showed higher germination with more proportion of big and medium seedlings compared to the others treatments indicating better vigor and physiological quality at the end of the process. The NaOH was very good to neutralize the sulfuric acid but as being a strong base affected seed physiological quality. The lint in the cotton seeds was removed after 10 minutes in sulfuric acid, some lint remained in the seed extremities in 4 minutes and most of the lint in 2 minutes.

Keywords: *Gossypium* L., Vigor, Lint, pH, Seedlings.

Acknowledgments: UFLA.

Plant Physiology and its Contributions to Society IISIFV

Cowpea seed germination in different proportions of poultry litter and coffee straw

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Cowpea is a leading North and Northeastern subsistence crop in Brazil where organic compounds are an alternative of fertilizer. The aim of this research was to verify the interference of different combinations of poultry litter and coffee straw compounds on germination of cowpea seeds subclass Vinagre. The experiment was conducted in a greenhouse at the Universidade Federal de Uberlândia in Monte Carmelo. Six mixtures with poultry litter, coffee straw and soil were used. The soil was sifted and organic compounds were added according to the following proportions (soil - poultry litter - coffee straw): 3-1-1, 3-2-1, 3-1-2, 3-0-1, 3-1-0, 3-0-0 and control with mineral fertilizer, totaling seven treatments. The design was a randomized complete block design with three blocks and 21 plots. The mixtures were placed in 10-liter pots and seeds were sown with 20 seeds per plot. Sowing was made on 05/29/2015 and scores of germination were noted daily. Data were subjected to analysis of variance (F's test) after attempted the assumptions of the model by Shapiro-Wilk test for normal residuals, and Levene for homogeneity of variances. The means were compared by Tukey test at 5% probability. Of all germination characters, only coefficient of variation in time was the same in all mixtures. Treatments 3-0-1 and 3-0-0 had higher germinations. However, mixtures 3-2- 1, 3-1-2 and 3-1-1 showed toxic effect. The use of coffee straw is a viable alternative when there is a large availability and quantity on the rural property, as an environmentally correct alternative for the final disposal of this waste, avoiding contamination of water bodies, springs and streams, but not in higher amounts of one part of coffee straw per three parts of soil. The poultry litter can also be used, however it must be noted that its use is more toxic for the subclass Vinagre cowpea seeds, so the producer should increase the seeding density in order to obtain the same final stand.

Keywords: Organic residues, emergency speed, *Vigna unguiculata*, family farming.

Plant Physiology and its Contributions to Society IISIFV

Physiological quality and enzymatic activity of coffee seeds and seedlings submitted to drying stress

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The tolerance of plants to abiotic stress, such as drying on seeds, is a complex resource associated with several factors, such as the expression of antioxidante enzymes. These enzymes perform an importante role in the romoval of reactive oxygen species in cells and subcellular compartments of plants. Thus, the objective of this work was to evaluate the physiological quality and the expression of antioxidant enzymes of coffee seeds and seedlings subjected to two drying methods. Arabica coffee seeds of the cultivar Catuaí Amarelo IAC 62 were used with an initial water content of 46%. The stress on the seeds were done by the drying process, in a natural way (terrace), which were separated in two batches with different water contents, 40% (without stress) and 10% (with stress), whereas the time of drying was 2 and 16 days respectively. The following physiological tests were performed: germination rate, first germination count, accelerated aging test, emergence rate and emergence speed index, in order to verify the physiological quality of the seeds. The quantification of lipid peroxidation and activity of the enzymes superoxide dismutase (SOD), catalase (CAT) and ascorbate peroxidase (APX) were verified using the seeds and complete seedlings of the thirtieth day of germination test. A significant difference was observed for germination, emergence rate and speed index. The germination rate was higher in seeds without stress (40%), different from that presented by the other tests which, seeds with stress (10%) were superior. The lipid peroxidation was higher in the seeds and on the treatment with higher stress. The same was observed for the SOD enzyme. There was no activity of CAT and APX enzymes in seeds, only in seedlings. For CAT, a higher activity was observed in seedlings from seeds without stress. However, for APX, the enzyme activity was opposite of what was found for CAT, which means a higher activity in seedlings from stressed seeds. Therefore, the difference in the physiological quality observed occurs due to the different water contente between the batches, once the drying method used causes damage to the membrane, being higher in the seeds with stress. In addition, the were variations in the enzymatic patterns for the SOD, CAT and APX enzymes in coffee seeds and seedlings subjected to drying stress.

Keywords: *Coffea arabica L.*, antioxidant enzymes, reactive oxygen species, ELISA, environmental stress.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Overcoming dormancy in seeds of *Guazuma ulmifolia* Lam.

Plant Physiology and its Contributions to Society IISIFV

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A dormant seed has a blockage to germination, preventing the completion of this process, even if the environmental conditions are suitable for germination. *Guazuma ulmifolia* is a plant species widely distributed throughout Brazil (from Amazonas to Rio Grande do Sul), producing dormant seeds. These seeds have physical dormancy (PY), i.e., the seed coat is water-impermeable. Our work aims to evaluate an efficient method to overcome PY in *G. ulmifolia* seeds and the implications for production of native trees. *G. ulmifolia* seeds were subjected to the following treatments: (I) thermal treatment, immersion in water at temperatures of 40, 60 and 80 °C for 10 minutes; (II) thermal shock, subjecting the seeds to 40, 60 and 80 °C (for 10 minutes), followed by immersion in running water for 10 minutes; and (III) chemical scarification with sulfuric acid (H_2SO_4) 40, 60 and 80%, for 10 minutes. Intact seeds were considered as a control group. Intact seeds (control) did not germinate. Seeds were sown in plastic cups containing commercial substrate, buried approximately 3 cm deep and placed in laboratory conditions (25±5 °C). The evaluation was performed at each 5 days for 30 days. The criterion for evaluation of germination was the emergence of seedling. Seeds submitted to thermal shock at 80 °C reached 33.3% of germination. Seeds submitted to thermal treatment at 80 °C reached 63.3% of germination, which is the most efficient treatment to overcome PY of *G. ulmifolia* seeds. The other treatments used did not show a significant germination percentage, remaining at or below 3.3%. Our work concluded that the thermal treatment at 80 °C allows a better response to overcome PY of *G. ulmifolia* seeds, providing subsidies for conservation and restoration projects using the studied species.

Keywords: mutamba, physical dormancy, seed germination, thermal treatment.

Acknowledgments: CAPES, UNIFUCAMP and UFU.

Plant Physiology and its Contributions to Society IISIFV

Physiological quality and enzymatic activity of rice seeds and seedlings submitted to water stress

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The tolerance of plants to abiotic stress depends on several factors, however the relation between oxidative stress and antioxidant activity has become a major agent combating adverse environmental effects. This stress is caused by reactive oxygen species (ROSs) which are natural products of all aerobic organisms. ROSs holds a signaling role in plants when they are under some sort of stress (biotic or abiotic), although, when they are in excess they can cause cell damages, leading to the destruction of membranes, mutations and even the paralysis of essential metabolic activities. The activity of enzymes from the antioxidant complex is fundamental to control this cytotoxic effect, as they are responsible for converting the toxic compound into non-toxic compound of ROSs. Hence, the objective was to evaluate the physiological quality and the expression of antioxidant enzymes of rice seeds and seedlings produced under water deficit conditions. Seeds of the CMG 1509 line were used, submitted to treatments with and without water restriction. After obtaining the seeds, the following physiological tests were performed: germination rate, first germination count, accelerated aging test, emergence rate and emergence speed index. To evaluate the membrane damages and enzymatic expression, the quantification of lipid peroxidation and activity of the SOD, CAT and APX enzymes were done through the ELISA method, using the seeds and seedlings from the germination test. The results for the physiological tests were considered not statistically significant. The quantification of lipid peroxidation was higher for the treatments under water stress (seeds and their seedlings), regarding the enzymatic activity, SOD presented a different pattern between the seeds and their respective seedlings, being higher in the seeds not submitted to stress (water restriction) and also higher in seedlings obtained from seeds under stress. For CAT, a difference was verified only when comparing seed with stress (higher activity) and seedling from seeds without stress (less activity). For the APX, the activity was similar between seeds and seedlings, and did not differ statistically. Lastly, even though the seeds subjected to water stress presents physiological quality similar to those that did not suffer water stress, the water restriction during the production of these seeds caused damage to the membranes and variations in the enzymatic patterns for the SOD and CAT enzymes.

Keywords: *Oryza sativa L.*, stress conditions, antioxidant enzyme, membrane damage, Elisa.

Acknowledgments: CAPES, FAPEMIG, UFLA, CNPq, EMBRAPA and EPAMIG.

Plant Physiology and its Contributions to Society IISIFV

Physiological quality of tobacco seeds submitted to red and white led light

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Knowledge of the physiological processes for plant species has an important role in the preservation and use of potentially economical plants. It is known that each species has its own requirements for its development. The success in producing vigorous and uniform tobacco seedlings depends on seeds with a high percentage of seedling emergence with fast and uniform growth. However, the disuniformity maturation of tobacco fruits and seeds has been a problem for the tobacco industry. The use of red light diodes (LED) has been used in controlled environments to study the influence of red light on the uniformity and speed of germination of seeds from different species. This work aimed to determine the germination and development of tobacco seedlings under white and red light conditions. The experiment was composed by two cultivars CSC445 and Bat 2111 belonging to the varietal groups Virginia and Burley, respectively; two light systems (white and red) and two coatings (with and without pelletizing). The evaluations were carried out according to the Rules for Seed Analysis (RAS) on the seventh day after sowing for the first germination count and on the sixteenth day, by counting normal seedlings. Concomitantly with the germination test, the number of seeds with protruded roots were evaluated daily, obtaining the germination speed index. For statistical analysis it was used the completely randomized design, in a 2x2x2 factorial scheme (two cultivars, two light systems and two coatings). It was found that the initial development of the bare seeds was faster when they were subjected to red light, for both cultivars. For pelletized seeds, the type of light did not present a significant influence on germination, once the pellet represents a barrier to light absorption. Wherefore, the red light can be used to accelerate the germination of bare tobacco seeds. For pelleted seeds, light does not accelerate germination, because the presence of the pellet represents a barrier to no absorption of light, in addition to other factors such as water absorption at the beginning of the germination process. However, the pelletizing process does not affect the final germination, it only delays the germination process of the seeds.

Keywords: *Nicotina tabacum L.*, Light emitting diodes (LED), Germination, Pelletization, Vigor.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Seed dormancy breaking methods for bird of paradise

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The bird of paradise (*Strelitzia reginae*) is one of the most commercialized flowers in Brazil and has an expressive commercial value. Strelitzia seed's coat creates a barrier that difficults the embryo to exchange water with the environment, preventing the seed imbibition. Thus, it is necessary to study methods that can enable the commercial production of seedlings with seeds, seeking efficient treatments to overcome dormancy, since there are several hypotheses to explain their origin. The aim of this research was to evaluate different methods to break the dormancy in bird of paradise seeds, using scarification and gibberellin. Seeds were collected and the aril of the seeds, located in the micropyle region, was totally removed to avoid fungi contamination. It was tested two methods of scarification with or without the addition of gibberellin (GA_3) totaling six dormancy break treatments: T1- scarification in the micropyle region + 24 hours of imbibition with GA_3; T2- scarification in the opposite region of the micropyle + 24 hours of imbibition with GA_3; T3- no scarification + 24 hours of imbibition with GA_3; T4 - no scarification + 24 hours of imbibition with water; T5 - scarification in the micropyle region without imbibition; T6 - scarification in the opposite region of the micropyle without imbibition. The imbibition with gibberellin was performed with the addition of 500 mg/L of GA_3. It was used 50 seeds per plot. The plots were placed in B.O.D germination chambers, in a temperature of 25±2 °C. Seed germination was accounted daily for 60 days, where the germination criteria was the radicle emission. Except for the time for the last germination and coefficient of variation of the time, all the variables presented significant differences by F test. The seeds with scarification in the micropyle region + 24 hours of imbibition with GA_3 presented the best germinative characters. In this treatment, the highest germination occurred (79.41%) compared to the other methods by Tukey's test, followed by the treatment without scarification with gibberellin imbibition (64.71%). Seeds without a dormancy break treatment showed germination of 4.41%, confirming that the seeds have a physical and physiological dormancy.

Keywords: physiological dormancy, *Strelitzia reginae* L., gibberellin, scarification.

Plant Physiology and its Contributions to Society
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Physiological quality and enzymatic activity of soybean seeds submitted to high drying temperature

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The analyzes of antioxidant enzymes can provide information upon the physiological state of plants and seeds exposed to different environmental conditions. These enzymes are associated with the removal of reactive oxygen species, which are formed in different cell compartments as a result of the abiotic and biotic stresses to which plants are subjected. Based on that, the present work aims to evaluate the physiological quality, the amount of lipid peroxidation and the antioxidant enzymes activity of soybean seeds and seedlings submitted to drying stress. For this, soybean seeds of SYN 13671cultivar were submitted to two drying treatments: with stress (dried in a stationary dryer at a constant temperature of 42 °C until reaches 13% of water content) and with no stress (dried in the shade until reaches 13%). After obtaining the seeds, the following physiological tests were carried out: germination rate, first germination count, accelerated aging test, emergence rate and emergence speed index. The quantification of lipid peroxidation and activity of the enzymes superoxide dismutase (SOD), catalase (CAT) and ascorbate peroxidase (APX) were carried out by ELISA method, using the seeds and seedlings from the germination test. The physiological tests had no significant results, except for the germination, which was lower for treatment with stress. By the analysis of variance for lipid peroxidation it was possible to identify that the damage caused in the membranes of seeds and seedlings were similar, regardless of the stress, being higher in seeds than in seedlings. This same pattern was found for SOD activity. As for the enzymes CAT and APX, a difference was verified only when comparing seed (higher activity) and seedling (less activity), regardless of the stress. It is concluded that, even though the seeds submitted to drying stress presents a lower percentage of germination, they are high vigor. In addition, drying these seeds in a stationary dryer at 42 °C caused damage in the cell membranes and the activity of the enzymes SOD, CAT and APX, are similar to those that were dried in the shade.

Keywords: *Glycine max L.*, stress conditions, antioxidant enzyme, membrane damage, Elisa.

Acknowledgments: CAPES, FAPEMIG, UFLA and CNPq.

Plant Physiology and its Contributions to Society IISIFV

Physiological quality of osmoprimed Crambe seeds

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Crambe *(Crambe abyssinica* Hochst), a species belonging to the Brassicaceae family, is an oilseed widely used as forage and in biodiesel generation, since it has high production of inedible oil in its seeds. However, there are factors that interfere the germination of these seeds such as the chemical variability of lipids and the pericarp that surrounds them. One of the techniques used in seed treatment to improve its activity, reducing germination time, increasing the germinability, uniformity and vigor of seedlings is osmoconditioning, which consists of immersion of seeds in an osmotic solution for a certain period of time, in order to provide controlled hydration. The objective of this study is to evaluate the effect of osmoconditioning on polyethylene glycol 6000 on the physiological quality of crambe seeds. For this, the seeds of the cultivar FMS Brilhante were sown in the Experimental Field of the Agronomy Department of the Federal University of Viçosa and, after harvest, manually extracted and benefited. With a water content of approximately 10%, the seeds were conditioned for eight hours at 25 °C, in airy solution of polyethylene glycol (PEG 6000) in six osmotic potentials (0.0 MPa; -0.2 MPa; -0.4 MPa; -0.6 MPa; - 0.8 MPa and -1.0 MPa); and taken to perform viability and vigor tests, they were: germination test, first germination count, Main Root Emission Velocity Index (IVERP) and Germination Speed Index (IVG). The experiment was conducted in a completely randomized design, the results were submitted to variance analysis, and the means were compared to by the Scott-Knott test. There is observed favorable effect of osmoconditioning treatment in relation to germination and first germination count in the osmotic potentials -0.2 and -0.4 MPa. In relation to root emission, in these same concentrations, better results were also obtained, adding the potentials -0.6 MPa and only water. Regarding IVG, there were no statistical differences in results between treatments. It is concluded that the osmoconditioning of crambe seeds with polyethylene glycol 6000, in the osmotic potentials of -0,2 and -0,4 MPa favors the physiological quality and the vigor, being therefore indicated its accomplishment in plantations this species.

Keywords: Osmotic conditioning, germination, polyethylene glycol 6000.

Acknowledgments: CAPES and EPAMIG.

Plant Physiology and its Contributions to Society IISIFV

Physiological conditioning of stored sunflower seeds

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The seed quality is an important issue to guarantee seed germination. During storage, seeds can show physiological changes that result in reduced viability and deterioration. In oilseeds, such as sunflower (*Helianthus annuus* L.), the deterioration is mainly associated with the chemical instability of lipids caused by oxidative stress. Techniques such as physiological conditioning aim at recovering or maintaining seed viability. Thereby, the objective of this work was to evaluate the stability and viability of stored seeds of the sunflower hybrid (Helio 251) after physiological conditioning. The experiment was conducted in a completely randomized design with 4 treatments: control, conditioning with deionized water, conditioning with 100 mM nitric oxide (NO) and conditioning with 100 mM ascorbic acid (AsA). The seeds were conditioned in solution for 4 hours, then washed in deionized water and dried during 12 hours in an oven at 35 ^{o}C. After drying, they were placed into germination chambers with 12h photoperiod, average temperature of 25 ^{o}C and relative humidity of 60%. Each treatment consisted of 4 repetitions with 25 seeds each. During the germination period, two sampling were performed: at 8 and 24 hours after the start of imbibition. The activity of the enzymatic antioxidant system (superoxide dismutase - SOD, catalase - CAT and ascorbate peroxidase - APX), the germination speed index (GSI), H_2O_2 and malondialdehyde content (MDA, an extension of lipid peroxidation) were evaluated. It was observed that the H_2O_2 content did not differ significantly between the different treatments in both periods. Lipid peroxidation was greater 24 hours after imbibition, without differing between treatments. SOD activity decreased over time after imbibition and, after 24 hours, it was lower in conditioning treatments compared to control. Conditioned seeds showed higher activity of CAT and APX at 8 and 24 hours after imbibition, respectively. The conditioning with water, NO and AsA promoted a higher GSI compared to the control. Thus, it is clear that the three conditioning agents used were efficient, even though they did not differ from each other, and that the levels of H_2O_2 in these seeds were controlled avoiding lipid peroxidation, which in oilseeds is more probable to occur due to the higher lipid content. However, the conditioners seemed important to the germination process, modulating the activity of antioxidant system enzymes.

Keywords: priming, nitric oxide, ascorbic acid, Helio 251, oilseed.

Acknowledgments: CAPES, CNPq, UFLA and UFSJ.

Plant Physiology and its Contributions to Society IISIFV

Effect of storage conditions on germination and emergence of chickpea seeds

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The chickpea (*Cicer arietinum* L.) crop has been expanding in Brazil, and studies related to the definition of adequate seed storage conditions are essential to preserving seed physiological quality. Thus, this study aimed to evaluate the effect of packaging materials and storage environment on germination and seedling emergence of chickpea seeds *cv*. BRS Aleppo during eight months of storage. Therefore, chickpea seeds were packed in plastic and multiwall paper sacks and stored in a cold chamber (8 ± 2°C and 35 ± 2% RH) and in a laboratory condition (24 ± 4°C and 73 ± 18% RH). Evaluations of water content, germination, and seedling emergence were made at 0, 2, 4, 6, and 8 months of storage. Characteristics evaluated were influenced by storage environment and packaging materials. The results showed a progressive reduction in the percentage of germination and percentage of seedling emergence with increasing storage time. Laboratory condition combined with multiwall paper sacks was the storage condition in which the seeds showed a greater reduction in percentage of germination (80, 62, 56, 55, 39% respectively for each evaluatied period) and percentage of seedling emergence (84, 83, 50, 44, 36%), and it was also the condition in which the seeds had a higher water content during most of the storage period (11.4, 12.8, 12.6, 12.6, 10.6%), when compared to other treatments. The storage of chickpea seeds in a cold chamber, regardless of the evaluated packaging, and in a laboratory condition in plastic packaging was the most suitable conditions for the storage of chickpea seeds.

Keywords: *Cicer arietinum*, physiological quality, storage.

Acknowledgments: CNPq, CAPES, UFV and FAPEMIG.

Poster Presentations

LINE OF RESEARCH | Sustainability and sustainable development

Plant Physiology and its Contributions to Society IISIFV

Efficient microorganisms (EM) as inducers of wheat germination and development

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In times marked by major ecological impacts, sustainable food production is becoming increasingly necessary. For this, one of the ways to promote sustainable plant cultivation is using the efficient microorganisms (EM), since this social technology has the potential to improve plant development. The present work aimed to evaluate the application of EM in the germination and development of wheat *Triticum sp* in two different environments: natural and controlled. The experiment was conducted in a completely randomized design (CRD) in a 4x2 factorial scheme with 5 replications and 8 treatments: control (distilled water); distilled water + brown sugar (0.1%) (WBS); distilled water + brown sugar (0.1%) and EM (0.1%) (WBSE); EM 100%. Each treatment had five petri dishes in which 15 wheat seeds were distributed on germitest paper. The petri dishes were arranged in: natural environment (on bench) and controlled (germination chamber with 20 °C in the day and 15 °C at night, and 12H of light). Each plate received 10 ml of their respective treatments on the first day, and then distilled water was added as needed. The germination speed index (IVG) and the shoot length were evaluated during 12 days. There was contamination of the WBS treatment, resulting in its elimination. When assessing the environmental condition, a significant difference was registered for the germination and development index, obtaining the highest average values for plants in a natural environment, (GSI 10.56 and 11.74 cm) compared to the germination chamber (GSI 5.82 and 4.08 cm). In germination, the EM doses differed statistically, with the AAME treatment having the highest mean in the GSI followed by the control and EM 100% (12.87; 10.51; 1.2). The length of the aerial part of the seedling was not influenced by the use of EM. The treatment of wheat with EM 100% impaired the germination and development of the seedling, thus, it is possible that the high concentration of bioactive, this, may have caused the negative effects. In the WBSE treatment, due to their low concentration, the amount was sufficient to benefit germination. In addition, the presence of EM in this treatment was probably relevant to avoid the contamination that occurred in the treatment of WBS, without the presence of EM. Therefore, further studies on EM are needed, since they can be used as growth inducers and have the potential to improve seed germination.

Keywords: Efficient microorganisms, germination, growth inducer, sustainability, social technology.

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Plant Physiology and its Contributions to Society
IISIFV

Influence from soil cover with crotalaria biomass on common beans

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Sustainable agricultural production includes the use of soil cover crops, a practice known for the improvement of soil attributes for areas of cultivation. However, this practice requires attention, because the biomass of some cover crops species may release chemical compounds into soil that are harmful to the species cultivated in succession. The objective are this research was to investigate of biomass concentration and decomposition period of *Crotalaria spectabilis* on the emergence and initial growth of common beans. The experiment was conducted in a greenhouse at the Universidade Federal da Fronteira Sul, PR, Brazil using randomized-complete blocks design and factorial scheme 4x3+1, with four repetitions. The factors consisted of four time intervals between cover crop cutting and common beans sowing (0, 10, 20 and 30 days) and three biomass amounts (15, 30 and 45 ton ha^{-1}) and control, without crotalaria biomass. The crotalaria biomass was harvested when it reached full bloom, cut into 5 cm particles and distributed in trays where common beans were sown subsequently. The variables analyzed were emergence percentage, emergence velocity index, chlorophyll *a* and *b* and leaf area of common beans. The results showed that the emergence and emergence velocity index were impaired when common beans was sown 20 days after crotalaria cut, regardless of the cover crop biomass amount. The level of chlorophyll *a* and *b* in common beans leaf were not influenced by crotalaria biomass amount, but were reduced when common beans was sown 10, 20, and 30 days after cover plant cut. The lowest levels of chlorophyll *a* and *b* was reached when common beans was sown 20 days after crotalaria cut. In general, crotalaria biomass boosted common beans leaf area index when compared to control, independent of the time interval between cover crop cut and cash crop sowing. The increase in the common beans leaf area index was directly proportional to the crotalaria biomass concentration. In conclusion, the decomposition of crotalaria biomass influenced common beans establishment, possibly by the release of chemical compounds into the soil that demands more research for understanding. Future experiments can focus on identifying, quantifying, isolating and testing crotalaria allelochemicals in target plants.

Keywords: Agroecology, allelopathy, cover crops, *Crotalaria spectabilis*, *Phaseolus vulgaris*, Sustainability and sustainable development.

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Closing Ceremony

Saturday | September, 5th, 2020.

Closing lecture: Plant physiologist: a multitask professional?

Professor Elisa Monteze Bicalho

Universidade Federal de Lavras, Brazil.

Plants are fabulous organisms capable of tolerating the most broadly environmental conditions. With them, we have learned how they get and transform light energy into biochemical energy, how they use this energy into growth, development, and defense processes. Beyond physiological and biochemical processes, plants have been teaching us how to behave. Why is it so curious and why are we, as humans, so blind in front of plant physiology since they are an important part of our days? We eat plants, we breathe due to the oxygen produced by plants. We have no answers to this question. This way, being a plant physiologist in a plant blindness world is more than challenging, it's hard work. While we are surrounded by plant physiologists, botanists, agronomists, and related professionals, we are comfortable to talk about plants´ importance. Outside of this ball, the interests are others. Nevertheless, plants are there to teach us besides physiology, much more. Plant physiologists not always will work with only that knowledge we have read in the books since graduation. There is a kind of knowledge that books do not teach us. This is how to solve problems in the field, to teach, and to motivate students, to advise, to get financial support for research, to improve food security, to manage post-graduation programs and entire institutions. In other words, plant physiology impacts society. However, the academy does not teach us how to do that, we need to learn them with the career we choose, with practice. So, being open to embrace and discovering features is a great part of the job. This way, interdisciplinarity must be discussed in its totality, not only between related subjects. The Plant Physiology Interdisciplinary Symposium is, undoubtedly, the greatest opportunity to bring up all potential skills the plant physiologists must root. Nonetheless, the knowledge around plants is beyond physiology per se, it is a way to pursue and use plants to better improve life quality in many ways.