



Editorial and Highlights



Despite the difficulties and challenges that Covid-19 pandemic continued to impose throughout this year, it was in 2021 that CITAB and UTAD managed to lead, for the first time, an Associated Laboratory – Inov4Agro. This unit, which turns out to be a milestone in the history of CITAB, was born with the intention of promoting precision agriculture while supporting the transition of the agricultural sector to sustainability. In this 13th issue, interesting articles on plant genetic resources or water scarcity can be read, both topics impacted by the influence of climate change. Relevant cases of ongoing projects are highlighted along with new Doctorates. Furthermore, several face-to-face activities have been developed this year as CITAB's outreach continues to be an important pillar in our dissemination.

Thanks to all CITAB researchers. It is with your commitment and ambition that CITAB continues to take solid steps towards its goals.

Ana Barros, CITAB's Director

Support the agricultural sector's transition to sustainability



Inov4Agro is a strategic consortium of two R&D units, CITAB and GreenUPorto, which have a successful long-lasting cooperation track record and a high scientific productivity in agriculture related areas. By combining a multidisciplinary background with complementary expertise, Inov4Agro gathers high quality PhD researchers to work on cross-disciplinary groups promoting high problem-solving capacity and ability to achieve highly reputed brand value.

The mission of Inov4Agro is to support the Government during the next crucial decade of transition to sustainability with the application of public policies in a multilayer approach, aiming to promote smart and conservation agriculture, to foster the adaptation to climate changes, to mitigate the territorial

dissimilarities by increasing the attractiveness of low-density territories and by fitting the primary sector to the regional diversity of endogenous resources. This will be done by acting as actor of capacitation closest to growers and farmers, providing them the scientific and technological grounds required for essential upgrades to the digitalization of the agriculture.

All the intervention areas of INOV4Agro will provide support on the main public policies namely, the National Plan for Energy and Climate (PNEC 2030), Rural Development Program (PDR 2014-2020), Common Agriculture Policy (PE-PAC 2021-2027) and of the National Agenda for Innovation in Agriculture 2020-2030.



Valdemar Carnide and Isaura Castro

Plant Genetic Resources: facing threats of climate change

Everyone knows that the world is facing new challenges. Climate changes and world population growth are the two main challenges for humanity. There are several causes for climate changes which can be categorized in two classes, natural or anthropogenic. The main anthropogenic causes are fossil fuels, agriculture and land use changes. They will be responsible, for example, by the global temperature rise, drought, unpredictable and extreme weather events, land degradation and loss of biodiversity. The impact of climate changes is not the same in different European regions. In the South European countries, and for the next future (2021-2050), a reduction in precipitation and an increase of temperature are expected. The crops will shorten their life cycles (earlier ripening and reduction of time for assimilation) as response to the increase of temperature, water scarcity and precipitation regimes during crop development, which lead to a yield reduction, mainly in summer crops, and appearance of new pests and diseases. With a global warming of 2°C, an expansion of 14% of the arid zone in the Mediterranean region is expected; in a high warming scenario, it can increase more than twice its current extent. We must have in mind that not only climate changes affect crops' biodiversity and consequently plant genetic resources for food and agriculture; world population is increasing (9-10 billion people by 2050) and a large increase in food production, with nutritional quality, will be needed to feed this population. Housing and feeding so many people, urban expansion, increase pollution, markets and trade, land use change, changing economics, socio-political factors, natural disasters, a more intensive agriculture, greater pressure from pests and diseases, overexploitation and overharvesting are among the factors with a negative impact on plant genetic resources. To deal with these challenges breeders have to release new climate-resilient crop varieties to cope with or adapted to climate changes and at the same time responding to consumer preferences. Underutilized crops must increase their representativeness and new crops must be integrated in agricultural systems.

How can Plant Genetic Resources for Food and Agriculture help to mitigate the climate changes and the increased need for food?

Plant Genetic Resources for Food and Agriculture (PGRFA) refers to genetic material with actual or potential value for food and agriculture. Crop wild relatives, neglected and underutilized crop species, landraces, old cultivars, modern cultivars and genetic stocks are the different types of PGRFA. They are the raw materials for plant breeders to improve the crops productivity and quality and are crucial for sustainable production systems and also as providers of traits that can help crops coping with new biotic (diseases and pests) and abiotic (high temperatures, drought, salinity, etc.) stresses.

The success of any plant breeding programme depends to the access to a wide range of genetic diversity, specially to crops wild relatives, neglected and underutilized crop species, landraces, and the combination of specific alleles that they carry. Plant breeders goal is to obtain the best alleles combination to release varieties with higher productivity and quality without increasing inputs. The loss of this diversity/alleles, called genetic erosion, is therefore worrying.

Genetic erosion within species has been defined as "the loss of individual genes and the loss of particular combinations of genes (i.e. of gene complexes) such as those manifested in locally adapted landraces". Today, the greatest threat for genetic erosion is climate change. Other important causes are: the replacement of local varieties by modern varieties, urbanization, changes in agricultural practices and land use, overexploitation, introduction of exotic species, calamities, both natural and anthropogenic.

The replacement of local varieties by modern varieties enhanced the genetic vulnerability, defined as "the condition that results when a widely planted crop is uniformly susceptible to a pest, pathogen or environmental hazard as a result of its genetic constitution, thereby creating a potential for widespread crop losses". The genetic vulnerability is higher when large areas are cropped with one (or only a few) variety.

In response to the decline in plant diversity, researchers have been actively collecting and conserving PGRFA ex situ. There are now c. 1750 genebanks worldwide, maintaining over seven million samples. However, genebanks have largely focused on the conservation of major crops, while minor crops represent only 2% of materials conserved and crop wild relatives are also poorly represented. In situ conservation, either on-farm or in the wild, which allows the plants to continue to evolve in response to human and natural pressures also, is also essential. These two approaches are complementary and fundamental for preservation of the plant genetic resources.

In conclusion, one can say that the future of the next generations also depends on the plant genetic resources legacy that we leave them.

Water Scarcity: Why Not More Dams?



Rui Cortes

I must point out that some of the measures that have been pointed out to address water scarcity often play a palliative role, though not entirely despicable, in the context of climate change. Agriculture accounts for 75 % of water consumption, so it is obvious that we have to start from here. However, I do not want just to refer the need to adapt the crops to climate change scenarios, namely the need to strong restrict intensive and hyper-intensive land use in a country where it seems that water is not lacking, if we consider the successive increase in the irrigated area...

Within the measures that arise when the drought worsens, the options for Water Reuse (WR) always emerge (from wastewater treatment and irrigation plants) as well as the desalination of seawater and also the construction of new dams and even water diversion from one catchment to other one. Considering WR from waste water it requires an appropriate treatment, followed by a careful risk analysis in order to protect destination users, through tertiary treatment processes, and by creating physical barriers to reduce contact with people and to minimize risk of environmental degradation. So there are important limitations to take into account. With regard to desalination, reverse osmosis and electrodialysis processes are the most used ones. Nevertheless, the costs of water produced by these techniques are much higher and the distribution to remote agricultural areas implies also the construction of pumping circuits, with prohibitive final costs due to energy expenditures.

After all, in these circumstances, why not to build more dams? But the regularization of watercourses did not solve the problem of the successive drought cycles, which are more and more frequent, but rather they lead to the intensification of environmental degradation by habitats destruction and loss of river connectivity, reduction of biodiversity and dissemination of exotic species, where we should emphasize as well the effects of eutrophication and the degradation of water quality. In recent decades there has been a better perception of this situation and are rising the plans to remove these transversal obstacles as well as there is an increasing awareness in Europe of the effects of river artificialization.

Rather, we must look with special attention to the adoption of structural measures, with relevance for the regularization of the hydrological cycle, especially the processes that promote infiltration and recharge of aquifers because they are generally more resilient to severe droughts. Thus, actions to reforest burned areas and to promote soil and water conservation should be a constant concern in the agroforestry planning of river basins. A forest with a monoculture of eucalyptus trees is extremely vulnerable to fires and it is responsible for the dramatic desertification in Portugal, since it favors surface runoff during peaks of rainfall, which is the fundamental vector for soil loss.

Essential is also the so-called stabilization emergency, using Bioengineering Techniques, which represent the first step for the recovery of burned areas. But in Portugal, after the great fire events measures of soil recovery and hydrological mitigation are rare. In the case of eucalyptus stands, soil loss is even enhanced in periods of high rainfall due to the effect of hydrophobicity (water repellency), which occurs in situations of special fire severity and may lead to the formation of an impermeable layer at the surface, preventing infiltration and driving to high runoff, causing erosion intensification. Further, these sediments will be deposited in the streams and later in the reservoirs, reducing their storage capacity (siltation). Thus, this phenomenon of siltation leads to the accumulation of sediments in the reservoirs and it will end up,



Trickle of water wavening it's way through the sediment (Montalegre)

sooner or later, to dictate the uselessness of the dams due to the decrease of storage capacity of the reservoirs. Many of our reservoirs already need to be dredged but this practical only in the small ones. Several studies conducted by CITAB researchers show clearly the relationship between forest fires and siltation in reservoirs and, in addition, their contribution to the eutrophication of the aquatic systems due to the input of phosphorous adsorbed to the soil particles.

Atlantida – A precise view to the North Atlantic Ocean

ATLANTIDA aims to develop a platform for monitoring the North Atlantic Ocean and tools for the sustainable exploitation of marine resources. This project is structured in 5 research lines (RLs), supported by a multidisciplinary team, from the UNorte institutions and CIIMAR (Interdisciplinary Centre of Marine and Environmental Research), mobilizing other 6 R&D units. CITAB hosts members involved in all RLs thus contributing to the expertise of the human resources involved in the consortium. ATLANTIDA will create a coastal observatory and monitoring, focusing on data collection and supply, including monitoring platforms and systems, sensors, data management, and information technologies. It will assess the impact of climate change on the wave energy resource, study the role of global change as a driving force of biological change in coastal habitats, and contribute to the management of coastal and estuarine ecosystems by developing new operative tools. The project also focuses on monitoring the contamination and effects of microplastics, other contaminants, and pathogenic bacteria in the environment. It explores new opportunities to unlock the sustainable growth of aquaculture by minimizing the environmental impact of fish farms whilst contributing to safe and healthier food items for consumers. ATLANTIDA will create biobanks of marine organisms and valorize marine biomass, exploring them in terms of biotechnological applications such as pharmaceutical, industrial and environmental -bioremediation. Macroalgae and marine invertebrate species will be identified and selected as model organisms and used as raw material for the isolation of biopolymers with industrial interest, particularly sulfated polysaccharides, collagens, and bioadhesives. ATLANTIDA is promoting a strong cohesion of the UNORTE institutions regarding Ocean research and technologies, developing the conditions for a leading position at national and international levels.

Soil Rec4+Health - Solutions that start in the soil

The soil quality in the northern region of Portugal has been gradually decreasing, and that is one of the main reason that brought to life the Soil Rec4+Health project. The soil quality decline, exacerbated by the effect of the climate changes, particularly the extremes on temperature and droughts, triggers an intricate number of negative effects. They request an integrated approach to problem-solving. Soil is the fundamental limiting resource to ensure high yields and high-quality plant food products.

To face these challenges, and the increased threat to the socio-economic development of agriculture in this region, it was designed an overarching project, which aims to find affordable and pragmatic solutions. Some of the objectives are related with the recover/improve of the soil quality and adopt accessible management practices for the practitioners. Other with the use of organic residues and plant-growth-promoting rhizobacteria (PGPR) and arbuscular mycorrhizal fungi (AMF), integrated with new technological supporting systems to ensure higher yields and improve the overall quality of the food products and create added-value with the development of novel foods, from recovered traditional crops (cowpea).

It was gathered a high expertise group of multidisciplinary senior researchers, supported by a young team of contracted researchers and scholars. With this team it was designed a 3 RLs project: the first RL is dedicated to evaluate new soil management practices on soil quality, the second RL is focused on the development of a new technological tool to support an accurate soil management under climate change, and the third RL will evaluate the quality of the food products and the production of novel high added-value and affordable protein food product (cowpea puree). The project encompasses several domains of the public policies and societal challenges in the various steps of the agriculture value chain with pragmatic solutions.

Multicam – An array of cameras equipped to help

Precision agriculture involves intensive crop monitoring, which is done essentially using technological solutions. One of these methodologies with growing use in the field of viticulture is hyperspectral imaging, which provides fast and environmentally friendly solutions. The major drawback for its widespread use is the equipment cost, which is can be significantly lower if only a number of wavelengths are used – multispectral cameras -, at a cost of providing less spectral information. This project aims to develop a new low-cost multispectral camera that can be left in the field, sending images regularly to a user. The multispectral camera will be formed by an array of cameras each with an optical filter transparent to a certain wavelength of light. Two uses of multispectral technology will be developed: 1) Automatic fish identification system on fishing vessels; 2) Non-destructive measurement of sugars in grapes. This will be done using artificial intelligence and/or "traditional" machine learning algorithms, in order the keep the final performance of the models the closest possible of the ones based in similar data (namely images) obtained with more expensive equipment. Finally, the multispectral camera will be connected to the XtraN freight transport fleet management platform and the Monicap box used in the fisheries sector, which is highly innovative.

The Consortium is led by XSEALENCE - SEA TECHNOLOGIES S.A. and includes another company - TECMIC, and two research units - INOV INESC INOVAÇÃO e CITAB-UTAD, and is completely in line with CITAB's Thematic Strand 2. The project is coordinated by CITAB researcher Pedro Melo Pinto.

FIC.A - A Taste of Sabor

The film promoted by SPECO "Long-Term Ecological Research Baixo Sabor" coordinated by LEA and LEF researchers, from CITAB, in articulation with CIBIO-UP, was presented at the FIC.A Festival – Festival Internacional de Ciência (12th to 17th of October). CITAB researcher Margarida Marques also dynamized, in the same event, the workshop "A ciência não escolhe género: Cientistas, Química e Ambiente", promoted by the Associação Portuguesa de Mulheres Cientistas (AMONET).



LTER Baixo Sabor

How old are this olive trees?



Several high school teachers attended the lecture

The "5X Ciência às 5" lectures promoted for high school teachers by Agrupamento de Escolas Morgado de Mateus had the participation of CITAB researcher José Louzada on the 20th of October. By presenting, in the first person, the challenge launched by stakeholders and the development path, the speaker enthusiastically showed how the application of the scientific method was indispensable to develop a unique and patented tool that allows ageing millennial olive trees.

Science and Technology for all ages

Researchers of CITAB joined, once again, the Science and Technology Week (22nd to 26th November). The dynamized activities, from online to hands-on format, were: "Papel da micropropagação na agricultura do futuro"; "À descoberta dos rótulos dos alimentos"; "Recursos genéticos: um património para a sustentabilidade mundial"; "Oficina do Pão"; "A casa e o trabalho da minhoca" and "A minhoca cientista, Dra *Eisenia fetida*". These actions reached a wide audience from preschool children to adults.



Children are always very curious about this activities

An interesting way to occupy the holidays



OCJF brought nine high school students to CITAB

CITAB welcomed nine high school students from all over Portugal in activities included on the "OCJF 2021- Scientific Occupation of Young People on Vacation". The actions were coordinated by the researchers Ana Sampaio, Isaura Castro, Manuela Matos and Paula Oliveira and focused themes like the discovery of ancient DNA, the evaluation and valorization of natural products and *in vitro* culture of aromatic plants.

Operational Groups

Operational Groups are intended to bring together multiple actors such as farmers, researchers, advisers, businesses, environmental groups, consumer interest groups or other NGOs to advance innovation in the agricultural and forestry sectors.

GO Cherry – Valorization of the Resende cherry production and market's positioning of the chain

This project, in partnership with INIAV, is promoting a strategic approach to energy recovery from the flows generated in the agricultural and livestock activity, ensuring sustainable development at a regional/national level and reducing the exploitation of natural resources through recycling.

Coordination: Berta Gonçalves



Partners **7**

GO Arouquesa Meat - Preserve the quality of Arouquesa meat

Intend to elaborate an adequate supplement to the needs of the calves, incorporate more innovative procedures and based on new technologies at the level of the production chain, contributing to the quality of the Carne Arouquesa – DOP.

Coordination: Carlos Venâncio



Partners **6**

GO VITISHIDRI – Strategies for the management of water stress of the Douro Superior vineyards

The project evaluates the adaptive potentials of the Guyot training system and deficit irrigation as water management strategies to climate change in the Douro Demarcated Region.

Coordination: Aureliano Malheiro



Partners **13**

GO EGIS – Soil and water management

Cover crops, biostimulants, fertilizers and deficit irrigation strategies were studied in order to increase the sustainability of production systems in chestnut, almond, hazelnut and walnut trees.

Coordination: Carlos Correia



Partners **17**

GO OLIVE – New practices for rainfed olive orchards

New practices were studied to mitigate climate change, through reduction of greenhouse gas emissions and increase of soil carbon sequestration, and to adapt rainfed orchards to a changing environment.

Coordination: Carlos Correia

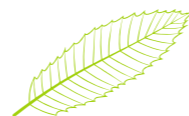


Partners **11**

GO VALORCAST – Chestnut valorization and optimization of this commercialization

The GO PDR2020 “ValorCast” provided improvements in the mechanical harvesting, in the use commercial and hydrophobic coatings efficient to preventing water loss, and in Inhibition of microbial growth, with a reduction in the levels of rotting of the chestnut, without altering its chemical composition and sensory characteristics.

Coordination: Jorge Ventura Cardoso



Partners **11**



GO Vespa Velutina – Control and minimization of damages caused by invasive species *Vespa velutina nigrithorax* (*Vespa velutina*) in beekeeping

Some of the objectives of the project are the restoration of the ecosystem prior to the involuntary introduction of *Vespa Velutina*, recover the interest in the activity by new beekeepers, guarantee the productivity of the orchards and the plant ecosystem and identify and monitor the destruction of nests.

Coordination: José Aranha



Partners **10**

GO CSindDouro – Sexual Confusion against grape moth, *Lobesia botrana*

Improve the knowledge about the impact of climate, landscape (alternative hosts), operations cultural characteristics and characteristics of the vineyards of the Douro Demarcated Region in the distribution of the pheromone cloud to improve the effectiveness of using sexual confusion against grape moth.

Coordination: Laura Torres



Partners **6**

Operational Groups

153 PARTNERS AND STAKEHOLDERS INVOLVED

GO ClimCast – The new challenges for the chestnut orchards in the context of climate change

The main achievements include a network of demonstration chestnut groves and weather stations, the ecophysiological characterization of the main varieties and the modelling of chestnut production.

Coordination: José Gomes Laranjo



Partners **14**

GO Apple - Phytosanitary protection strategies for sustainable apple production

The combined spray of plant defence inducers and fungicides allowed an effective control of apple scab (*Venturia inaequalis*) and a great reduction in the number of sprays. Codling moth (*Cydia pomonella* L.) effectively controlled was using sexual confusion. Some fungicides used in apple orchards have residual effect on Phytoseiidae mites.

Coordination: Isabel Cortez



Partners **13**

GO Efluentes - Livestock effluents: strategic approach towards agronomic and energetic valorization of flows in the farming activity

This project, in partnership with INIAV, is promoting a strategic approach to energy recovery from the flows generated in the agricultural and livestock activity, ensuring sustainable development at a regional/national level and reducing the exploitation of natural resources through recycling.

Coordination: Henrique Trindade



Partners **13**

GO + PrevCRP – Development of integrated strategies for the prevention of pine pitch canker

The main objective is to implement, on a large scale, strategies to minimize the risk of spread of resinous pine canker at national suppliers of MFR without compromising seed germination or plant quality.

Coordination: Luís Ferreira



Partners **15**

GO BioChestnut - IPM – Implement effective control strategies against chestnut and almond diseases

One of the objectives pursued with this Operational Group is to implement the biological control for Hypovirulence against Chestnut Canker based on the bioproduct DICTIS in the regions of DRAP Norte and DRAP Alentejo.

Coordination: José Gomes Laranjo



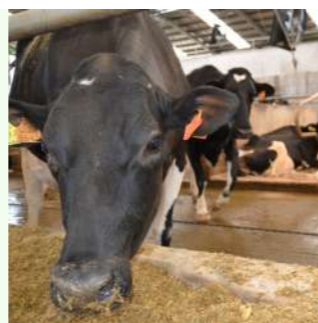
Partners **17**

Did you know that?



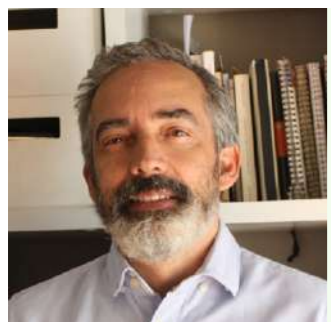
CITAB took the top three places in the NEWFOOD contest? Combining science with creativity, CITAB researchers Sónia Gomes, Irene Gouvinhas, Ana Barros, Rita Martins, Sara Reis, Guilhermina Marques and Juliana Garcia presented the winning products Mousse D'Olive(1st), Healthy Gums (2nd) and Brôa Shitake (3rd).

The "GO Efluentes" won the first prize in the "Innovation in Partnership: Operational Groups" category, of the 7th edition of the Entrepreneurship and Innovation Award of Crédito Agrícola? This Operational Group (GO) is coordinated by the CITAB researcher Henrique Trindade.



CITAB researcher João Santos was distinguished among the top 1000 climate scientists at Thomson Reuters, being one of the only 6 portuguese in the list? A distinction that recognizes more than 25 years of devotion to the study of the impact of climate on agroforestry ecosystems.

Rita Martins received the award for best oral communication at the XV Encontro de Química dos Alimentos, held in Funchal? The award was given by ReadyToPub - Author Services Provider to the best communication presented by students. Rita is in her last year of the PhD doctoral programme AgriChains, coordinated by CITAB.



CITAB researcher João Fidalgo Carvalho joined a list of experts of the European Commission within the framework of the European Union's Biodiversity Strategy for the next decade? They will prepare guidelines for the problems and challenges related to the conservation of biodiversity, ecosystem services, climate change and the contribution of forests to sustainability in the european space.

Did you know that?



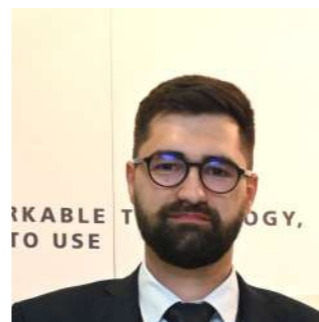
For the 4th consecutive year, CITAB has researchers selected in the FCT's "Concurso Estímulo ao Emprego Científico – Individual (CEEIC)? CITAB researcher Luis Félix obtained a final score of 9,51 in this edition. In the CEEIC, 400 work contracts are awarded to researchers holding doctoral degrees in all scientific areas.

Sara Bernardo's PhD thesis was awarded by the Agronomy Journal for the "Agronomy 2021 Best PhD Thesis Awards"? "Understanding vine response to Mediterranean summer stress for the development of rationale adaptation strategies: the kaolin case" was among the three winners of this prize. Each winner received CHF 500, a certificate, and a chance to publish a paper in Agronomy in 2022.



Researcher José Luís Louzada published the article "Tropical tree growth driven by dry-season climate variability", as a co-author, in the prestigious Nature (Nature Geoscience, IF=17,933)? Based on the work and experience of some of the world's leading researchers in the field of dendrochronology/dendroclimatology, it was possible to study how meteorological phenomena are recorded in the trees rings.

Rafaela Santos, researcher at CITAB, won the AE2021 Student Spotlight Award, from the European Aquaculture Society - EAS - Student Group? Rafaela's work was selected from a total of 120 entries. The winner was chosen by popular vote among conference participants.



Luís Pádua received the Soldara Case Basse International Young Researchers Award, in the viticulture category, from the Accademia dei Georgofili, (Italy)? "Individual Grapevine Analysis in a Multi-Temporal Context Using UAV-Based Multi-Sensor Imagery" was the title of the awarded journal article.

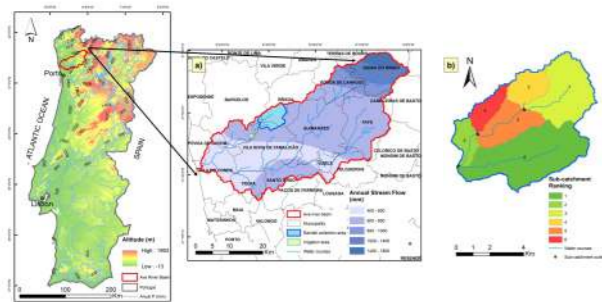


Daniela Terêncio

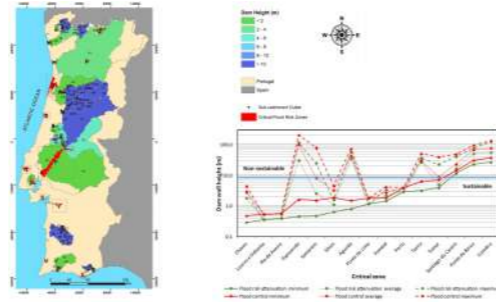
Decision Support Systems for Rainwater Harvesting and Runoff Control in Watersheds

CITAB researcher Daniela Terêncio successfully defended her doctoral thesis “Decision support systems for rainwater harvesting and runoff control in watersheds”, in January 2020. Her supervisors were Professor Luís Filipe Sanches Fernandes (CITAB-UTAD), Professor Rui Cortes (CITAB-UTAD) and Professor Fernando Pacheco (CQ-UTAD).

This work aimed to study ways of storing surface water. Having an interest not only in the use of rainwater for certain purposes such as environmental, agricultural, forestry, but also for the control of natural disasters (floods and droughts), two lines were developed a) Rainwater Harvesting (RWH), which are small infrastructures to store water for agriculture; b) Flood Detention Basins (FDB), which may be small or large infrastructures with the purpose to control floods. Taking into account all water-related problems, we developed an in-depth study and an assessment of the potential of rainwater harvesting and floodwater detention for multiple agro-forestry applications and flood control in Ave River and Sabor River basins located in the northern part of Portugal. To accomplish the goal, RWH allocation and flood detention methods were developed and tested in the aforementioned basins that make it possible to plan the retention of rainwater in catchments, allowing the later use for the benefit of crop irrigation, wildfire fighting and mitigation of flood risk areas. In this regard, the RWH allocation methods were embedded in decision support tools, such as Geographic Information Systems, and validated by univariate and multivariate analysis and advanced use of spreadsheets. This research was funded by the INTERACT project.



Allocation map indicating the rainfall collection area and the application area



Spatial distribution of dam wall heights



Sandra Cabo

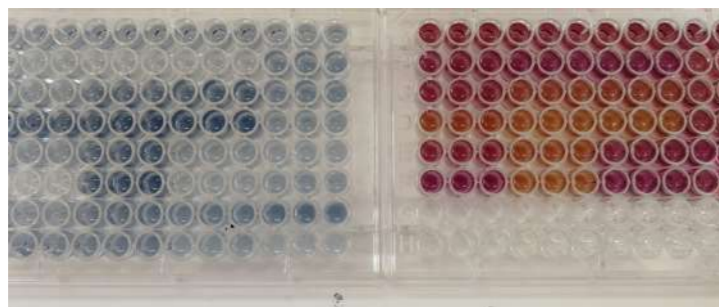
Innovative strategies to mitigate effects of climate change for sustainable hazelnut production

CITAB researcher Sandra Cabo defended her doctoral thesis “Innovative strategies to mitigate effects of climate change for sustainable hazelnut production”, in September 2020. Her supervisors were Professor Berta Gonçalves (CITAB-UTAD), Professor Ana Paula Silva (CITAB-UTAD) and Professor Núria Pascual Seva (Universitat Politècnica de València).

The main objective of this Doctoral Thesis is to contribute with strategies to mitigate effects of climate change and to enhance the quality and production of hazelnut by different approaches. To achieve these goals, an evaluation of the suitability of preharvest foliar spray treatments was performed, gaining a further insight in the agricultural management strategies by understanding the plant physiological and biochemical response, enhance hazelnut quality, environmental sustainability and economic viability for hazelnut production. In addition, regarding the massive amounts of bio-wastes, the determination of the suitability of husks (hazelnut by-product) as a source of bioactive compounds was also studied. Results showed that kaolin, natural bioestimulant *Ascophyllum nodosum* and salicylic acid improve the hazelnut tree physiological response, without compromising the hazelnut chemical and sensorial quality. The valorization of hazelnuts husks gives an important contribution for the isolation and purification of bioactive molecules. Received a PhD studentship from the FCT (PD/BD/113615/2015), under the Doctoral Programme 'Agricultural Production Chains - from fork to farm'.



Hazelnut leaves treated with kaolin



Antioxidant activity of hazelnut extracts



Leaf gas exchange asurements with IRGA



Miguel Oliveira

Introducing legumes in Mediterranean cropping systems: nitrogen supply, soil carbon sequestration and greenhouse gas emissions

CITAB researcher Miguel Oliveira successfully defended his doctoral thesis “Introducing legumes in Mediterranean cropping systems: nitrogen supply, soil carbon sequestration and greenhouse gas emissions” in February 2020. His research was supervised by Prof. Henrique Trindade (CITAB-UTAD), with the collaboration of Prof. Iñigo Virto (UPNA - Public University of Navarre, Spain). The main aim of his thesis was to improve the knowledge on the agronomic and environmental impacts of introducing pulses (grain legumes) in Mediterranean cropping systems in order to promote their cultivation in the European Union (EU).

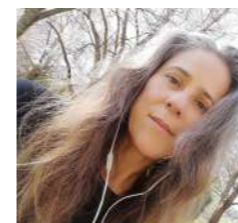
Miguel found that introducing faba bean (*Vicia faba*) or pea (*Pisum sativum*) crops in a rotation with triticale (× Triticosecale) increased the cereal yields up to 30–59 %, equivalent to an application of 72–153 kg fertilizer-N ha⁻¹. Irrigated cowpea (*Vigna unguiculata* L. Walp) did not benefit yields but proved to be a suitable summer crop for sustainable intensification in Mediterranean conditions, as the overall productivity of the agroecosystem was increased with minimal inputs.

He also showed that pulse-cereal rotations cannot improve soil organic carbon storage in this soil in the short-term. Nevertheless, pulse-based cultivation reduced the cereal yield-scaled N₂O emissions in a wet year when compared with fertilizer-based cultivation, and thus can help mitigate climate change in Mediterranean agroecosystems.

This research was supported by the European Social Funds and the Regional Operational Programme Norte 2020 (NORTE-08-5369-FSE-000054), under the Doctoral Program “AgriChains”, and by the EUROLEGUME project (n° 613781) under FP7.



Field trials in UTAD with chambers for sampling gas emissions from soil in the Summer (cowpea crop and fallow plots ; on the left) and in the Winter (triticale crop; on the right).



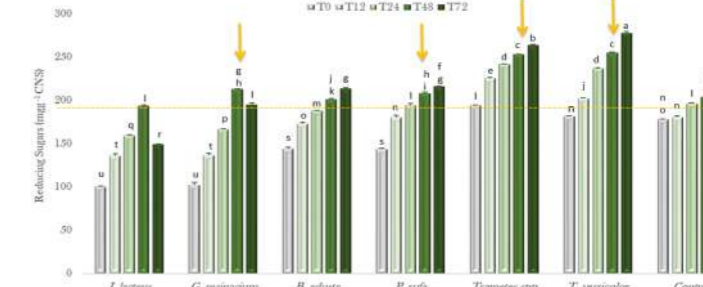
Paula Botelho

Fungal bioconversion of agro-industrial by-products and modeling of laccase kinetics

CITAB researcher Paula Botelho Pinto defended her thesis “Fungal Bioconversion of Agro-Industrial By-Products and Modeling of Laccase Kinetics” in June 2020. Supervised by Professor José Albino Dias and Professor Rui Bezerra, both from CITAB-UTAD, her PhD work focused on the study of enzymatic processes involved in fungal bioconversion of lignocellulosic byproducts (wheat straw and chestnut shell) which was done through mathematical modeling aiming to predict/evaluate the behavior of the interveners allowing an optimization. The effect of some variables (hydrolysis time, enzymatic activity (e.g. laccase) and holocellulase concentration) was estimated whilst a general predictive model of saccharification. A high consistency was found relating the effect of xylanase and laccase activities on the final release of reducing sugars from the chestnut shell. These results can be used for optimization planning in saccharification of this substrate. Also, several linear and nonlinear Michaelis-Menten models were applied to clarify the laccase inhibition mechanisms, that might influence the optimization of the processes. The models were submitted to a ranking methodology regarding the relative quality of kinetic models, using Akaike Information Criterion (AIC) with respective Akaike Weights, confirming chlorine as linear competitive inhibitor of laccase. When Bi-Bi substrate kinetic models were tested, including inhibition by reducing and/or oxidizing substrate, it was found that the catalytic efficiency of oxygen conversion to water appears to be compatible with a process relatively independent of reducing substrate and bisubstrate mechanism type. Lastly, the development of a new methodology and a new integrated equation concerning the interaction between inhibitors was attempted. This research was supported by INTERACT project (NORTE-01-0145-FEDER-000017)



Chestnut shell solid state fermentation



Saccharification of chestnut shell (CNS) pretreated by fungi



Thanks, Valdemar Carnide

Valdemar Carnide is retiring from academic activity at UTAD after 43 years of service with enthusiastic dedication to education and research in several thematics with main focus on plant breeding. He was one of the pioneers in the study of local genetic resources, through its agro-morphological and molecular characterization. Active in the prospection of regional germplasm throughout the country, with an important role in the plant breeding programs of several crops, such as cereals, different cucurbits, brassicas and legumes, being responsible for the registration in the national variety catalogue of several varieties. Valdemar Carnide was board member of the Forages and Pasture Society (Vice-President 1996-1998 and President 1998-2000) and the portuguese representative, since 2005, in "The European Cooperative Programme for Plant Genetic Resources (ECPGR)", Bioversity International, of the Cucurbits Working Group. Much of his research was developed in collaboration with public agricultural institutions and farmers. He has published his research in dozens of JCR indexed journals and also technical brochures regarding plant breeding results for different crops. Valdemar Carnide is also an enthusiastic disseminator of his research, particularly to young students, having carried several outreach activities in elementary and secondary schools regarding food crops diversity. CITAB acknowledges Valdemar Carnide valuable research and will continue to rely on his expertise.



Valdemar Carnide

Thanks, Rui Cortes



Rui Cortes

After more than 43 years of activity at UTAD, CITAB's researcher Rui Cortes has been retired. He dedicated his career to the monitoring of aquatic ecosystems, forest ecology, ecology and restoration of riparian layers, river restoration with incidence on soil engineering techniques for erosion control and mitigation measures on regulated rivers.

Rui Cortes has always held prominent positions in the organization of research at UTAD, having been Director of the Center for Studies in Ecosystem Management (CEGE), Vice-Director of CITAB and President of the Scientific Council of the School of Agricultural Sciences and Veterinary Medicine. He was also member of the General Council of UTAD, member of the National Water Council (as a

representative of the Rectors Council) and a member of the Independent Observatory of Rural Fires (nominated by the Portuguese Parliament).

Throughout his career as a researcher of excellence, he created close and trusting partnerships with stakeholders, which allowed the development of projects that were very relevant to the research areas to which he dedicated himself and to UTAD. He created and coordinated research teams always with a spirit of leadership, inspiring people, believing in their abilities and giving them the opportunity to grow. Although retired from UTAD, he remains an integrated member of CITAB and CITAB recognizes and appreciates the excellence of all his research work and his contribution to becoming an increasingly strong and recognized research center.



Brief

First steps as a researcher

Half a year to take the first steps in research is the challenge launched by CITAB which promotes the opening of eight research initiation grants from September of 2021. This is an opportunity to improve knowledge and, in parallel, acquire scientific skills in a reference research center such as CITAB. "With the opening of these scholarships, CITAB opens the door for students in the areas of Food Engineering, Biochemistry, Clinical Laboratory Biology, Environmental Engineering, Forest Engineering, Enology and Viticulture, Agronomic Engineering or Electrical Engineering, to discover the world of science and research.

I am sure that their contribution will be essential for the development of the research lines underway at the Center», emphasizes the director of CITAB, Ana Barros.



An opportunity to improve knowledge



Location and contacts

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