



CITAB | NEWSLETTER

Centre for the Research and Technology of Agro-Environment and Biological Sciences

issue 11

DECEMBER 2019

Editors: José Lousada, Ana Coimbra, Alfredo Aires, Daniel Faiões and Lúcia Pinto

Editorial and Highlights



The 11th issue of CITAB's newsletter presents 2019 foremost accomplishments, in a year marked by the reclassification of our unit as VERY GOOD by the Portuguese Foundation of Science and Technology, with a total funding of 1.9M€ for the period 2020-2023.

This current edition "Hot topic" addresses Circular Economy new challenges, presenting grape stems as raw material for bioactive compounds in the cosmetic, pharmaceutical and food industries. Under collaboration protocols, the joint effort of CITAB with the R&D units INESC TEC and CIIMAR resulted in the organization of two successful international events that gathered researchers and stakeholders at UTAD (Vila Real). Relevant cases of our applied research are also highlighted, along with the new international projects and the European Doctorates titles by AgriChains Doctoral Programme.

Thanks to all CITAB researchers. Our scientific merit and efforts foresee the scientific progress of our Centre in the years to come.

Ana Barros, CITAB's Director

Innovation & Technologies at CITAB's International Congress



Opening Session, with José Caldeira (INESC TEC), Ana Barros (CITAB), Isabel Ferreira (Secretary of State) and Artur Cristóvão (UTAD)

On December 12th and 13th 2019 took place the international congress organized by CITAB, "Digital Agro-food & Forestry (r)evolution", on the topics of the Internet of Things & Big Data, Artificial Intelligence, Robotics and Remote Sensing, applied to agri-food and forestry chains. Within a collaboration with INESC TEC, this 2-day congress gathered prominent keynote speakers from Australia and Spain and also from the Portuguese industry.

The opening session had the presence of the Portuguese Secretary of State for Interior Valorisation, Isabel Ferreira, who encouraged the initiative and highlighted the importance of emerging technologies and their understanding. "Pursuing precision agriculture, without waste, in the most appropriate place and at the right time is essential. The digital revolution will have a considerable impact on the integrated development of regions. Knowledge and technology transfer actions have to be promoted.

The congress ended with a debate dedicated to viticulture, and a technical visit to Quinta das Carvalhas (Real Companhia Velha), in Douro Demarcated Region. CITAB's Director, Ana Barros, and José Boaventura, Coordinator of the INESC TEC Pole at UTAD, expressed the "pleasure for the success of the initiative" that brought to UTAD renowned national and international specialists, whose contributions can in fact address the needs and challenges of the industry, promoting the use of new technologies for a more sustainable food production.



Paulo Fernandes, PhD
Fire, Forest

A new fire environment is unfolding

Vegetation fires are an intrinsic element of terrestrial ecosystems under seasonally dry climates, and affect an annual average of about 4.5 million km² of the Earth surface. However, the global relevance of fire is hardly acknowledged, because most of the burned area coincides with scarcely populated regions, namely tropical and temperate savannahs and grasslands and boreal latitudes. Wildfires have become more prominent in recent years, a consequence of their heightened impacts as measured by the loss of human life and assets. The tragic events of 2017 and 2018, respectively in Portugal and Chile, and in Greece and the USA, are still vivid in the collective memory.

Wildfires in the Brazilian Amazon and in the southeast of Australia (still on-going) were the highlights of 2019. The former were mainly a collateral consequence of the loss or degradation of natural forest cover, rather than its cause, and reflect slash and agricultural burning in recently deforested

areas, as the moist environment of evergreen tropical forests inhibits fire spread. The Australian situation is substantially different, as it bears the mark of climate change, which induces more severe and lengthy fire seasons.

South-eastern Australia is no stranger to the occurrence of devastating fires, well documented in the region since the 19th century. Nonetheless, the current wildfires are a new phenomenon, given their overall extent, ca. 10 million hectares, and the extremely large size of the individual fires. Worldwide, this is the first time an event of this scale unfolds in forest-dominated landscapes adjoined by densely populated areas. Additionally, the impact extended to forests either without a prior history of fire or adapted to very infrequent fire, probably signalling a tipping point that will change vegetation types.

What are the causes of the disaster? Eucalypt forests in the region form very large and continuous patches. The prevalence of national parks and public forests did strongly constrain human activity in the last decades, and vegetation management for hazard reduction is mostly limited to the vicinity of urban areas. An unusual drought resulting from a sequence of years with precipitation much below normal was the predisposing factor, by lowering vegetation moisture to critically low levels. Maximum daily temperatures in excess of 40°C combined with very dry and strong winds and unstable atmosphere favouring fast and intense fire spread. Finally, the region was swept by successive waves of dry lightning that ignited most of the fires.

Whether the likelihood of extreme fire weather conditions will decrease in the future will depend on the long-term and uncertain results of energy policies. In the meantime, society will have to learn to live with and adapt to this new fire environment, by enabling both long-known and new fire-risk reduction strategies conducive to fire-resilient communities and ecosystems.



Low-intensity (left photo) and high-intensity (right photo) aspects of fire behaviour in eucalypt woodland in Australia.



European Doctorates in AgriChains doctoral programme

Since its beginning, in 2014, the International Doctoral Programme “AgriChains – Agricultural Production Chains: from fork to farm” received almost 50 students from different continents and nationalities (Portuguese, Chinese, Croatian, Indian, Tunisian and Colombian) willing to become specialists in different areas of the agri-food chains sciences. Such pursuit is



AgriChains students and teachers

now a reality, with the first PhD thesis concluded in 2019. Iva Prgomet and Chenyao Yang were pioneers developing part of their research studies at AgriChains partners' premises of Polytechnic University of València (UPV) and Wageningen University (WU), respectively, which allowed them to achieve the European Doctorate title. During this year, Márcia Carvalho, Cátia Brito, Weina Hou, Sofia Correia, and Catarina Teixeira also accomplished their PhD degree in this innovative but challenging doctoral programme in Agriculture. In the beginning of 2020, AgriChains will launch its 6th edition, with additional 6 grants funded by FCT – Portuguese Foundation for Science and Technology.

Algerian wild plants analysed at CITAB's Lab

In the light of providing healthy food to consumers, the agri-food industries are permanently seeking for natural ingredients from plant-based materials. Within this scope, the policy of the Algerian government is to encourage the exploitation of plant resources all over the country in order to enhance both local and circular economy.

Dr. Chikhouné Anis, a university lecturer from the High College of Food Sciences and Food-Agri Technologies (ESSAIA), in Algiers (Algeria), was a visiting scholar at CITAB Phytochemicals Lab, in December 2019. He worked on the optimized methods established in this laboratory to assess antioxidants and antioxidant activities of two Algerian wild plants: *Myrtus communis* (wild myrtles) and *Terfezia* sp (desert truffles). This constitutes a part of Dr. Chikhouné Anis postdoctoral research, who will return in 2020 to follow up his research activities.



Left: Chikhouné Anis Top: *Terfezia* sp (desert truffles) Bottom: *Myrtus communis* (wild myrtles)

TranCastNut - Enhancing Trancoso's chestnut sector

A new 5 year cooperation agreement – TranCastNut, was formalized between Trancoso County and UTAD-CITAB, extending the cooperation initiated in 2013. This new agreement seeks to improve chestnut production, using new tools of orchard management. Beekeeping installations will be used, since pollination is decisive for the success of this crop, with an experimental orchard already in function. A Focus Group was created to participate in Open days actions, with near 200 producers already registered.

In cooperation with the Lamego Hotel and Tourism training School, a second Focus Group was created to participate in show cooking workshops of traditional and new chestnut recipes, in order to preserve and promote the heritage of this valuable diathetic fruit.

TranCastNut also previews the evaluation of the chestnut sector's economic impact to Trancoso County.



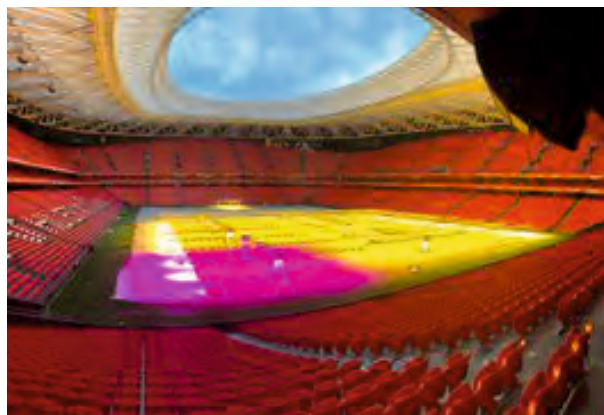
TranCastNut cooperation Network, including CITAB researchers José Laranjo (leader), Guilhermina Marques, Jorge Ferreira Cardoso, Teresa Pinto, Rosário Anjos and Luís Martins



CITAB researchers monitor Athletic Club de Bilbao lawns

CITAB researchers Cátia Brito, Lia Tânia Dinis, José Moutinho Pereira, Carlos Correia and Alexandre Gonçalves established a partnership with two LED lighting companies (Loki - Portugal and Andled Energy - Spain) in a pilot study that aims to optimize the use of LED lights in football stadium lawns maintenance and recovery in the post-match.

The shadow of modern stadiums structures covers the lawns compromising growth and the maintenance of a homogeneous plant carpet. Some clubs implemented, with significant costs, the use of high-pressure sodium (HPS) lights which help the plants to growth. The LED illumination solutions aim to reduce energetic costs and at the same time select and combine the wavelengths of light spectrum to promote efficient plant photomorphogenesis and photosynthetic process.



Stadium of Athletic Club de Bilbao lawns

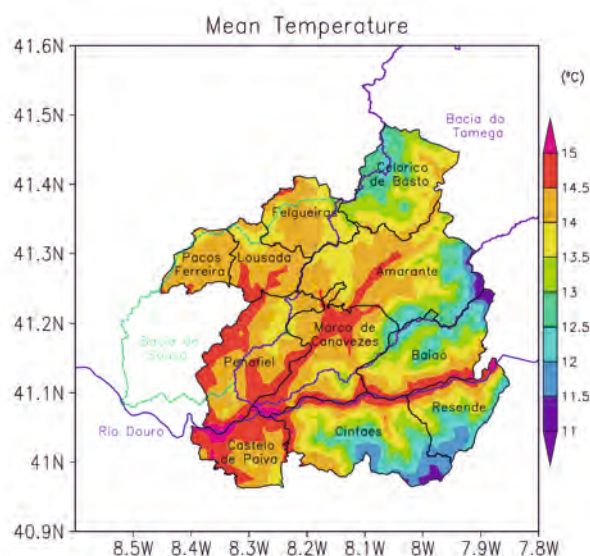
The study conducted in the San Mamés Stadium (Bilbao Athletic Club, Spain) joined the scientific knowledge of researchers in the field of plant physiology with the technological companies' know-how. After comparing the performance of laws under different illumination technologies, it was achieved a reduction of energetic costs in 83%, relatively to the HPS technology used by the Athletic Club of Bilbao maintaining the lawn quality. Posteriorly, in the Workshop "Iluminación led para césped natural" at the San Mamés Stadium, directed football clubs and companies related to lawns maintenance, CITAB researchers showed the importance of the scientific knowledge in terms of plant physiology and respective light requirements.

Digital atlas for environmental and socio-economic sustainability

The Tâmega and Sousa region has now a digital atlas of high spatial resolution which will support the Intermunicipal Community (CIMTS) decision-makers in the necessary planning to potential climate change for a better adaptation of the territory. There will be a consequent reduction in associated risks and the promotion of its environmental and socio-economic sustainability.

Besides the digital atlas, an executive summary was also published, as well as a report developed with the study results. A very wide range of areas was contemplated, namely the impacts of climate change on water resources, on public drainage infrastructures, agriculture, forest, biodiversity and on the various socio-economic sectors of the CIMTS territory. Also, an extensive assortment of decision support recommendations was prepared, which should soon be turned into concrete measures to be implemented in the region. For knowledge transfer process effectiveness, several training actions have been taking place with the various decision makers of CIMTS.

"Plano Intermunicipal de Adaptação às Alterações Climáticas do Tâmega e Sousa" (PIACC-TS) was funded by the Portugal 2020 program, POSEUR, with CIMTS as promoter. The study was carried out as part of a partnership established between IDARN (Institute for Agrarian Development of the Northern Region), the University of Trás-os-Montes and Alto Douro, the Institute of Sciences, Technologies and Agri-Environment (ICETA) of the University of Porto and the University of Minho. The coordination of the partnership was responsibility of IDARN, having been the technical-scientific coordination of the study under the responsibility of researcher João Santos.



Average annual temperature of the Intermunicipal Community of Tâmega and Sousa



e-Buoy: How to predict the formation of toxins in “raw waters”

The e-Buoy project, an Intelligent *in situ* Monitoring System, with the intent of predicting the formation of cyanobacteria blooms (biotoxin production) in "raw waters" of dams/reservoirs, won the 1st Prize of INOV@UTAD - Spin-Offs at the Summer Innovation Campus, awarded with 5.000€.

A lot of the drinking water that reaches the tap comes from artificial “raw water” storage systems, namely dams/reservoirs. The main impacts resulting from the water reserve in the dams/reservoirs correspond to two phenomena: thermal stratification and eutrophication. With the phenomenon of eutrophication, the presence of cyanobacteria (cyanotoxin producers), frequently contributes to conditions of high adversity, both for aquatic ecosystems and also for public health through public water supply.

In view of the noted climate changes, it is possible to observe the extension of the typical periods of development of these blooms of cyanobacteria in dams/reservoirs of "raw water" for consumption. These blooms, which correspond to uncontrolled growth of these organisms in lakes, dams or reservoirs, are responsible for the production of cyanotoxins (neurotoxins and Hepatotoxins), classified as potentially carcinogenic to human (International Agency for Research on Cancer - 2006) and even in low concentrations, present a high risk to public health, since water treatment systems (ETAs) are sometimes permeable to these toxins, allowing their entry into supply systems, promoting silent and cumulative intoxication in populations.

The e-Buoy system is part of the area of environmental

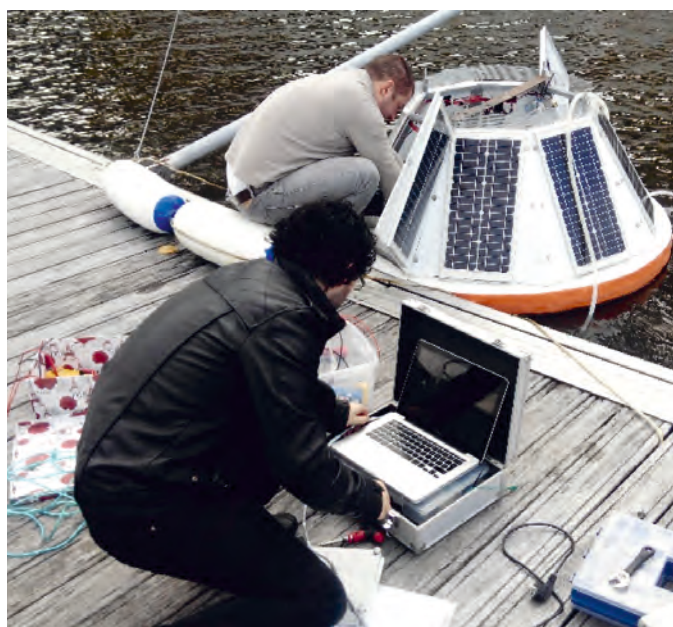
engineering solutions, leading to the provision of useful information in the scope of monitoring the quality of “raw water” used for human consumption.

This intelligent *in situ* monitoring system, in addition to the information it produces in real time (physical-chemical, meteorological and biological sensors) feeds a database that provides the stochastic-dynamic model with the ability to anticipate the development of these critical phenomena in dams/reservoirs supplying water to populations. The system comprises two main components:

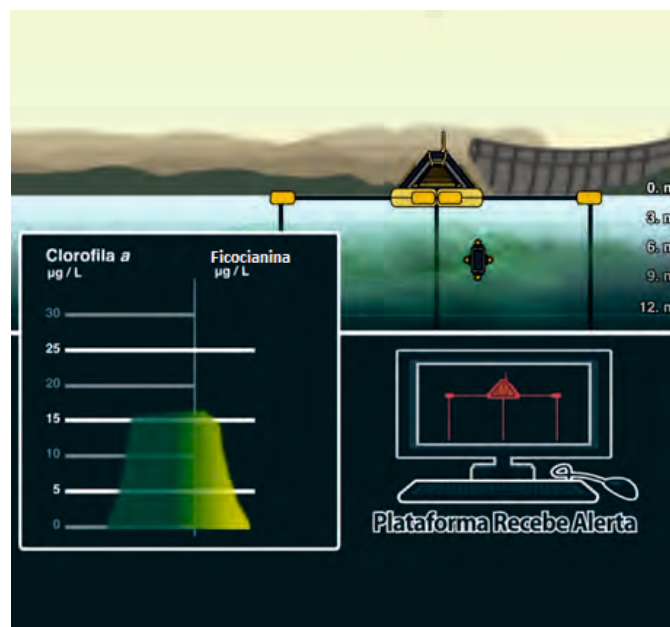
- Smartbuoy: e-Buoy, installed in the dam/reservoir, performs *in situ* monitoring of water quality and sends this information via GPRS / GSM or via satellite.
- Web platform that receives data sent by Smartbuoy, which, after being validated in the back office, are made available on a qualified access web portal.

The project, financed by Freshwater and supported by UTAD's business incubator, has been widely accepted by the scientific community, authorities and water management entities. A system, of the same technological family (e-Buoy-SmallRiver), has already been installed in the Baceiro river (Vinhais), for data acquisition by the Polytechnic Institute of Bragança for the purpose of scientific research in the area of water quality and another is being installed in the municipality of Penafiel.

E-buoy was developed by CITAB researchers Joaquim de Jesus and Rui Cortes, with the collaboration of Mário Santos.



e-Buoy in Bagaúste dam, during tests period



Online web platform

TURBO SUDOE Project- Fostering the transference of knowledge



Event "Innovative model of technological offer-demand collaboration" held in the University of Burgos

The TURBO SUDOE Project - Development, validation and demonstration of a model based on a network of Transference Brokers (TB) for direct technology transfer between R&D centres and companies in the SUDOE territory (2016-2019), was coordinated by the University of Burgos, and hosted by CITAB at the UTAD, by Professor Eduardo Rosa. The partnership included 4 R&D entities, 3 business clusters and a technology transfer company.

This project, which covered 3 distinct sectors, agri-food, energy/ICT and automotive, was focused on fostering the effective transference of knowledge, between the public and private sectors, through an innovative and sustainable process, feature by an active role of a Transference Brokers, in a total of 10.

To achieve its objective, were developed 2 pilot experiences, to fully integrate the TB, first on the operational environment of the Offer (I&D units and researchers) and subsequently in the operational environment of the Demand (clusters and companies). The TB allocated at CITAB, interacted with more than 30 researchers at UTAD, from 3 R&D centres, and was engaged to work directly with one of the major private agri-food organizations in Spain, the Federación Empresarial de Agroalimentación de la Comunidad Valenciana - FEDACOVA, in Valencia (30 Associates in a total of 2200 companies); within the working period was established an interaction with more than 40 companies.

Within this project was made a significative progress to define and design a strategic and operational model for the transference of science and technology. The project outcomes illustrate that the project had contributed to close the gap between SUDOE area and the more innovative and technologically developed regions in Europe by encouraging participation of private players in R&D activities. Following the two and half years of the project, can be stressed some results of the implementation of the model (in the agri-food sector): 28 disclosed inventions, 132 disclosed market needs, 181 presentation of technologies by the TBs to companies.

Overall were promoted 60 network events organized by both the Offer and the Demand side, as a crucial point for the validation of the process. The fostered collaborations between the different market players, was materialized in 6 project proposals (Regional, National and European).

3rd Annual Meeting of the Interreg SUDOE Project Open2Preserve



Open2Preserve Project team

Between the 16th and 19th of September 2019, the 3rd Annual Meeting of the Interreg SUDOE Project Open2Preserve - Sustainable Management Model for Mountain Open Spaces with High Environmental Value, coordinated by Rosa Canals of the Universidad Pública de Navarra, was held in Vila Real. UTAD is a partner in this project with a multidisciplinary team, including CITAB researchers Paulo Fernandes and Luís Ferreira.

The event included a set of lectures by invited specialist on the themes of protection and prevention of rural fires (AGIF representatives), on product valuation strategies (Universidad de Girona) and on issues regarding economic and financial studies related to valuation strategies (Center de Recerca en Economia i Desenvolupament Agroalimentari).

The last two days were reserved for visits to the Centro Tecnológico da Carne (Ourense) and the Pilot Experiences of UTAD (Aveção do Cabo, Vila Real), the Polytechnic Institute of Bragança (Romeu, Mirandela) and the Universidad de Santiago de Compostela (Navia de Suarna, Lugo), where the participants had the opportunity to observe, on the field, the evolution of the experimental plots, to question cattle breeders, local organizations linked to pastoralism and specialists in prescribed burning.



Dairy4Future - Propagating innovations for more resilient dairy farming in the Atlantic Area

The Dairy4Future (D4F) project is funded by the Interreg Atlantic Area Programme and aims to increase the competitiveness, sustainability and resilience of dairy farms in the Atlantic area. In this project, Portugal is divided in two regions (North and Centre and South and Azores) and CITAB's team is responsible for collecting data from eighteen pilot farms in the regions of North and Centre of Portugal.

Its objective is to identify, evaluate and then widely propagate innovative practices to European dairy technicians and breeders, through transnational seminars or farm open days. CITAB is already working with stakeholders and they have been invited to attend a focus group seeking their views about the sector and to engage in active dialogue with them.

D4F focusses on four key issues: analysing strengths and weaknesses of the dairy sector in Atlantic Area, fostering dairy sector economic resilience, improving resource use efficiency and determining sustainable dairy systems for the future.

The project puts innovative farmers at the centre of practice-based research work and combine several methods (SWOT analysis, research activities, economic simulation) to adapt and develop scientific knowledge, which will lead on technical solutions and recommendations to be shared across the network.

D4F project involves 5 countries (Portugal, Spain, France, United Kingdom and Ireland) and covers, from Scotland to Azores, 12 Atlantic regions that together represent 20% of EU-28 milk production and 100 000 farmers working in a wide diversity of milk production systems. With 11 technical partners and 21 associated partners, D4F relies on a strengthened scientific and technical network, completed by 10 experimental farms and more than 100 pilot farms. The project, coordinated by CITAB researcher Henrique Trindade, started in January 2018 and will finish in December 2021.



D4F projet team in S. Miguel island (Azores)

TRIPLE-C - Capitalising Climate Change projects in Risk management for a better Atlantic Area resilience

CITAB is a partner of the INTERREG Atlantic Area project TRIPLE-C “Capitalising Climate Change projects in Risk management for a better Atlantic Area resilience” in a partnership with 7 institutions: Association Climatologique de la Moyenne-Garonne et du Sud-Ouest; Chambre d’Agriculture de la Dordogne; Instituto Vasco de Investigación y Desarrollo Agrario S.A.; Westcountry Rivers Trust; Limerick Institute of Technology; Universidade de Coimbra and Universidade de Trás-os-Monte e Alto Douro.



Triple-C Project team

Triple-C is conceived as a capitalization initiative focused on the analysis, evaluation and exploitation of best EU projects on the prevention and management of risks deriving from climate change. The project partners will collaborate to disseminate and transfer the best practices and results identified in this domain with the final aim of mainstreaming into policymaking. Coordinated by Ronaldo Gabriel, CITAB's team is focused on the development of contributions based on “Nature and Health Promotion to Face Climate Change”.



Vegetables in our world

The H2020 project BRESOV - Breeding for Resilient, Efficient and Sustainable Organic Vegetable production, promoted the activity entitled “Vegetables in our world”, within the scope of the Science and Technology Week. This activity took place in the elementary schools (1st cycle), Centro Escolar da Lixa and Centro Escolar de Sande-Marco de Canaveses, North of Portugal, on 27th and 28th November 2019. The main objective was to show to young students the importance of vegetables (tomatoes, broccoli and beans) to human health, its own richness in beneficial compounds, and the diversity of shapes, colors, and the importance the different parts of the plants (roots, leaves, flowers, fruits and seeds). Children learned how these vegetables can be consumed and the importance of to the use of environmentally friendly agricultural methods.



Children learning about the importance of vegetables

European Researchers' Night – Science Wars



Science Wars activities

CITAB participated in the “European Researchers' Night - Science Wars” initiative, that took place on 27th September 2019, in Espinho and Braga. Research results were presented in a ludic way to a non-scientific public through a set of exhibitions such as “War to pollution”, “River mussel” and “Molecular Gastronomy”.

Visitors tasted strawberry pearls, spaghetti with mango and floating coca-cola, peek under the microscope fish embryos and saw river mussels water filtration capability. The European Researchers' Night is an initiative promoted by European Commission since 2005, with the aim of bringing science closer to citizens. The European Researchers' Night takes place simultaneously in more than 30 countries and 300 cities throughout Europe.

‘Cientificamente Provável’ initiative

CITAB is part of the “Cientificamente Provável” network, promoted by the Education State Secretary and the Science, Technology and High Education State Secretary in articulation with the National Agency “Ciência Viva”. This network aims through the national Basic and Secondary Education libraries to create opportunities to approach young students to the High Education system through activities that present the research and technologies developed by research units. Under this programme CITAB established partnerships with 6 groups of schools and promoted in February and March workshops, talks and visits to CITAB's laboratories. Among the activities, Ana Barros was responsible for the Molecular Gastronomy workshop given to the Restoration Kitchen/Pastry Technicians students of the professional school of Fermil and João Carrola presented the talk “The water importance” to students of the Agrupamento de Escolas Dr. Júlio Martins (Chaves).



Molecular Gastronomy workshop

Encontro Ciência 2019- Annual meeting of Portuguese researchers



Ana Barros presenting CITAB's research

From 8th to 10th July of 2019, researchers from CITAB, Pedro Melo-Pinto, Luís Filipe S. Fernandes PhD student Rita Martins and CITAB's Director, Ana Barros, participated in the national annual meeting of Portuguese scientists – Encontro Ciência 2019, that took place in Lisbon, presenting CITAB's research. Pedro Melo-Pinto discussed the use of non-invasive technology in viticulture, Luís Filipe S. Fernandes discussed the management of water resources in the context of floods and droughts, and Rita Martins presented preliminary results on the use of by-products (in flour) for the production of gluten-free bread. Ana Barros ended the session with a brief presentation of CITAB.



Grape stems: from waste to a powerful bioactive compounds source

Grapes are one of the most important and widely fruit crops produced worldwide, from which around 80% are addressed to the winery industry, representing one of the most important economical activities in several regions. The most important wine producing regions are in Europe (Italy, Spain, France, Germany and Portugal), America (USA, Argentina and Chile) and also Australia and South Africa. This industry generates huge amounts of by-products, consisting in organic wastes (around 9 million tons generated annually), such as grape pomace, seeds, pulp, skins, grape stems, and grape leaves, wine lees, wastewater, emission of greenhouse gases (CO₂, volatile organic compounds), and inorganic wastes, namely diatomaceous earth, bentonite clay, and perlite, representing large amounts of solid wastes, reaching more than >30% (w/w) of the total material transformed that constitutes only in Europe up to 14.5 million Tons.

In fact, winery by-products represent a negative environmental impact in several regions in the world despite recent improvements of waste management strategies. The principal objective is to use wastes from one sector as raw materials for other sectors. Grape stems contain a rich source of valuable compounds, namely phenolics, showing potential to be used directly, minimally processed, in distinct applications, besides composting, production of spirits, or power production. Effectively, although grape stems constitute a less-valorized residue from grapes, this natural source of bioactive compounds allows opportunities for innovative uses for this material. Furthermore, the high biological activities demonstrated by several authors concerning the phenolic compounds present in grape stems can be a useful tool to recovering and using these bioactive compounds as nutraceutical, natural food additives/ingredients, therefore showing potential to be used in pharmaceutical, cosmetics, and food industries. Therefore, multidisciplinary collaborations relative to phytochemical evaluations and biological activities will contribute to find promising uses for these by-products toward added-value products, contributing to the environmental protection of wine production zones.

Antibiotic resistance is a public health problem worldwide, having impact in morbidity and/or high mortality rates, especially in developing countries.



Colorimetric and extract analyses



Grape stems

Specific microorganisms such as *Listeria monocytogenes* and *Escherichia coli* are present frequently in processed food, constituting a health risk. In addition, one of the main causes of hospitalization worldwide are diabetic foot ulcer infections, mostly caused by *Staphylococcus aureus*. To combat bacterial resistance, alternative antibiotics should be searched and developed to overcome the effectiveness of those currently available.

Thus, in order to replace synthetic drugs/antibiotics with more effective natural compounds, there is a growing demand to find natural compounds that can be used in the development of new products. Grape stems may be integrated into this demand due to its polyphenolic content, thus enhancing sustainable development, with advantages for both the environment and the corporate economy.

The aim of this study was to evaluate the scavenging activity and the antimicrobial activity of grape stem extracts, against gastrointestinal and diabetic foot wound bacteria. As well as, the anti-inflammatory and the anti-aging activities, allowing to prove if this by-product will be a good bet to produce new formulations.

Grape stems proved to be a raw material that can be utilized in the cosmetic, pharmaceutical, and food industries, due to its great biological potential, demonstrating to have a high antioxidant power, besides being a matrix that can be applied in the fight against bacterial resistance through its use in the formulation of new antibiotics or in synergy with them. In addition, grape stem extracts, due to their anti-inflammatory power, may be used in the development of new anti-inflammatory drugs, and may also be applied in cosmetic products delaying skin wrinkling and treating/preventing pigmentation disorders due to its anti-tyrosinase and anti-elastase capabilities.



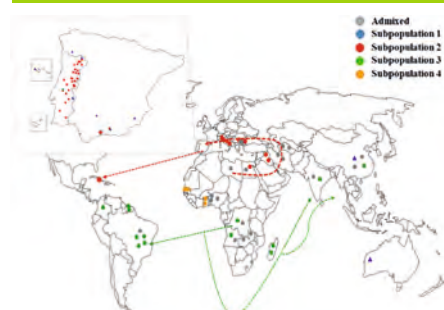
Márcia Carvalho

Genetic diversity and molecular responses to drought stress in *Vigna unguiculata* L. Walp

CITAB researcher Márcia Carvalho, defended her doctoral thesis “Genetic diversity and molecular responses to drought stress in *Vigna unguiculata* L. Walp.” on AgriChains Doctoral Program in December 2018. The use and improvement of crops with the ability to mitigate the effects of drought will be a key step for future crop sustainability. Cowpea (*V. unguiculata* L. Walp) is a warm-season grain legume, considered as an interesting crop due to its high adaptability to heat and drought, as well as to its association with nitrogen fixing rhizobia. As other legumes, cowpea plays a major role in the global food security by providing an affordable dietary source of nutrients mainly proteins. The main objective of the thesis was to contribute for a higher cowpea production in Europe, anticipating the upcoming climate changes. To achieve this goal, multidisciplinary approaches were undertaken involving field trials, molecular genetics, physiology and biochemistry approaches. The main achievements were: cowpea landraces had a high variability being Iberian Peninsula an adequate environment for cowpea production; cowpea accessions were grouped based on their geographical origin allowing to infer about cowpea dispersion routes using SNPs; stomatal function and quantification of proline and anthocyanins content were the suitable methods to discriminate genotypes drought tolerant; seven cowpea genotypes were selected as drought tolerant using germination tests. These results were published in seven journal articles and presented in several national and international conferences. The thesis scientific supervisors were Professor Valdemar Carnide (UTAD-CITAB) and Professor Teresa Lino-Neto (UM-BiolSI-CBFP). This study was partially supported by EUROLEGUME project (n° 613781) under FP7.



UTAD cowpea field trial



Population structure of 91 cowpea accessions. Geographical distribution of cowpea accessions and inferred cowpea dispersion routes



Drought stress glasshouse experiments
FC – field capacity

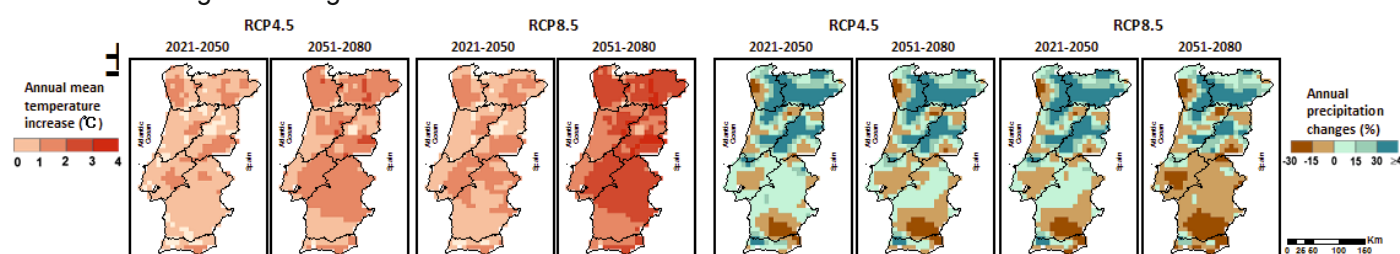


Chenyao Yang

Efficient tools to simulate main crops in Portugal for decision support systems

CITAB researcher Chenyao Yang, successfully defended his doctoral thesis entitled “Efficient tools to simulate main crops in Portugal for decision support systems” in November 2019. His thesis work aims to explore food security prospects for farmers and stakeholders in Portugal, by providing crucial information and insights on yield projections of three main crop production systems (i.e. irrigated grain maize, rainfed winter wheat and perennial grassland). He also aims to evaluate potential effectiveness of different adaptation options, in order to aid in developing, planning and enacting feasible adaptation strategies. Mediterranean region has long been identified as a prominent “hotspot” due to ongoing and projected changes in its climate means and variability.

Projected overall warming and drying trend, accompanied by greater frequency and intensity of extreme weather events across Mediterranean region, represents a substantial threat for sustainable crop production. Based on a modelling methodological framework, where climate projections deriving from climate model outputs are used to drive crop model simulations of crop growth and development, the risk assessment exercise provides qualitative and quantitative estimates of likely climate changes impacts on crop production, with added value to enhance the resilience of agri-food chains. The works were carried out under supervisions of João A. Santos (CITAB), Helder Fraga (CITAB) and Wim Van Ieperen (WUR). The thesis work was funded by FCT – Portuguese Foundation for Science and Technology (PD/BD/113617/2015), under the Doctoral Programme “Agricultural Production Chains - from fork to farm”.



Projected short-term (2021–2050) and long-term (2051–2080) climate change in Portugal



Sofia Correia

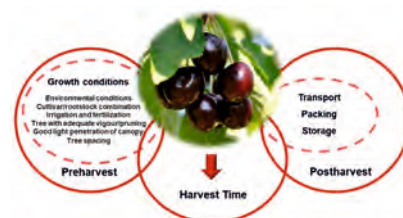
Pre and postharvest innovative strategies to enhance cherry quality

CITAB researcher Sofia Correia successfully defended her doctoral thesis “Pre and postharvest innovative strategies to enhance cherry quality”, in September 2019. Her supervisors were Professor Berta Gonçalves (CITAB-UTAD), Professor Ana Paula Silva (CITAB-UTAD) and Professor Rob Schouten (Wageningen University).

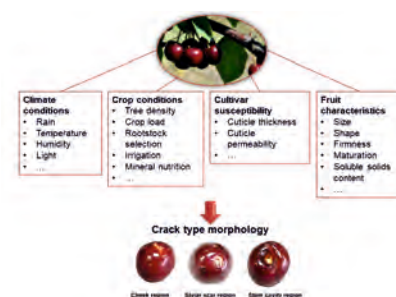
Cherries are attractive fruits, due to their colour, flavour, nutritional value and potential health benefits. However, cherry tree (*Prunus avium* L.) is susceptible to damage caused by low winter temperatures, spring frosts and cracking

of fruit during ripening. Moreover, the increasing frequency of intense preharvest rainfall resulting from climate change will aggravate the effects of cherry cracking.

In this context, the main objective of this study was to enhance the quality and yield of sweet cherries by different approaches, focusing on an evaluation of the suitability of the preharvest foliar spray treatments and also by the application of postharvest compounds, to extend cherry shelf-life. Moreover, Sofia's research intended to achieve further insight into preharvest spray treatments as part of orchard management practices, by understanding the physiological and biochemical response of the tree, and also to mitigate the impact of environmentally stressful conditions, to reduce the severity of cherry cracking. Results from Sofia's doctoral research showed that gibberellic acid and glycine betaine sprays increased the physiological performance and yield of sweet cherry trees and cherry quality attributes, thus could be a new strategy in the fruit production system. In addition, spray treatments in combination with calcium might be a promising strategies for cherry cracking mitigation. Sofia was funded by the Portuguese Foundation for Science and Technology PhD individual grant SFRH/BD/52541/2014, under the Doctoral Programme 'Agricultural Production Chains - from fork to farm' (PD/00122/2012) and by the project PTDC/AGR-PRO/7028/2014.



Factors affecting the quality of sweet cherry



Overview of the factors involved in sweet cherry cracking, including the types of the cracking



Andreia Carneiro-Carvalho

Silicon fertilization promotes the tolerance of chestnut plants (*Castanea sativa* Mill.) to abiotic and biotic stresses

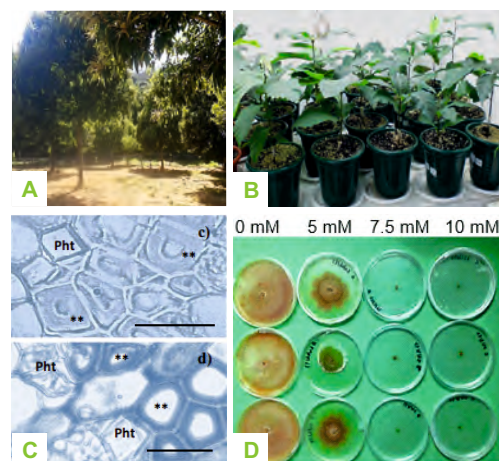
CITAB researcher Andreia Carneiro-Carvalho, defended her doctoral thesis “Evaluation of the silicon fertilization on resistance of chestnut plants (*Castanea sativa* Mill.) against to abiotic and biotic stresses” in December 2019. The aim of this work was to evaluate the role of potassium silicon (SiK) application in seedlings of chestnut plants submitted to conditions of abiotic stress (heat stress and water stress), and biotic stress (ink and blight diseases). Moreover, the effect of this fertilization was also evaluated on the chestnut production in adult trees. The presence of SiK in plants helped them to better tolerate the heat stress (34°C), limiting the reduction on gas exchange rates, and allowing faster and complete recovering after heat stress alleviation. Moreover, it was improved the

activity of many antioxidant enzymes and phenol content increasing the resilience. Histological studies revealed the

presence of phytoliths in tissues. These structures are largely referred by many authors as the main responsible for the improvement of stress tolerance, due to the promotion of the cell walls vitrification. In what concerns to water stress (-2 MPa), it lowered the decay on plant water, and improved the recovering of seedlings after the reintroduction of irrigation. In relation to the tolerance against diseases, the presence of phytoliths improved the enzymatic activity of phenylalanine ammonia lyase (PAL), polyphenol oxidase (PPO) and peroxidase (POD), and phenol acids and phytoalexin content with antifungal proprieties. Moreover the in vitro tests shown that phenol extracts from SiK fertilized plants promoted inhibition of *Phytophthora cinnamomi* and *Cryphonectria parasitica* development.

In the actual context of climate change, our conclusion supports the important function of this group of fertilizers into the increasing of the resilience of chestnut plants against abiotic and biotic stresses, opening a promissory future for it.

The thesis supervisors were José Gomes-Laranjo, Rosário Anjos and Teresa Pinto (CITAB-UTAD).



A. Sernancelhe assay field. B. Growth chamber assay. C and D. Histological sections of roots fertilized with Si and inoculated with ink disease. Pht. Phytoliths. ** fibers



Weina Hou

Molecular Mechanisms of Agrobacterium Recognition and Defense Activation in Recalcitrant Plants

CITAB researcher Weina Hou successfully defended her doctoral dissertation entitled “Molecular Mechanisms of Agrobacterium Recognition and Defense Activation in Recalcitrant Plants”, in June 2019, in the University of Minho. Her doctoral research was achieved under the supervision of supervisor Prof. Alberto Dias (CITAB, CBMA, CEB-UM), co-supervisor Dr. Franklin Gregory and tutor Prof. Ana Cunha (CITAB-UM) and developed in collaboration with researchers at the CBMA (UM), and CIB-CSIC (The Biological Research Center, Spanish National Research Council), Madrid, Spain.

Hypericum perforatum L. is a reservoir of high-value secondary metabolites, with a rapidly increasing interest for both researchers and the pharmaceutical industry. Hence, improving the production of these compounds via genetic manipulation is a challenging task. However, a major drawback is the recalcitrance of *H. perforatum* to *Agrobacterium tumefaciens*-mediated transformation. Hence, in the PhD study, *H. perforatum* was chosen as model plant to investigate the molecular mechanisms underlying plant recalcitrance to bacterial infection, by identifying and characterizing two key genes: Phenolic oxidative coupling protein (Hyp-1) and Polygalacturonase inhibiting protein (PGIP) selected from a forward subtractive cDNA library from *H. perforatum* suspension cells elicited with *A. tumefaciens* involved in these responses. In addition, to further contribute to understand the mechanisms of *H. perforatum* defense against *A. tumefaciens*, the transcripts of the core genes encoding enzymes involved in the plant defense pathways were analyzed by quantitative real-time PCR in *H. perforatum* cell suspensions challenged with *A. tumefaciens* and in dark glands obtained from *H. perforatum* seedlings. Overall, the PhD study provided a solid functional characterization of Hyp-1 and HpPGIP genes from *H. perforatum*, and contributed towards understanding the molecular mechanisms underlying *H. perforatum*-*A. tumefaciens* interaction. The study was funded by the FCT-Portuguese Foundation for Science and Technology (SFRH/BD/52561/2014), under the Doctoral Programme “Agricultural Production Chains – from fork to farm” (PD/00122/2012).



H. perforatum L. plant (A) and glands on flowers (B) and leaves (C) and the arrows indicate the glands. Adapted from Araújo PV (2018) *H. perforatum*, Flora-On: Flora de Portugal Interactiva, Sociedade Portuguesa de Botânica. www.flora-on.pt.



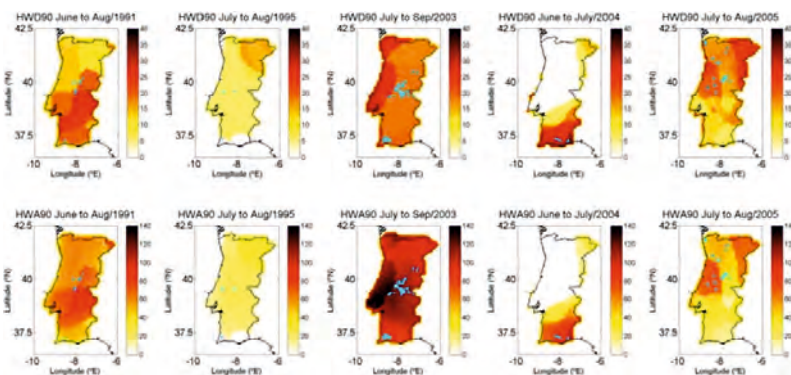
Joana Parente

Spatial and temporal characterization and the human and biophysical factors of wildfires in Portugal

CITAB researcher Joana Parente obtained her PhD degree on December 2019, with a thesis on the “Spatial and temporal characterization and the human and biophysical factors of wildfires in Portugal”. Her supervisors were Professor Mário Gonzalez Pereira (CITAB-UTAD), and Professor Marj Tonini (UNIL- Switzerland). Her study was focus on the identification and characterization of spatial - temporal variability of fire incidence as well as its main drivers, in particular for different fire causes, namely negligent and intentional wildfires. The temporal variability analysis was focus in the large wildfires (LWs) and their relationship with extreme weather and climatic conditions, namely heat waves (HWs) and droughts.

The main result of the temporal analysis indicates that the spatial-temporal distribution of LW is clearly associated with the high/low inter-annual variability of HW/drought. More specific, it is important to highlight: (i) 97% of the total number of LW was active during an HW; (ii) 90% of the total LW days was also HW days; (iii) 82% of the LW had duration completely contained in the duration of an HW; (iv) 83% of LW occurred during a HW; (v) almost all LW (97% to 95%) and corresponding BA (98% to 97%) occurred during drought; and, (vi) the relationship between drought and fire incidence is particularly strong for moderate and severe drought assessed by 3-month SPI, 3- and 6-month SPEI.

This study was developed during Joana's participation in the FIREXTR - Prevent and prepare society for extreme fire events: the challenge of seeing the “forest” and not just the “trees”, co-financed by the European Regional Development Fund (ERDF) through the COMPETE 2020 - (POCI Ref: 16702) and national funds by FCT-Portuguese Foundation for Science and Technology (FCT Ref: PTDC/ATPGEO/0462/2014).



Sum of heat wave duration (HWD90) and amplitude (HWA90) associated to the occurrence of extreme wildfires (burnt area > 5000 ha) in the years (1990, 1991, 1995, 2003, 2004 and 2005) with the largest burnt area and the number of extreme wildfires



4th INTERACT Conference - Challenges for rural territories in Trás-os-Montes and Alto Douro

On the corollary relating to the disclosure of the results obtained and the dynamic of interaction with local and regional entrepreneurs and agents, the 4th INTERACT Conferences, held in UTAD on April 10th, were the perfect moment to discuss the challenges that the agrarian sector face in the north of Portugal and how the research will act on those issues.

During the event, scientific experts and producers associations, invited to be part of this discussion, participated on three round tables that debated crucial topics of the agroforestry and food sectors, namely: “Environmental sustainability and climate change”; “Bio-products and technological innovation”; and “Rural desertification and territorial cohesion”.



INTERACT welcoming speech

Clim4Vitis conference: Evaluating the impact of climate change on viticulture



Clim4Vitis launch event

Clim4Vitis, CITAB's H2020 Twinning project, held its first event at Vila Real, from 18th to 21st February 2019. During the three days, took place the Clim4Vitis launch event, the “Grapevine Modelling” workshop and the “Viticulture & Climate Change” short courses. Representatives from major wineries, public entities and academia participated in the event.

Clim4Vitis launch event counted with four internationally renowned key speakers, from academia and industry, invited to present the most advanced research outreaches related to viticulture and climate change. During the “Grapevine Modelling” workshop, Clim4Vitis partners presented their research on climate and

crop simulation models. A surprising 113 participants, among students, researchers and relevant stakeholders, attended this event. The “Viticulture & Climate Change” short courses, given by the Clim4Vitis partners aimed to raise the audience awareness on the climate change impact in viticulture. These were attended by about 80 participants (among students, researcher and stakeholders) and addressed topics such as observation and modelling of the climate system, past and future projections in climate change in Luxembourg and climate changes projection and analysis of some approaches for evaluating the impact of climate change on viticulture.

From the Stream to the Coast: Valuing Ecosystem Services to promote the Sustainable Development of River Basins

Under the established collaboration protocol between CITAB and CIIMAR, the International Workshop “From the Stream to the Coast: Valuing Ecosystem Services to promote the Sustainable Development of River Basins” was carried out in 8th and 9th November. The Workshop gathered 70 participants within several networking sessions lectured by invited national and international experts on Ecosystems Services.

The main goal was to collect information and views on the valuation of ecosystem services from various regions of the Douro River basin from the source to the coast, and to understand how this approach based on ecosystem services can be used to support decision-making. Therefore, the Workshop payed special attention to the demonstrative relevance of freshwaters, estuarine and coastal ecosystem services, promoting the participation of different stakeholders and policy decision-makers, since they influence and are influenced by decisions on land uses and management. A special focus was given to the economic valuation of the ecosystem services, not only for the methodological challenges involved, but also because the final outputs can be of major interest for managers and policy-makers, with high impact on stakeholders.



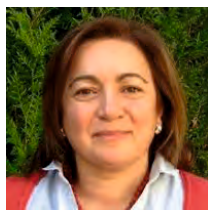
Opening session



Networking groups



Did you know that?



Felisbina Queiroga was elected for the Executive Board of the World Small Animal Association (WSAVA), in the general assembly meeting of July 15th 2019, in Toronto (Canada), for a 2-year mandate. This is the first time a Portuguese researcher takes on a position in the Executive Board of this world association, with 87 countries, 110 associations and over 200.000 members. Prof. Felisbina is also the president of the North Regional Section of the Portuguese Association of Veterinary Medical Specialists in Small Animals.

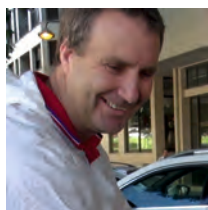


Nelson Machado, Miguel Rodrigues, Irene Gouveias, Rose Sousa, Bruna Carbas and Ana Abraão won the first prize of UTAD's competition "FoodValorization", with "Couscous of alternative flours" an innovative Couscous, made out of alternative flours and gluten and lactose free. Alexandre Gonçalves, Cátia Brito, Ermelinda Silva, Luís Rocha and Sandra Martins conquered the 3rd place with "Sheep cheese DOP - Olive+", a new sheep cheese with olive oil.



Domingos Lopes, Professor from the Forestry and Landscape Department of UTAD and member of CITAB, was appointed as the Vice President of the Côa Foundation, which was created for managing the heritage of the Côa Valley, by order of the Minister of Culture and under the appointment of the Minister of Science, Technology and Higher Education.

At the Côa Foundation, chaired by Prof. Bruno Navarro, Domingos Lopes will be responsible for scientific activity, studies and projects.



Luís Martins led the team responsible for the recovery and rehabilitation of "Freixo Duarte de Armas" the iconic and symbolic tree of Freixo de Espada à Cinta. This tree age is estimated to be over 500 years and is considered to be a Public Interest Tree.



Paulo Fernandes' article "Fire-severity mitigation by prescribed burning assessed from fire-treatment encounters in maritime pine stands" was selected as Editor's Choice by the Canadian Journal of Forest Research.



Mário Gabriel Santos's student Reinaldo Cajaiba PhD thesis, entitled "Soil beetles assemblages as ecological indicators in the neotropics: Implications for ecosystem conservation and restoration" was awarded with a Honorable Mention by CAPES Annual Awards Edition (Brazilian Coordination of Superior Level Staff Improvement), among 1140 candidates.



Pedro Melo-Pinto, Véronique Gomes, Armando Fernandes, Ana Mendes-Ferreira work "Wine grape ripeness assessment using Hyperspectral Imaging" was on the top 5 of 37 works submitted to competition in the international contest SIVE OENOPPIA AWARD 2019, promoted by the Italian Society of Viticulture and Oenology

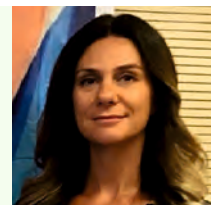
Did you know that?



José Laranjo is the new Coordinator of EuroCastanea - European Chestnut Network. EuroCastanea is the representative structure of the chestnut value chain at European level and currently includes representatives from Portugal, Spain, France and Italy, being supported by the Assembly of European Regions producing fruit, vegetables and plants (A.R.E.F.L.H.). José Laranjo is also the president of RefCast- Portuguese Chestnut Association and the coordinator of the International Society for Horticultural Science Chestnut Group



Lia-Tânia Dinis oral presentation "Grapevine Ecophysiology and Berry's Quality: Best Adapted Varieties in Douro Region Terroir" in the Conference "ISER - 636th International Conference on Agricultural and Biological Science (ICABS)", that took place in Crete (Greece) on the 8-10th of August, was awarded with the 2nd Best paper.



Publons recognized as Top Reviewer Felisbina Queiroga, Paula Oliveira, Carlos Correia and Rui Cortes in the fields of Agricultural Sciences, Plant and Animal Science, Cross Field, and Environment Ecology.



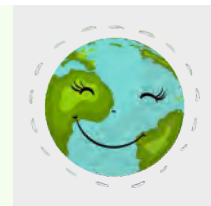
Maria José Saavedra is one of three Portuguese researchers in the Study Group of Veterinary Microbiology (ESGVM) of the European Society of Clinical Microbiology and Infectious Diseases (ESCMID), with members from all European countries and all continents.



In early 2019, CITAB received the visit of two prestigious North-American scientists. Prof. Arthur E. Bogan (left photo), from the North Carolina State Museum of Natural Sciences (USA) presented the lecture "Freshwater Bivalve Research in Asia 1997-2018" and Prof. Howard Thistlewood (right photo), from the British Columbia University (Canada) presented the lecture "Drosophila suzukii – why this little fly is causing problems to fruit trees and vines?"



CITAB was the sole national beneficiary of the PyroLife project, approved within the scope of call H2020-MSCA-ITN-2019 (Innovative Training Networks - Marie Skłodowska Curie Actions). This project, initiated at 01-10-2019, aims to form a new generation of interdisciplinary specialists in holistic and integrated fire management. A PhD student, among the 15 attributed to the project consortium, will join Paulo Fernandes's team at CITAB.



João Paulo Fidalgo Carvalho published the book "Silvicultura Próxima da Natureza" ("Forestry close to nature") on the conciliation of economy with ecology, contributing for a sustainable, multifunctional, integrated and profitable forestry management. José Laranjo was part of the editorial team of the book "The Chestnut Handbook: Crop & Forest Management" that gathered information on over 550 worldwide and commercial cultivars and on the more recent achievements on sustainable planning and management of chestnut production from nursery to plantation, entomology, pathology, and ecosystem services.



Short notes & Upcoming events

Thanks Laura Torres

After 40 years of dedicated service to agrarian education and research, Laura Torres, full member of CITAB since its foundation, is retiring from UTAD.

Laura Torres was one of the pioneers in the study of the use of mating disruption techniques against pests in Portugal; particularly, of the European grapevine moth (*Lobesia botrana* Denis & Schiffermüller), and the olive moth (*Prays oleae* Bernard). Her research career focused mainly on the development and practice of sustainable crop pest management strategies. Her kindness and personal relationship skills created close and reliable partnerships with stakeholders, in particular with farmers, and technicians from companies and farmers' associations, which resulted in the organization of several important activities and the achievement of many outputs for the agrarian sector.

Laura Torres published extensively in national and international JCR indexed journals but very aware of the knowledge transfer importance to end users, in a simple and accessible way, she published several technical brochures and technical journals' articles. CITAB acknowledges the legacy of Laura Torres' work in such a valuable research field.



Laura Torres

Brazilian doctoral students elect CITAB expertise in wood science



Performing dendrometric analyses

Giving continuity to the institutional cooperation between the CITAB and several Brazilian Universities, the researcher José Luís Lousada received two PhD students during one year. The first, Maria Naruna Felix from the Rural Federal University of Rio de Janeiro (UFRRJ), from November 2018 to October 2019, to evaluate the physical, chemical and anatomical properties of *Eucalyptus urophylla* wood harvested in 12 regions of Brazil. From this joint effort one article has been published in JCR journal 'Forest Ecology and Management' entitled "Heartwood variation of *Eucalyptus urophylla* is influenced by climatic conditions".

The 2nd PhD student, Thayanne Caroline Neto, came from the Federal University of Espírito Santo (UFES), from August 2019 to September 2020, and she's developing research activities in the area of dendrochemistry to evaluate how Rio de Janeiro's urban pollution is recorded in the wood rings of the *Caesalpinia pluviosa*.

Upcoming events



Nature and Health Promotion to face Climate Change

Workshop promoted by the Interreg project Triple-C, on February 27th 2020.



71st Annual Meeting of European Federation of Animal Science

International conference, held at Porto from 31st August to 4th September 2020.



Call for AgriChains PhD scholarships 2020 (6th edition)

Six (6) PhD grants opening during 2020.

Location and contacts

CITAB - Centre for the Research and Technology of Agro-Environmental and Biological Sciences

University of Trás-os-Montes and Alto Douro
Quinta de Prados, Laboratorial building,
Room C1.10
5000-801 Vila Real - Portugal

Phone: +351 259 350 920
email: citab@utad.pt
website: www.citab.utad.pt

/CITAB.UTAD

