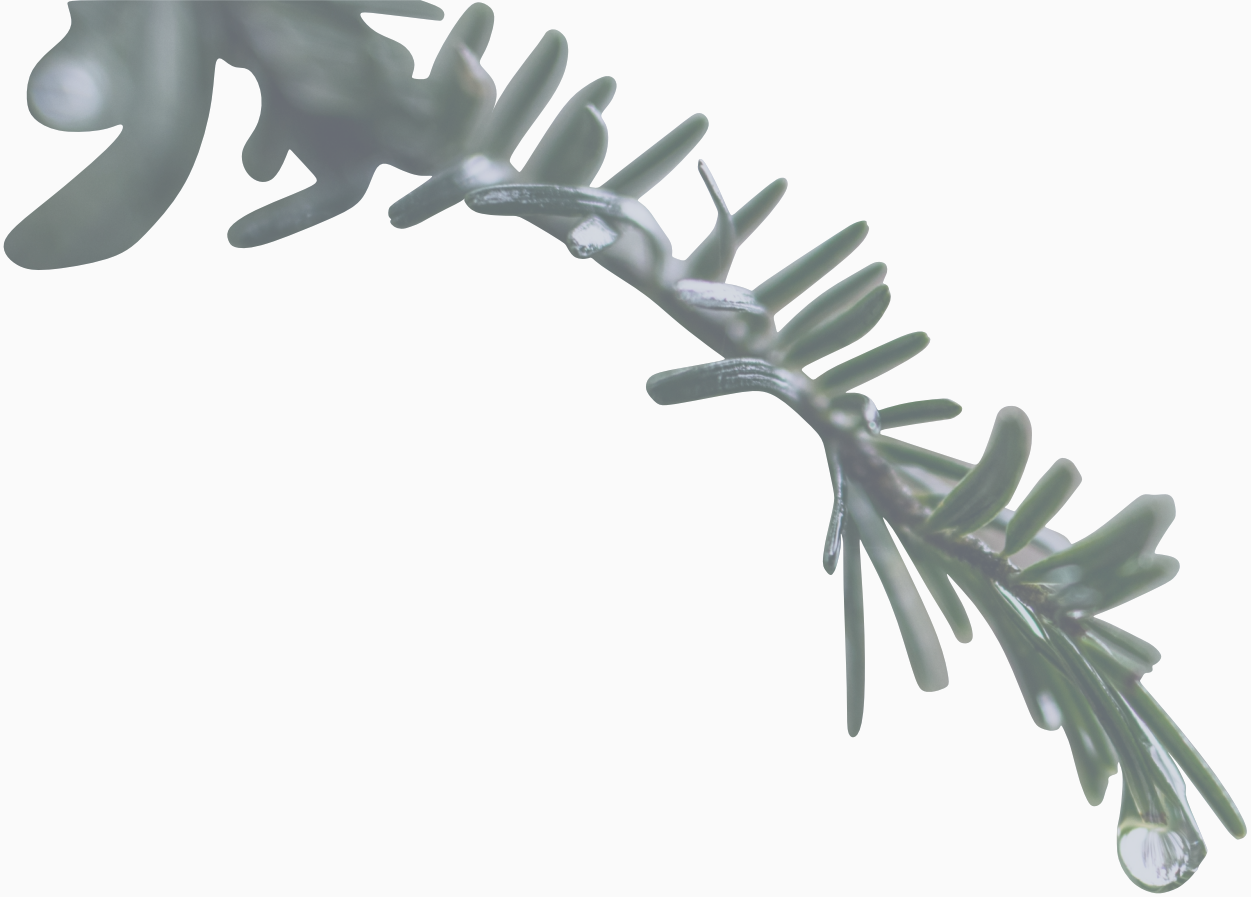
ACTIVITIES REPORT

2022

CITAB

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



Compiled and edited by:
CITAB Direction, Executive Committee, Management and Communication Team

INDEX

OVERVIEW

593
PUBLICATIONS

288 JCR/Scopus papers
15 PhD Theses
13 Books / Book chapters
277 Communications

80
ONGOING PROJECTS

17 International
39 National
24 Research contract

286

115 Full Members
95 Collaborators
76 Fellows

43% Men
57% Women

4.14M€
FUNDING

with stakeholders **1.87M€**
fundamental science **2.27M€**

10
CONFERENCES

5 International
5 National

1
SPECIALIZED LABORATORY

This CITAB Activity Report for 2022 demonstrates a sustained and quite strong vitality of the unit. Composed of 115 integrated members, 95 collaborators and 76 scholarship fellows, CITAB was composed of a total of 286 members, thus remaining the largest unit in northern Portugal in the scientific domains of Agrarian & Biological Sciences. In 2022, the CITAB scientific productivity was over 2.5 SCOPUS-indexed publications per Integrated Member, the highest ratio on record, with 93% of these articles in high-impact journals (Q1 and Q2). This stresses the growing international recognition of the CITAB's high scientific standards. As another key performance indicator, CITAB researchers were also participating in 80 national and international competitive projects. The participation in 17 European projects is still noteworthy.

As far as funding is concerned, similarly to previous years, an amount of almost 0.5 M€ of direct public funds was provided by the Portuguese Science & Technology Foundation (FCT), via the CITAB Strategic Plan 2020-2023 and within the framework of the Pluriannual funding of R&D units. Nonetheless, besides this direct public funding, which is critical for supporting the most essential activities of the unit, namely human resources for its day-to-day management and communication, publication fees, acquisition of laboratorial materials and equipment, and scholarship grants, CITAB was funded by many other sources, including important support from the private sector. In 2022, the total funding reached an unparalleled amount of over 4.1 M€.

In 2022, R&D funding with CITAB's stakeholders achieved a record high value of 1.87 M€. This value indeed corresponded to a further increase in our funding with the private sector from 40% (35%), in 2021 (2020), to 45%, in 2022, which is a remarkable landmark for the long-term sustainability of CITAB. The bulk of this value was obtained through both co-promotion projects with private partners (ca. 0.9 M€) and consulting services to private companies (ca. 0.8 M€), with a substantial increase in the former. In this context, a growing number of Mobilizer Projects (Agendas Mobilizadoras) under the Portuguese Plan for Recovery and Resilience (PRR) is worth mentioning. The Rural Development Projects (PDR 2020) are still relevant, though with a much less expressive contribution (ca. 0.2 M€). For the direct public funding (2.27 M€), it is notable that a very important part of it (more than 1/3) originated from FCT scholarship grants, both from Doctoral Programmes and Individual grants. The share of the FCT projects in the total funding keeps revealing a downward trend (only 5% of the total funding).

The CITAB events continued to represent a highly valued activity, as they are privileged communication channels between CITAB and society, promoting knowledge exchange between stakeholders, decision-makers, the general public and academia. Some of these events were also of utmost relevance in promoting the capacity building of CITAB researchers. Ten events were organized, or co-organized, by CITAB, 5 of them international.

The Institute for Innovation, Capacity Building and Sustainability of Agri-food Production (Inov4Agro) Associate Laboratory, which represents a strategic partnership between CITAB and the R&D unit GreenUPorto, from the University of Porto, is integrated into the national network of laboratories, being effective structuring components of the Portuguese Scientific & Technological System, with clear institutional commitments in the pursuit of national scientific and technological policies over a temporal range of at least one decade.

Overall, in 2022, the CITAB's activities reinforced its role as a major player in the Portuguese Scientific System, particularly in northern Portugal. The strong connection to the private sector highlights the applicability of its research, promoting knowledge transfer, capacity building and bringing added value to the Portuguese and European agrarian value chains, by the CITAB engagement in a growing number of national and international competitive projects, such as Horizon Europe.

CITAB has kept its way towards excellence. Its activities have been focused on both the R&D and T&I pillars, aiming at more resilient, efficient, sustainable and competitive agricultural and forestry production chains

The widely multidisciplinary approach of CITAB warrants a holistic viewpoint of the natural and anthropogenic systems. This concept enables integrated responses and the implementation of decision-support systems for stakeholders and policy-makers, envisioning the fulfilment of the United Nation's sustainable development goals and responding to the emerging societal transitions. All these research lines are complemented by cutting-edge technological support, always seeking innovative solutions. Knowledge transfer, capacity building, dissemination and outreach are also central to CITAB's

> *Agriculture is increasingly challenging, both in terms of agronomic activity itself, the promotion of agrifood products and issues related to climate change and new pests and/or diseases. The application of new techniques/practices and new concepts/strategies with the aim of enhancing not only the economic sustainability of agricultural enterprises but, above all, environmental sustainability, is an increasing need that producers have. The existence of CITAB in the region is fundamental to meet the needs of the agro-industrial companies of the region because, through the transfer of knowledge of the research/innovation developed by the CITAB, we will have much more efficient agriculture, from the economic, environmental and social point of view. This concept of a knowledge network is fundamental to boosting a new agronomic dynamic in this region, mainly through the close link between research and the needs of producers.*
>
> **Francisco Pavão, Associação de Proteção Integrada de Trás os Montes e Alto Douro (APPITAD)**

MISSION

CITAB is fully committed to collaborating and consulting stakeholders to understand their actual needs, problems or constraints. We follow multidisciplinary and integrated approaches towards the identification of solutions, creating new opportunities in the agri-food and forestry production chains. We are strongly committed to improving the competitiveness and sustainability of agrarian value chains, whilst developing holistic approaches to protect, improve and maintain ecosystems, and the services they provide, and promoting sustainable management of natural resources.

VISION

CITAB envisions contributing to the socioeconomic development of the Portuguese and European agrarian value chains through strong collaboration with stakeholders, exchanging knowledge and addressing their needs by incorporating innovative scientific and technological solutions.

Concerning its organizational structure, CITAB applies a "bottom-up" management approach. The **Directorate**, composed by one Director and two Vice-Directors, is supported by an **Executive Committee**, consisting of seven members from the different research tasks, which forms a dynamic two-way link between members and the Directorate for strategy development, progress checking and decision-making. All strategic issues are discussed and voted on by the **Scientific Council** (members with PhD and meeting regulations concerning publishing criteria), which meets a minimum of 4 times a year.

A dedicated **Communication & Management Office** handles the financial and administrative issues of the Centre, as well as the AgriChains FCT funded international doctoral programme, and supports the organization of national and international scientific events and outreach activities, liaises with UTAD administrative sections and assists the Board, Thematic Line coordinators, Tasks and the Executive Committee.

CITAB also has an **External Advisory Committee**, comprising four internationally recognized experts that make objective critical analyses of the unit's R&D activities and performance to provide recommendations. Additionally, the Centre relies on the advice of a **Stakeholders** Committee, which includes key stakeholders from the private and public sector and meets with CITAB members, the Directorate and Executive Committee periodically, to assess overall results and activities and lay down guidelines for the future.

THEMATIC RESEARCH LINES & TASKS

CITAB research activity is characterised by a streamlined approach, focused into two thematic lines that contribute to resolving societal and private sector issues in agriculture and forestry production chains and their impact on the natural environment: "Sustainability of Agri-food and Forestry Ecosystems in a Changing Environment"; and "Technology & innovation in Agri-food and Forestry Chains for a More Competitive Bioeconomy". This structure aims to balance scientific excellence with benefits and consequences across multiple dimensions that embrace environmental sciences and socioeconomic needs.

1-Sustainability of Agri-food and Forestry Ecosystems in a Changing Environment

Thematic Line "Sustainability of Agri-food and Forestry Ecosystems in a Changing Environment" (TL1) aims to monitor and assess how different types and scales of impacts affect agri-food and forestry chain systems, biodiversity and ecosystem services. It applies multidisciplinary research to develop integrated tools and methodologies to monitor how multiple scale impacts affect ecosystems and biodiversity. Activities in TL1 are focused into two Tasks: Task 1.1. Integrated monitoring of climate and environmental impacts and Task 1.2. Sustainability in agri-food and forestry ecosystems.

Task 1.1 *is highly interdisciplinary, using field, laboratory and computational techniques, advanced analysis, scaling and modelling tools and testing novel potential indicators of change. This task aims to (i) develop and apply new analytical technologies to (ii) understand climatic and environmental forcing on target ecosystems under current conditions; (iii) assess current and future scenarios of climate and environmental change to develop, test and implement suitable mitigation and adaptation measures, such as riparian restoration or bioclimatic cultivar adaptation.*

Task 1.2 *gathers multidisciplinary researchers in multivariate analysis and modelling of impacts of habitat and land use change on terrestrial and aquatic environments, ecosystem services and characterization of agri-food and forestry systems.*

2 - Technology & Innovation in Agri-food and Forestry Chains for a More Competitive

Thematic Line "Technology & innovation in Agri-food and Forestry Chains for a More Competitive Bioeconomy " (TL2) aims to use innovation to strengthen sector competitiveness by improving and expanding the potential range of agri-food and forestry products on offer. By promoting recycling, reuse and recovery of raw materials, TL2 brings added-value to agri-forestry ecosystems, agri-food and forestry products and co-products, by boosting both regional and national economic growth. TL2 directly involves sector stakeholders throughout the two vertically structured Tasks applying multidisciplinary research: Task 2.1. Innovative technologies and processes and Task 2.2. Valorisation of bio-based products and co-products.

Task 2.1 *promotes the optimization and development of innovative technology to the agri-food and forestry production chains, boosting competitiveness and income by improving food and forestry crop productivity, reducing management costs and increasing profit.*

Task 2.2 *research aims to uncover the potential of agri-food and forestry products and residues, including native flora and aromatic and medicinal plants to develop new high bio-based value products.*

ORGANIZATIONAL STRUCTURE (DECEMBER 2022)

CITAB

Executive Committee

Berta Gonçalves
(President)
Ana Coimbra
Ana Paula Silva
Emília Silva
Fábio Pereira
Isaura Castro
João Paulo Moura

Management Office

Daniel Faiões
Lídia Nóbrega
Lígia Pinto
Sandra Matos

BOARD

Director: João Santos

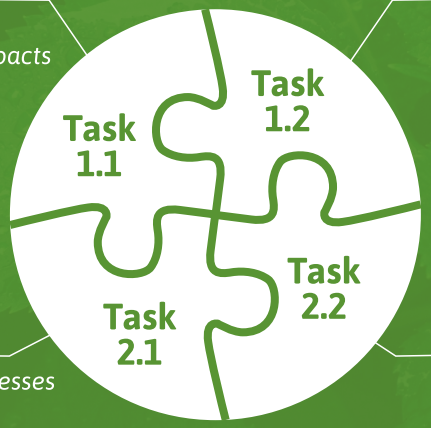
Vice-Director: Amélia Silva Vice-Director: Henrique Trindade

Research Lines & Tasks

1 - Sustainability of Agri-food and Forestry Ecosystems in a Changing Environment **(coord: Mário Santos)**

Integrated monitoring of climate and environmental impacts
Eunice Bacelar

Sustainability in agri-food and forestry ecosystems
Sandra Monteiro



Innovative technologies and processes
Pedro Couto

Valorisation of bio-based products and co-products
Ana Sampaio

2 - Technology & Innovation in Agri-food and Forestry Chains for a More Competitive Bioeconomy **(coord: Raul Morais)**

External Advisory Committee

David Lindsay
(EUROFEDA-UK)
Isabel Pardo Gamundi
(Univ. Vigo-SP)
Marco Bindi
(Univ.Florence -IT)
Uta Berger
(Univ.Dresden - DE)

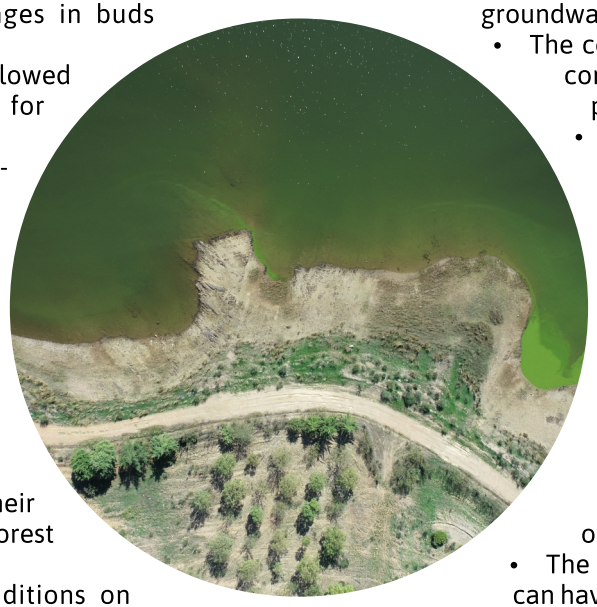
Stakeholders Committee

António Graça
(ADVID)
Braz Costa
(CITEVE)
Carlos Ribeiro
(PODES)
Francisco Pavão
(APPITAD)
Gonçalo Andrade
(Portugal Fresh)
Luís Rocharte Álvares
(WBCSD)
Nuno Calado
(Sonae Arauco)
Tiago Silva Pinto
(CNCACSA)

MAIN ACHIEVEMENTS

Task 1.1 - Integrated monitoring of climate and environmental impacts: adaptation and mitigation strategies

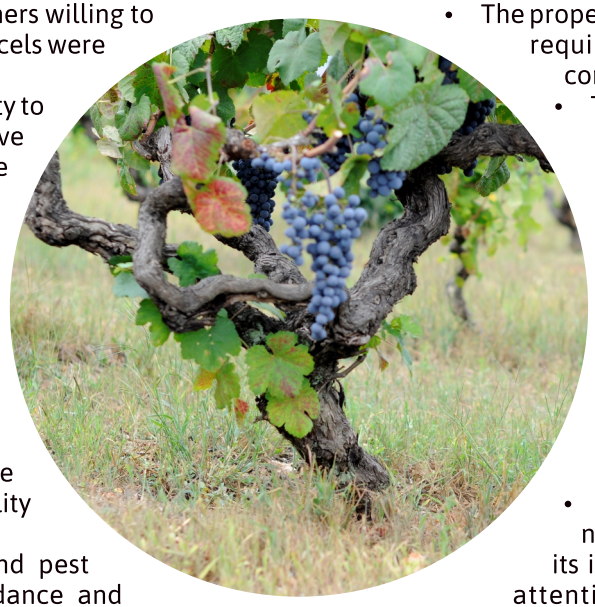
- Identification of European wine regions most susceptible to drought;
- Identification of Portuguese wine regions with potential for operational seasonal forecasts;
- Study of micro and mesoclimatic conditions on survival strategies of grapevines;
- Molecular analysis of the effect of alternative putative fungicides on grapevine defence genes against black rot, powdery mildew, and downy mildew;
- Metagenomic analysis of the influence of plant extracts and biological control agents' sprayings on grapevine leaves microbiome;
- New insights into the assessment of bud fruitfulness of grapevine varieties using different techniques and biochemical changes in buds between dormancy and forced bursting;
- The integration of cytogenetic and molecular data allowed the selection of the best biostimulant treatments for almond trees growing in Northeastern Portugal;
- Kaolin and seaweed-based extracts as a middle-long-term strategy to mitigate detrimental effects of climate change in the physiological performance of hazelnut tree and nut quality;
- The beneficial effects of exogenous compound sprays as a short-term strategy to mitigate cherry cracking were demonstrated;
- Cytogenomic assays revealed negative impacts of fire recurrence and induced water stress in root cell division of *Pinus pinaster* seeds collected in post-fire regenerated stands;
- Exploring the combination of fire risk indices and their persistence in predicting favourable conditions for forest fires;
- Recognize the influence of extreme weather conditions on wildfires. The relationship between fire time, fire incidence and vegetation was better understood;
- Tackling climate change impacts on biodiversity towards integrative conservation in Atlantic landscapes;
- Assessment of agricultural water security under climate change in the Iberian Peninsula;
- Fungal diversity and abundance in beach sand and recreational waters were screened in 91 bathing sites, spanning from the Atlantic to the Eastern Mediterranean coasts;
- Land use/cover influences the impacts of meteorological conditions;



- Shrublands are more suitable to burn in less extreme conditions than forests, a novelty for fire science in Portugal;
- Concerning the influence of climate on forests, namely on mixed forests, the findings reveal that regional climate moderately influences the species-mixing effect on tree growth-climate relationships and drought resistance for beech and pine across Europe;
- Improved understanding of the protective role of morphological features of some plant species against extreme weather events;
- Assessing groundwater resources and sustainability, considering areas for artificial recharge, as well as management of activities that can endanger groundwater quality;
- The concerns about water quality extend to the surface water compartment at the catchment scale, being focused on potential threats to humans caused by contamination;
- Development of mitigation measures related to river damming, particularly at the level of fish populations;
- The assessment of the consequences of a major damrupture, specifically in the level of water resources (superficial and underground);
- The effect of climate change on animal behaviour;
- Effects of outdoor activities on human well-being and health, without disregarding the ecological footprint associated;
- The development of innovative ecological multi-model frameworks by integrating biophysical, environmental and ecological data to understand the impacts of landscape changes and guide the conservation of endangered species and habitats;
- The effects of microplastics and copper, alone or combined, can have a negative impact at different biological levels, from the molecular to the physiological level in fish, emphasizing that microplastic toxicity is influenced by several factors;
- A dose-dependent toxicity of glyphosate-based herbicides (GBH) in zebrafish, concerning mortality and teratogenic effects was demonstrated;
- A participatory approach to landscape management, aimed at conserving biodiversity and assuring ecosystem services in the Atlantic area, has been tested with promising results and potential for application in other areas;
- Recent landscape ecology theories and animal behaviour hypotheses were tested using spatio-temporal models.

Task 1.2 – Sustainability in agri-food and forestry ecosystems

- The groundwater resources and their sustainable use were evaluated, considering the selection of areas for artificial recharge as well as the management of activities that can endanger the groundwater quality, namely agriculture, domestic and industrial effluents, or forest fires;
- Landscape composition and patterns on the control of contaminant propagation along streams were assessed, to approach the concerns about water quality to extend to the surface water compartment at the catchment scale, being focused on potential threats to humans caused by contamination;
- Water quantity and quality questions were analysed from the water security standpoint. Within the scope of water security problems, topics such as flood control and the payment for water services to landowners willing to produce clean water in their headwater catchment parcels were evaluated;
- Regarding the exploitation of genetic resources diversity to further cope with climate change some advances have also been achieved with the discovery of new grapevine genotypes identified in old vineyards of 'Trás-os-Montes' and 'Douro' regions that may reveal abiotic and biotic stress resistance and the molecular fingerprint of cowpea (*Vigna unguiculata* L.) and other Vigna species was performed for further screening to water deficit resilient genotypes;
- Biofortification of bread wheat seeds (S0 seeds) with Iron and/or Zinc improved the nutrition value of the whole flour and the grain yield of their offspring (S1 seeds) without the need to repeat the treatment. The unprimed S1 offspring surpassed the biochemical quality and agronomic performance of the S0 generation;
- Important contributions to species preservation and pest control have been achieved. The incidence, abundance and diversity of rots and fungi in three traditional chestnut varieties in Portugal (Longal, Judia, and Martaínha), sampled at various stages of processing and storage, were assessed. The causal agent of brown rot (*Gnomoniopsis smithogilvyi*) was detected for the first time in Portugal in post-harvest chestnuts, with a high frequency (up to 40%);
- Contributions were also made to promote a more sustainable production by using microalgae species to treat winery wastewater, simultaneously, producing biomass and added-values products. Mixotrophic cultivation of *Chlorella vulgaris* showed the best potential for application in both, wastewaters bioremediation and biomass productivity;



- A complex of 16 taxa of *Lobesia botrana* insect parasitoids, mostly belonging to Hymenoptera, was identified, with higher parasitism rates in vineyards with ground cover. The results obtained suggest a potential for the conservation biological control of L. *botrana* if ecological infrastructures around vineyards, and ground cover with native perennial plants within vineyards, are encouraged;
- Testing of new, more sustainable methodologies, replacing the use of plastics, demonstrated that the use of the developed biodegradable dispensers is effective in controlling the pest L. *botrana* in vineyards, and can be a viable alternative to reducing plastic waste in the viticultural ecosystem;
- The proper use of sustainable control techniques against insect pests requires an in-depth knowledge of the insect's behaviour concerning various biological parameters;
- The possible impact of climatic change on the (a)synchrony of L. *botrana* and vines has been studied. The phenology of both the grapevine and the pest has changed in the last decades due to the increase in temperature;
- Development of efficient and sustainable control strategies against D. *suzukii* by furthering the understanding of its bio ecology, and gaining insight into how the energy pathways of D. *suzukii* are modulated as a function of fruit nutritional geometry and sex. These findings are relevant as they can be used not only to control this pest population but also to better advise growers to invest in suitable fruit based on host nutritional geometry;
- Promotion of sustainable soil management practices, namely the type of soil inter row management, evaluating its impact on the water stress of vineyards. The results draw attention to the importance of considering soil interline management as a tool that can contribute to reducing the negative effects of drought;
- Promotion of the recycling and valorization of winery wastes for agronomic use through composting. The winery waste compost showed the potential to increase vineyard production, although further long-term field experiments are needed to clarify the effect of applying biochar to improve the sustainability of Douro vineyards.

Task 2.1 – Innovative technologies and processes

- Bread wheat seeds nutriprimed with Iron and/or Zinc improved the grain yield and quality of the untreated offspring as confirmed by field trials, high-performance liquid chromatography with fluorescence detection (HPLC-FLD) and high-performance liquid chromatography with pulsed amperometric detection (HPLC-PAD), respectively, and reduced the production cost;
- Improvement of enological parameter prediction models (pH, sugars, and anthocyanin content of whole grape berries), using data from hyperspectral imaging of local grape varieties (Touriga Nacional, Touriga Franca and Tinta Barroca). The model developed uses a deep learning approach (essentially) for sugar content determination, and allows for small errors in the inference stage, close to the upper limit (for field extended use) according to the industry partners, showing superior generalization ability than the other existing models;
- A novel complexity reduction scheme of the hyperspectral data was presented, based on posthoc DNNs explainability methods, and extensive testing of the impact of channel reduction using a low-cost multispectral camera (using the previous method for spectral region selection) instead of the usual hyperspectral one is underway;
- Orchard net covers increase resistance to cherry cracking disorder, by reducing the natural cracking index by 40%;
- The role of five selected flavonoids (apigenin, epigallocatechin-3-gallate, kaempferol, naringenin, and silybin) in the modulating receptor tyrosine kinase (RTK) and Wnt pathways was revised together with their relevance in the future design of drugs to mitigate and/or treat melanoma. Recent technologies and methodologies to improve the delivery of these poor water-soluble natural compounds were applied;
- Toxicological effect of commonly used pesticides: three pesticides of different physicochemical properties, namely, glyphosate (herbicide), imidacloprid (insecticide), and imazalil (fungicide), were selected to assess their cytotoxicity against distinct cell models (Caco-2, HepG2, A431, HaCaT, SK-MEL-5, and RAW 264.7 cells) to mimic gastrointestinal and skin exposure with potential systemic effect. *In vitro* cytotoxic profiles were correlated with pesticides' physicochemical parameters, namely molecular weight, water solubility, the partition coefficient in the *n*-octanol/water (Log Pow) system, the topological polar surface area (TPSA), and some hydrogen-bonds (donor/acceptor) and rotatable bonds. This study proposes the basis for a predictive model, that should be extended to a greater number of pesticides and other xenobiotics to further validate its effectiveness.

Task 2.2 – Valorization of bio-based products and co-products

- Assessment of cowpea immature pods and grains nutritional composition, compared with dry grains, highlighting this less water demanding legumes production as new plant-based protein products;
- Development of new edible coatings based on extracts of medicinal and aromatic plants for sweet cherry storage. Coatings improved the overall antioxidant activity of fruits, without negative effects on the content of bioactive compounds and the sensory profile of fruits. Coatings presented overall positive results, which might indicate that their use could be a safe, natural, effective, beneficial and innovative approach to preserving sweet cherry quality in postharvest storage;
- Characterization, for the first time, of *Thymus capitellatus* (Iberian Peninsula endemic species, listed as near-threatened) phytochemical composition and bioactivities. Extracts of this thyme species revealed neuroprotective and anti-diabetic activity, in addition to time- and dose-dependent anti-proliferative activity against Caco-2 (colorectal adenocarcinoma) and HepG2 (hepatic carcinoma) cells. Results highlight the need to preserve species with yet unknown molecular compositions and potential medicinal applications, as a means to not lose relevant nutraceutical and pharmaceutical sources of molecules;
- Valorization of labdanum resin from *Cistus ladanifer* L. (an abundant natural resource in the Iberian Peninsula) as a natural and sustainable ingredient for cosmetic, cosmeceutical and pharmaceutical industries. The phytochemical composition of labdanum resin was assessed by UPLC-DAD-ESI-MS, and anti-ageing and anti-inflammatory activity was reported for the first time (as UV protection, anti-elastase and anti-inflammatory activities in vitro), together with antimicrobial activities against relevant skin infecting microorganisms. It was concluded that labdanum resin showed potential to be used in sunscreen cosmetics, anti-inflammatory skincare cosmeceuticals;
- Assessment of potential health benefits of elderberries, the fruits of *Sambucus nigra* L., using *in vitro* methods. It was shown that extracts, rich in phenolic compounds, prevented glutathione depletion, reactive oxygen species production, abnormal morphological changes and DNA fragmentation, in response to t-BOOH oxidative insult. Results demonstrated that elderberries have a high potential in reducing cellular oxidative stress as well as in preventing inflammatory processes. It was also demonstrated that the major anthocyanins in elderberries effectively trap methylglyoxal (MGO) and reduce MGO-induced cytotoxicity in HepG2 cells. MGO is one of the main precursors of advanced glycation end-products (AGEs) production in the body which is implicated in numerous diseases;

- The phytochemical composition of several food products, namely broccoli, acorn and apple flours, beers, honey, strawberries, and other Mediterranean traditional foods, as well as agro-food co-products such as from olive, beer, and wine industries. Their potential antioxidant, anti-inflammatory, and antineurodegenerative properties were also evaluated, revealing interesting potential sustainable sources of bioactive compounds for medical and industrial applications. The valorization of these products has been also investigated through the development of new products, such as the production of gluten-free bread with the incorporation of apple flour or the production of muffins fortified with grape pomace from the Douro region, revealing both good technological and sensory properties as sustainable and healthy food ingredients.
- The development of a cowpea immature pod ready-to-eat purée for elderly people to promote the maintenance of their muscle mass and the synthesis of neurotransmitters implicated in depression disorder and sleep quality. The results suggested that cowpea immature pods have a remarkable potential to be included in the development of a new functional food product. The feasibility of distinct Fourier Transform Infrared Spectroscopy (FTIR) technologies in the near-infrared (NIR) and mid-infrared (MIR) intervals, in tandem with multivariate analyses, for the evaluation of *n*-alkane and long-chain alcohol concentrations in some food matrices was also investigated;
- Some *in vivo* studies have been conducted to investigate the anti-obesity effects of broccoli products flour (BF) in obese mice and the therapeutic properties of pomegranate (*Punicagranutum* L.) leaf infusion (PLI) towards an HPV16-transgenic mouse model. BF appears to have a beneficial effect in preventing weight gain and fat accumulation induced by hypercholesterolemic diets and the oral administration of PLI revealed antitumoral and chemotherapeutic potential against HPV16-induced neoplastic lesions and cellular damage;
- The treatment of chestnut shells (CNS), a recalcitrant and low-value agro-industrial waste obtained during the peeling of *Castanea sativa* fruits, by six white-rot fungal strains (Irpexlacteus, Ganoderma resinaceum, Phlebiarufa, Bjerkandera adusta, and two Trametes), followed by hydrolysis with a commercial enzymatic mix improved the saccharification yield. Both the high activities of laccase and xylanase explained the reduced sugars yield;
- Validation that oxidative stress mechanisms are implicated in the beneficial but also disruptive effects on the development of zebrafish larvae when exposed to bioactive compounds from plants.

ASSOCIATE LABORATORY

Institute for innovation, capacity building and sustainability of agri-food production - Inov4Agro

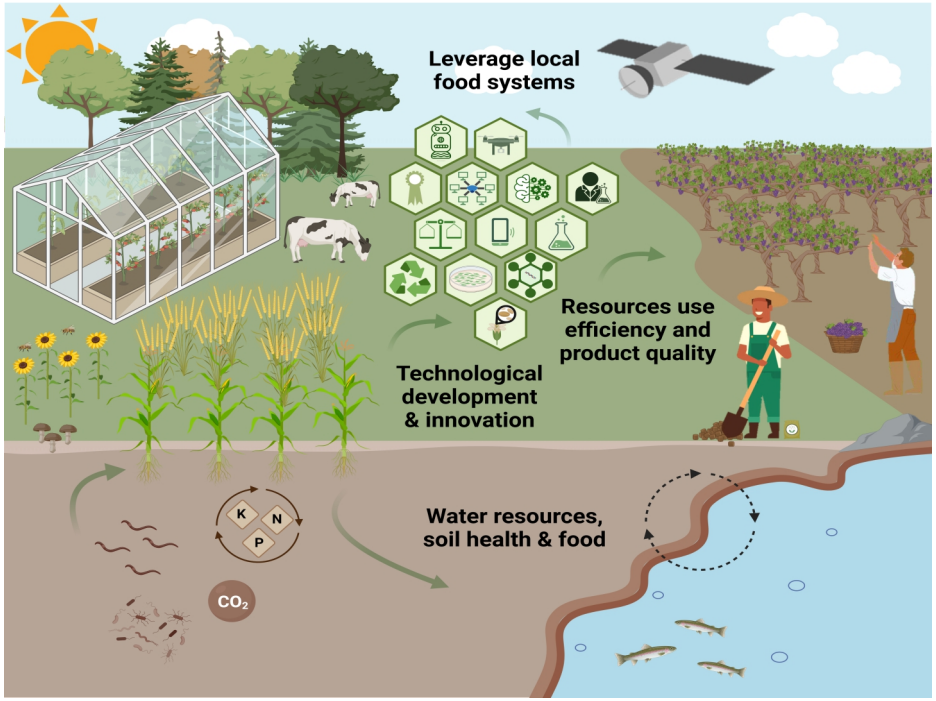
CITAB is the lead Research and Development (R&D) unit of the Associate Laboratory (AL) "Institute for innovation, capacity building and sustainability of agri-food production- Inov4Agro". Inov4Agro is a strategic consortium of two R&D units, CITAB and GreenUPorto, which have a track record of successful long-lasting cooperation and is the unit with the highest scientific productivity in the field of Agricultural Sciences in Northern Portugal.

A 10-year strategic plan has been developed, focused on four intervention areas: 1) Resources use efficiency and product quality; 2) Water resources, soil health & food; 3) Leverage local food systems; 4) Technological development & innovation.

Inov4Agro integrates the Portuguese Atlas of Associate Laboratories of FCT.

The Atlas of ALsisa FCT publication that gathers information on the 40 institutions or consortiums of institutions that have been awarded Associate Laboratory Status. FCT presented the Atlas during the conference "25 years of FCT in Science: Scientific Employment and Scientific Careers", an event held at the University of Coimbra, on March 31st, 2022.

Inov4Agro applied in July 2022 to the FCT call for Institutional Scientific Employment for Associated Laboratories (CEECInst-LA), to hirefourresearcherswithPhDsundertheScientificEmploymentRegulation (REC). CEEC Inst-LAaims to strength the critical mass needed to pursue specific objectives of national science and technology policy, bearing in mind the scientific challenges framed in the United Nations 2030 Agenda for Sustainable Development, to strengthen institutional cooperation in network, and to strength conditions for innovation.



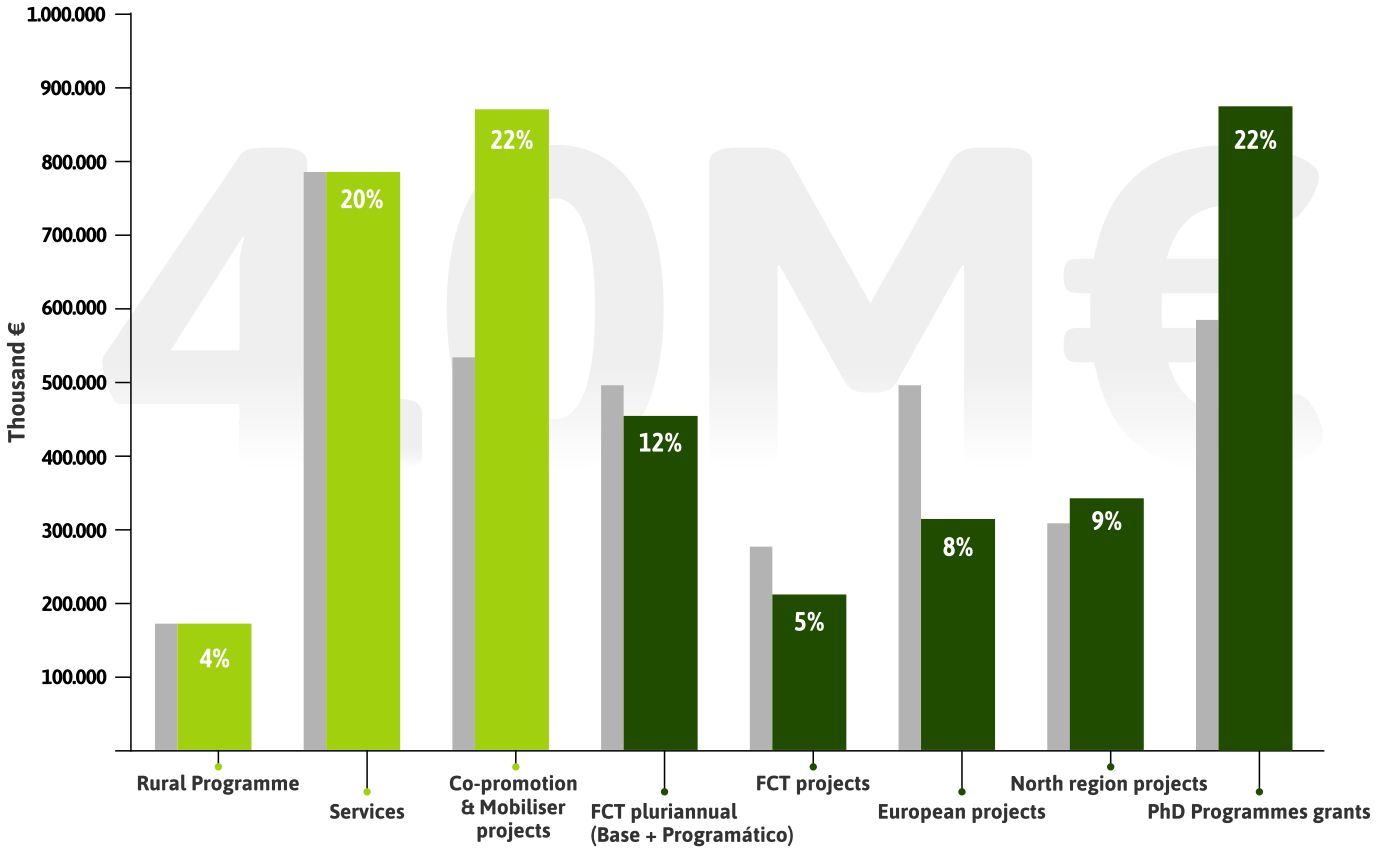
The International Congress 'Smartand Circular Agriculture towards Sustainability' (Porto, 21st-22ndJuly 2022) was the first major event sponsored by the Inov4Agro. The meeting sustained on three major themes: Feeding a growing population – Protecting the environment – Ensuring the livelihood of farmers; comprised the panels: 'Research, innovation and training in agriculture 4.0'; 'Circular agriculture and food systems' (with strong participation of CITAB, 'Vertical farming and urban farming' and 'Pest and disease control in sustainable agriculture'. The Scientific Committee of the event, which included the CITAB researchers Ana Barros, Cristina Carlos and Pedro Couto, was made up of specialists from Portugal, Spain, France, Austria, Greece, Netherlands, Latvia, Italy, Bulgaria and Hungary.

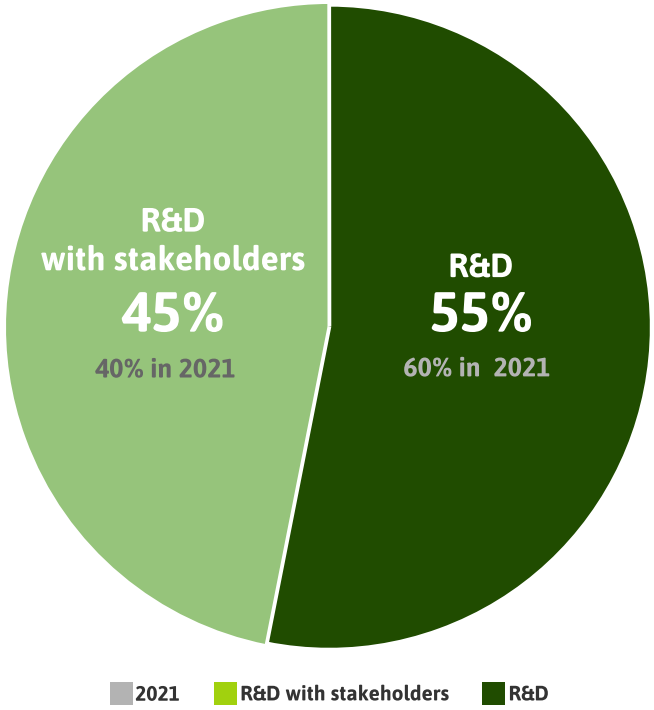
On December 16th2022, online meetings were promoted for the four the matic lines, when all the Inov4Agro members had the opportunity to share their main research fields and discussed potential collaborations.

COMPETITIVE FUNDING & RESEARCH PROJECTS

COMPETITIVE FUNDING

In 2022, the CITAB's total funding achieved an unprecedented amount of **4.14 M€**. Direct public funding represented **55%** of this value, which is the lowest ratio since the creation of the unit, thereby consolidating the pathway towards an increasingly stronger connection with stakeholders. The leading contribution of R&D projects with stakeholders is evident, with a share of **45%** in the total budget, mostly from the Mobilizer Projects (Agendas Mobilizadoras) under the Portuguese Plan for Recovery and Resilience (PRR) and consulting services to private companies, such as environmental impact assessments. The very important role played by the FCT scholarship grants (**22%** of the total funding), attributed within the framework of Doctoral Programmes or via Individual grants, is also a new outcome that illustrates the CITAB's ability to attract new young scientists, potentiating a continuous regeneration of its members and of its scientific competences. The relevance of European projects is also increasing at a solid pace (**8%** of the total funding), while FCT R&D projects are decreasing their relative importance (5% of the total funding). The North Region projects continue to have a secondary but still important contribution to the CITAB's funding (**9%** of the total funding). The FCT Programmatic funding corresponds to **12%** of the total budget. Although dissemination and outreach projects have only residual contributions, they are considered strategic for the CITAB's scientific communication plan.





ECONUTRI - Innovative concepts and technologies for ECOlogically sustainable NUTRIent management in agriculture aiming to prevent, mitigate and eliminate pollution in soils, water and air

Start date: November 2022 *Duration:* 42 months

ECONUTRI is a consortium of scientific experts and researchers from different disciplines, private companies, farmers' associations, and stakeholders. ECONUTRI is partnering with six Chinese Institutions, four from public research and two from industry, to complement activities and to strengthen the scientific collaboration between Europe and China. The project will scientifically support the EU's Green Deal in its target to reduce fertiliser use by least 20% by 2030, thereby reducing by 50% losses of nutrients associated with negative environmental impacts. More specifically, ECONUTRI will address water pollution caused by NO_3 and P leaching and run-off from cultivated soils, manure/slurry and plant residues, as well as greenhouse gas (N_2O, CO_2, CH_4) and NH_3 emissions from cultivated soils, barns, and organic biomass during storage, composting, and land application. ECONUTRI will optimise, validate, and demonstrate 24 innovative technologies that currently have a TRL of 4-6, and will increase their TRL to 7-8. These technologies are integrated parts of a holistic concept based on recycling of nutrients and organic material, novel machinery and fertilisers, novel decision support systems (DSS), and novel nutrient management plans incorporating nature-based solutions to reduce nutrient losses and to increase nutrient use efficiency. The expected results include hyperspectral analysis algorithms, advanced on-line DSS platforms to develop smart nutrient management plans for organic and conventional crops, protocols for circular cropping systems in open field and greenhouses, advanced emission monitoring feedback systems, novel manure spreaders, variable rate technologies for precision fertilisation, smart fertilisers, and biostimulants increasing N use efficiency. ECONUTRI will establish eight demonstration sites and deploy a comprehensive range of dissemination, communication, and exploitation activities to maximise the impact of the expected results and technologies.

econutri

Principal Investigator at CITAB: ***Henrique Manuel da Fonseca Trindade***
Leader Institution: ***Agricultural University of Athens***
Web site: ***econutri-project.eu***
Funded under: ***European Commission - Horizon Europe***

AGROSERV -Integrated Services supporting a sustainable Agroecological transitions

Start date: *September 2022* *Duration:* *60 months*

Developing a resilient and sustainable agriculture system, and the agroecological transitions requires a deep understanding of agroecosystems, their interactions with the environment, and management practices. AgroServ features a large consortium of research infrastructures, most of them being on the EU roadmap, and a vast offer of services at all scales, from the molecule to the organism, to the ecosystem, to the society. AgroServ will facilitate a systemic and holistic approach to understand the threats and challenges agriculture is facing, towards the implementation of a resilient and sustainable agri-food system. AgroServ propose a transdisciplinary offer of services, integrating the actors of the agriculture system in the research process, of which the farmers are the first, thanks to a wide offer of living labs across Europe. Most of the relevant field of sciences are represented in AgroServ, from natural to social sciences. It will develop a wider catalogue of integrated and customized services, thanks to a specific approach of service pipelines designed from a gap analysis, stakeholder and user demands. A strong community building and training program for access managers and users will be implemented to facilitate multi- and transdisciplinary research with all relevant actors. Results from the research performed under AgroServ will be synthetized to be used in the scope of evidence-based policy making. Data from AgroServ will be open and compliant with FAIR practices, and made available on the long-term to the communities, and be linked with the main European initiatives, as the EOSC. Strong links will be established with existing or future programs under H2020 and Horizon Europe, such as the partnerships agroecology, living labs and research infrastructures, and agriculture of data, as well as the two CSA AE4EU and ALL-READY, and the missions soil and plant health, and waters. AgroServ will collaborate with other relevant initiative in the Pillar II to of HE.

AGROSERV

Principal Investigator at CITAB: ***Mário Gabriel Santiago dos Santos***
Leader Institution: ***CNRS - Centre National de la Recherche Scientifique***
Web site: ***NA***
Funded under: ***European Commission - Horizon Europe***

LIFE FAGESOS - Phytophthora-induced decline of fagaceae ecosystems in Southern Europe exacerbated by climate change: preserving ecosystem services through improved integrated pest management (LIFE)

Start date: *September 2022* *Duration:* *60 months*

LIFE FAGESOS aims to address and remediate one of the most severe threats associated to global Climatic Changes: The outbreak of Alien Invasive Plant Pathogens, adversely impacting natural and semi-natural forest ecosystems. Phytophthora diseases are increasing their impact and distribution range in evergreen oak and chestnut ecosystems of the Mediterranean basin, boosted by temperature increase and higher frequency of extreme weather events such as flooding and drought. Scarce public awareness of the problem, severe human impact on forest areas and the new EU regulation on fertilizers, that limits the use of K-phosphonate, the most efficient and eco-friendly molecule to mitigate disease impact, further increase the risk of epidemic spread of these diseases. Challenged Forest Ecosystems need improved tools & strategies to enhance their adaptation to the outlined issue, finally ensuring their preservation as important natural carbon sinks. Indeed, FAGESOS will introduce tools to contrast diseases and enhance forests' resilience, by:

i) The delivery of regional maps for risk- and impact assessment of Phytophthora diseases in the Mediterranean basin in diverse current and predicted climatic scenarios, as a tool for policy makers and forest managers;

ii) The development, validation, implementation and dissemination of Integrated Pest Management (IPM) protocols, tailored to the specific target ecosystem, including a strictly scheduled use of new biomolecules and microorganisms with proven efficacy. Treatment protocols will be complemented by hygiene measures to prevent disease-spread;

iii) The delivery of fully accessible monitoring protocols, based on validated, innovative models & technologies;

iv) Intense communication, dissemination and capacity building activities, targeting different stakeholders to raise awareness and induce adaption of behaviour. The project will be implemented in Italy, Spain and Portugal through a multi-actor approach.

LIFE FAGESOS

Principal Investigator at CITAB: ***José Gomes Laranjo***
Leader Institution: ***COMUNE DI MONTE SAN BIAGIO (IT)***
Web site: ***NA***
Funded under: ***European Union LIFE Programme***

VineProtect - Ecological survey for biological management and protection of Mediterranean vineyards facing climate changes

Start date: March 2022 *Duration:* 36 months

Mediterranean vineyards are challenged by climate change that jeopardize the high-quality of its grape and wine. Also, diseases like mildews are limiting factors for grapevine production. Industrial management leads to a decrease of the vineyard ecosystem biodiversity, (over)uses of fertilizers and pesticides and may also overuse irrigating water. Thus, it urges to implement sustainable local strategies towards increasing biodiversity, reducing agrochemicals, increasing the resilience of the vineyard to climate change associated stressors like prolonged drought, and to common diseases (e.g., mildews).

VINEPROTECT consortium has 7 partners from Portugal, Italy, Turkey and Morocco, in a synergic complementarity. VINEPROTECT will take use of technological processes (e.g., genomics and microbiology, grapevine-(eco)physio(patho)logy, bio-gels, vineyards ecology, agronomy, and socio-economy) to develop sustainable agroecological procedures considering the specificities of the Mediterranean vineyards and the challenges associated to climate change.

The main objective of VINEPROTECT is to increase local vineyard resilience to both climate change (drought) and diseases, towards reducing the use of agrochemicals and boosting local circular agriculture.

VINEPROTECT

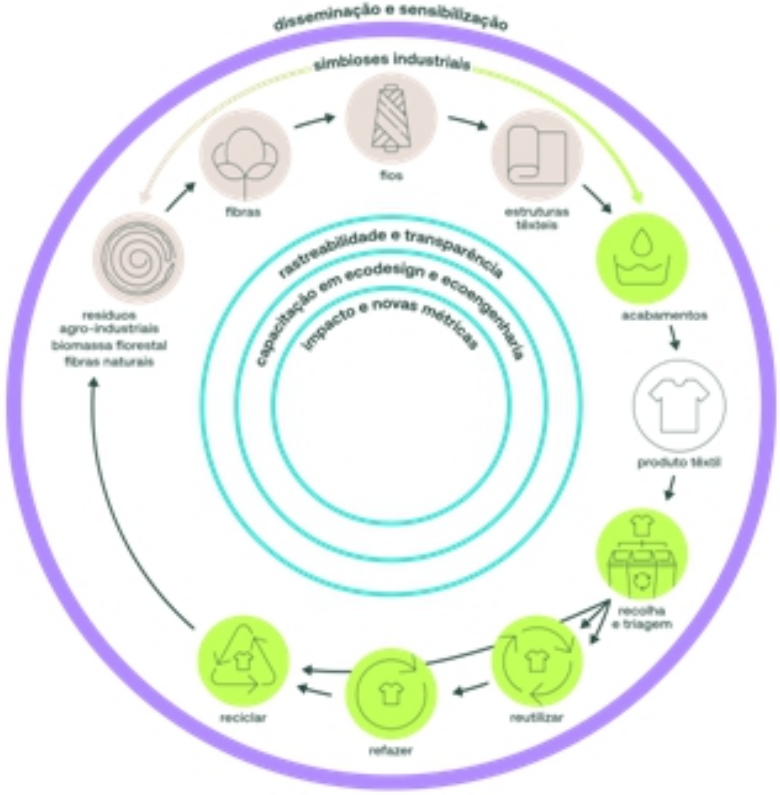
Principal Investigator at CITAB: ***Lia-Tânia Rosa Dinis***
Leader Institution: ***Faculty of Sciences University of Porto***
Web site: ***NA***
Funded under: ***PRIMA – Partnership for Research & Innovation in the Mediterranean Area*** *(section II)*

BE@T – Bioeconomy for Textiles and Clothing to Strengthen the National Bioeconomy

Start date: *July 2022* *Duration:* *36 months*

The Integrated Project BE@T – Bioeconomy for Textiles and Clothing to Reinforce the National Bioeconomy, Textile and Clothing Sector, within the scope of the Recovery and Resilience Plan of Portugal, in its component 12 – Sustainable Bioeconomy, Investment TC-C12-i01 – Projects Integrated, its main objective is to promote and enhance the Bioeconomy for Textiles and Apparel, with 54 entities involved in the development of the following 9 initiatives:

1 – Promote R&D activities for the use of forest cellulose (pulp and waste) for the production of artificial fibers and TNT.
2 – Boost the agro-industrial sector to value waste as a source of raw material for the production of new natural fibers.
3 – Boost the development of new cellulosic matrices for high technical textile applications.
4 – Promote the reuse of fibers (pre and post-consumer) for reintroduction in the extrusion process of natural and/or artificial fibers, through optimized recycling processes.
5 – Promote the use of waste and by-products from other sectors, as ingredients and/or raw materials for the development of new textile functionalization processes and new products.
6 – Stimulate the transfer and promotion of the intersection of Eco-Design and Eco-Engineering knowledge, in order to promote the development of products for circularity (zero waste).
7 – Stimulate the development of metrics that allow validating claims of sustainability and circularity of textile articles, in order to respond to the requirements of transparency and credibility.
8 – Stimulate the development of processes and tools to obtain the product's 'CV', which allows transparency and traceability in the supply chain, in a credible way, in robust systems such as blockchain.
9 – Strategic investment in consumer awareness campaigns and all stakeholders in the sector, with a view to information, awareness, stimulation of repair/reuse activities and enhancement of the "From Portugal" brand in the international market.



BE@T

Principal Investigator at CITAB: ***Eunice Luis Bacelar***
Leader Institution: ***CITEVE - Centro Tecnológico das Indústrias Têxtil e do Vestuário de Portugal***
Web site: ***https://bioeconomy-at-textiles.com/***
Funded under: ***Fundo Ambiental - PRR - Recovery and Resilience Plan***

RN21 - Innovation in the Natural Resin Sector to Strengthen the National Bioeconomy

Start date: July 2022 *Duration:* 42 months

The RN21 Integrated Project – Innovation in the Natural Resin Sector to Reinforce the National Bioeconomy, is based on three major guiding principles:
-Cover the entire Natura Resin (RN)value chain, from the forest to the final consumer, with a special focus on the markets and new products.
-To respond to the main needs and opportunities identified by the sector's agents.
-Contribute to the objectives of the PRR, specifically component C12 – Sustainable Bioeconomy but in articulation with other components, namely C8 - Forests and C5 - Business Capitalization and Innovation.
This is an aggregating consortium that brings together all the resin processing companies in Portugal, in an unprecedented effort at sectoral cooperation: three first processing companies; five second transformation industries, and three industries with vertical integration of the 1st and 2nd transformation.
This research and innovation consortium intends to enhance the great possibilities of application in the market, encouraging the revitalization of the entire value chain, with a view to its modernization, sustainability and incorporation of technical-scientific knowledge. The combination of public and private investments will leverage the ecological and digital transition and create favorable conditions for collaboration between companies and R&D&I partners.
GOALS: OG1. Contribute to the economic resilience and promotion of the sustainable bioeconomy in Portugal through the revitalization of the natural resin industry; OG2. Contribute to carbon neutrality and to a more productive and resilient productive and resilient Portuguese forest; OG3. Contribute to territorial cohesion; OG4. Contribute to the strengthening of investment in science and technology;
These goals will be achieved through the execution of 22 key measures that will result in products, projects and services, based on research and knowledge, for resin producers, industry and transformation and the market.

RN21

Principal Investigator at CITAB: ***Maria Emília Calvão Moreira da Silva***
Leader Institution: ***ForestWISE – Laboratório Colaborativo para a Gestão Integrada da Floresta e do Fogo***
Web site: ***www.forestwise.pt/projetos/rn21/***
Funded under: ***Fundo Ambiental - PRR - Recovery and Resilience Plan***

Vine & Wine PT - Driving Sustainable Growth Through Smart Innovation

Start date: November 2021 *Duration:* 50 months

This project aims to foster energy transitions, digital innovation and value throughout Portugal's vine and wines value chain. This will be achieved by developing and deploying mainly TRL9 innovations that will be the key to fostering a sustainable and environmental-friendly production chain and respective labels for the identified products. Moreover, the project will lead to an improvement in environmental responsibility and accountability, which will create the added benefit of attracting national and international consumers – who are increasingly aware that their commercial choices can lead to significant changes in industrial and agricultural practices.

In a summary analysis of the key points critical to solving the major current problems of the National Wine and Vine sector (extendable also to other wine-producing player countries), the greatest proof of the synergies between the consortium members of this Agenda can be given by the simultaneous participation of the consortium members in one or several R&D and Productive Innovation projects, framed in 3 key areas:

Sustainability:
Zero carbon, decarbonisation and green economy; Energy spent on harvest and vineyard work, fuel processing and hybridisation; Waste-free vertical chain; Recycling and reuse of water; Circular economy.

Automation, innovation and production efficiency:
Robotisation and dronetisation; Intelligent wineries of the future.

New processes and new products:
New enology production processes; New materials; New wines: soft drinks from the exploration of wine aromas, new types of wine, wines with a lower alcoholic degree, wines in packages with a lower carbon footprint.

Principal Investigator at CITAB: ***Raúl Morais dos Santos***
Leader Institution: ***Granvinhos, Lda.***
Web site: ***NA***
Funded under: ***Mobilising Agendas / PRR - Recovery and Resilience Plan***

TRANSFORM - Digital transformation of the forestry sector for a resilient and low-carbon economy

Start date: October 2021 *Duration:* 48 months

TransForm is an Agenda created under Component 5 (C5) of the Recovery and Resilience Plan (RRP), which focuses on Business Capitalisation and Innovation, in the context of the incentive systems for Mobilising Agendas and Green Agendas for Business Innovation.

The TransForm Agenda is a unique national initiative whose main aim is to trigger the structural transformation of the Portuguese forestry sector, intervening in a concerted manner throughout the value chain towards digital transition, economic resilience and carbon neutrality, driving the sustainability of the forest and contributing to increased business competitiveness in the sector. The Agenda brings together 59 participants who make up a full consortium representing the entire forestry value chain, from forest producers, companies, territorial management entities and knowledge centres. It is materialised in 28 collaborative, mobilising and mutually complementary projects, which will result in new products, processes and services, supported by digital technologies, with a high degree of innovation, which will contribute to more sustainable forest management and improve the efficiency of companies, ensuring a greater connection to markets and consumers.

The work of this consortium will give rise to new products, processes and services of high added value in the areas of sustainable forest management, green operations and logistics, industrial transformation and circular economy, markets and consumers and professionalisation of forest employment.

The implementation of this Agenda will have a national scope and the total investment planned is around 130 million euros, allocated to productive investment, research, development and innovation, qualification and internationalisation, dissemination and training of human resources.

Principal Investigator at CITAB: ***Maria Emília Calvão Moreira da Silva***
Leader Institution: ***AltriFlorestal S.A.***
Web site: ***https://www.forestwise.pt/projetos/transform***
Funded under: ***Mobilising Agendas / PRR - Recovery and Resilience Plan***

VIIAFOOD - Platform for the Agri-Food valorisation, industrialization and Commercial Innovation

Start date: October 2021 *Duration:* 51 months

The Agenda Mobilizadora VIIAFOOD is a platform for industrialization and commercial innovation for the agri-food sector. It aims to create a platform, on a national scale, for the development of innovative products, processes and services, materializing in a concerted strategic plan, with joint measures and actions oriented towards the common objectives of the sector.
This agenda intends to develop 130 products, services and packaging, as well as new processes, by 2025, in a sector of great importance for the economy that aggregates more than 11 thousand companies, 287 thousand employees and represents 6% of the national GDP.
The aim is to boost the transformation of the Portuguese food sector and increase the competitiveness of national companies in line with national and international trends in healthy eating and sustainability. This project represents a global investment of around 110 million euros, of which around 50% is financed under the Recovery and Resilience Programme's "Mobilizing Agendas for Corporate Innovation" and the remaining 50% by the companies involved.
The VIIAFOOD Mobilizing Agenda involves 29 companies from different activity areas in the food sector and 20 entities from the National Scientific System, associations and collaborative laboratories with competences in the areas of R&D applied to the food sector.

Principal Investigator at CITAB: **Ana Novo Barros**
Leader Institution: **SONAE MC S.A.**
Web site: **NA**
Funded under: **Mobilising Agendas / PRR - Recovery and Resilience Plan**

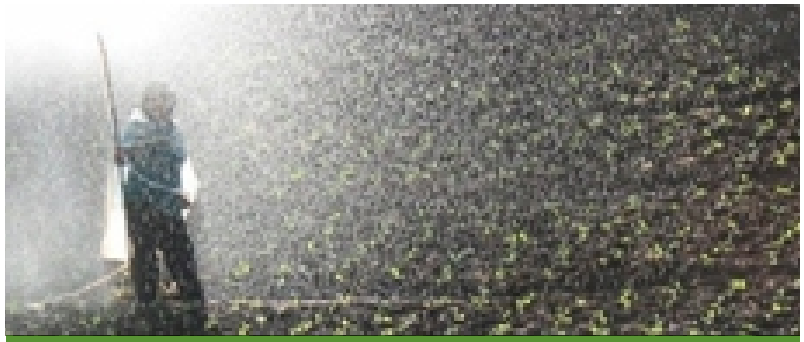
GREENValue - Valorisation of Resource Generation in Natural Space

Start date: *July 2022* *Duration:* *29 months*

The GREENValue project aims at the ecological restoration of significant areas of forest land at risk of desertification in the Municipality of Alfândega da Fé (classified as semi-arid and dry sub-humid according to the 1980-2010 Aridity Index). In this sense, the project proposes to test the introduction of 4 tree species (2 coniferous species - stone pine and maritime pine - and 2 leafy species - cork oak and holm oak), well known for their adaptability to this type of ecosystems, in the afforestation plans to be implemented.

Additionally, GREENValue proposes the inclusion of biofertilizers, mainly from wastewater treatment plants of the Alfândega da Fé municipality, treated through stabilization with calcium oxide (quicklime) or composted, in order to improve soil quality and its ability to provide ecosystem services, particularly in terms of maintenance and development of vegetation cover. In this context, it is intended to validate the forest application of these by-products, giving them added value and allowing to mitigate two current environmental problems: the loss of soil quality (and consequent desertification process) and the destination and recovery of large quantities of by-products from the WWTP and structuring materials from the activity of the company Resíduos do Nordeste, in order to promote circular economy but also to make their application to soil more eco-compatible. We intend to monitor these field tests in order to evaluate the effectiveness and sustainability of the applied restoration plans, as well as the effectiveness of the application of biofertilizers in the mitigation of desertification, namely by assessing the effects on the soil, and on the plant cover at the silvicultural and ecophysiological level.

Furthermore, we also intend to develop alternative processes for the treatment of sludge from wastewater treatment plants, through the conventional composting technique and vermicomposting, testing solutions that include the evaluation of different mixtures in order to obtain a final product properly sanitized, stabilized and matured. These solutions will be subsequently tested in bench trials, with the intention of leaving the door open for future field trials in an attempt to obtain safe biofertilizers for future use in the forestry sector, in a closing the loop perspective.



GREENVALUE

Principal Investigator at CITAB: ***José Gomes Laranjo***
Leader Institution: ***Águas do Norte, S.A.***
Web site: ***NA***
Funded under: **Compete/ REACT-EU**

MULTI-CRASH - Multidimensional ecological cascades triggered by an invasive species in pristine habitats

Start date: *January 2022* *Duration:* *36 months*

Biological invasions are responsible for multiple effects on ecosystems, affecting species interactions and various ecological processes. Predicting and managing the impacts of biological invasions on communities and ecosystems depends on the ability to empirically characterize complex biological interactions at appropriate spatial and temporal scales. However, successful predictions of the effects of invasive non-native species depend on our ability to quantify these impacts in terms of biodiversity dynamics and ecosystem functioning, which makes overall assessment very complicated, as data acquisition can be methodologically demanding. In addition, it is rarely known whether non-native species are "drivers" of observed ecological changes over time or only "transient" in response to other global factors (e.g., climate change, pollution) . Finally, increasing evidence suggests that the effects of non-native species may affect other ecosystems not directly invaded (e.g., impacts of aquatic non-native species may spread to adjacent terrestrial ecosystems. This project will assess the multi-trophic, multi-dimensional ecological impacts mediated by a non-native species in pristine areas.

Principal Investigator at CITAB: ***Simone da Graça Pinto Varandas***
Leader Institution: ***Universidade de Trás-os-Montes e Alto Douro***
Web site: ***NA***
Funded under: ***FCT – SR&TD Project Grants***

DMIMPT - Development of methods for the identification of mechanical properties in tissues of plant origin

Start date: December 2021 *Duration:* 18 months

Skin appearance and cracking is one of major causes of fruit value decrease and losses. It is well recognised that fruit skin (FS) is subjected to a complex stress field during fruit growth, harvesting, storage and transportation. Furthermore, FS has a complex mechanical behaviour, rendering the identification of its constitutive laws a challenging issue from both theoretical and experimental points of view. Understanding the relationships between the composition and morphology of FS and its mechanical behaviour is an important research topic, with a clear economic impact in the agro-food industry.

In the literature, the majority of works address material parameters of fruits and fruit skin (such as rupture force, rupture energy and firmness) with conventional approaches and try to relate them with production and post-harvesting factors. The experimental and data reduction methods used in those works did not allow the identification of intrinsic mechanical properties of FS, which can be used in numerical simulations of fruit behaviour. Considering this, we intend to develop direct and inverse methods, based on numerical simulations and full-field displacement measurements, to identify the hyperelastic constitutive behaviour of FS. With this approach, the relationships between mechanical properties and material composition and morphology can be accessed in a rational way.

It is worth mentioning that the global objective of the research team (RT) is to develop methods based on an inverse approach for the identification of the entire properties package in fruits from a single mechanical test. The achievement of this objective is attainable in three main steps. The first one involves the development of a set of methods to characterize the mechanical behaviour of each anatomical structure (exocarp, mesocarp and endocarp). The second one regards the development of numerical tools to generate the geometry of the referred fruit structures. The third one involves the conception of inverse methods to estimate material properties based on a single test at the fruit (organ) scale. For this exploratory work the RT will be focused on one major component, i.e., the skin (or exocarp). Apple will be used as the fruit model in this work, due to its importance in the deployment region (University, UTAD) as well as to the Portuguese agro-based economy. It is worth mentioning that the proposed methodology can be applied to other materials. Despite the importance of the agro-industry to the Portuguese gross value added, there is still a lack of knowledge among the Portuguese research community dedicated to the plant tissue biomechanics. Hence, besides the scientific objectives, this work will contribute to develop the research skills of CITAB in the domain of plant tissue biomechanics.

DMIMPT

Principal Investigator at CITAB: ***Fábio André Magalhães Pereira***
Leader Institution: ***Universidade de Trás-os-Montes e Alto Douro***
Web site: ***NA***
Funded under: ***FCT – SR&TD Project Grants***

ECONUTRI - Innovative concepts and technologies for ECOlogically sustainable NUTRIent management in agriculture aiming to prevent, mitigate and eliminate pollution in soils, water and air. CITAB Coordinator: Henrique Trindade. Staring date: November 2022, duration: 42 months (Grant Agreement nr 101081858). CITAB/UTAD funding: 283.885,00€.https://econutri-project.eu/

AGROSERV -Integrated Services supporting a sustainable Agroecological transition. CITAB Coordinator: Mário Santos. Staring date: September 2022, duration: 60 months (Grant Agreement nr 101058020). CITAB/UTAD funding: 45.325,00€.

LIFE FAGESOS - Phytophthora-induced decline of fagaceae ecosystems in Southern Europe exacerbated by climate change: preserving ecosystem services through improved integrated pest management. CITAB Coordinator: José Laranjo. Staring date: September 2022, duration: 60 months (GA n. 101074466). CITAB funding: 181.859,34€.

VineProtect - Ecological survey for biological management and protection of Mediterranean vineyards facing climate changes. CITAB Coordinator: Lia-Tânia Dinis. Staring date: March 2022, duration: 36 months (PRIMA). CITAB/UTAD funding: 24.989,78€.

DATI -Digital Agriculture Technologies for Irrigation efficiency. CITAB Coordinator: Joaquim João Sousa. Staring date: June 2021, duration: 36 months (PRIMA/0007/2020). CITAB funding: 148.440,00€. https://datiproject.eu/

AGreen'Smart - Make agriculture sustainable through smart farming. CITAB Coordinator: José Aranha. Staring date: September 2020, duration: 36 months (KA203-D04DD1DA). CITAB funding: 49.217,00€. https://erasmusplus-agreensmart.eu/

PYROLIFE - Training the next generation of integrated fire management experts. CITAB coordinator: Paulo Fernandes. Starting date: October 2019, duration: 63 months (H2020-MSCA-ITN - GA 860787). CITAB/UTAD funding: 237.720,24€.https://pyrolife.lessonsonfire.eu/.

CONFREMU - Conservation of freshwater mussels: a pan-European approach. CITAB coordinator: Simone Varandas. Starting date: October 2019, duration: 48 months (COST Action Ca18239). CITAB/UTAD funding: N/A

Atlantic-Positive - Conservation of Atlantic pollination services and control of the invasive species Vespa velutina. CITAB coordinator: José Aranha. Starting date: May 2019, duration: 36 months (INTERREG Atlantic Area). CITAB/UTAD funding: 136.500,00€. http://www.atlanticpositive.eu/.

TRIPLE-C: Capitalising climate change projects in risk management for a better AA resilience. CITAB coordinator: Ronaldo Gabriel. Starting date: April 2019, duration: 51 months (INTERREG EAPA_772/2018). CITAB/UTAD funding: 137.156,25€ https://www.triplecproject.eu/

FIRElinks - Fire in the Earth System: Science & Society. CITAB coordinator: Mário G. Pereira. Starting date: April 2019, duration: 48 months (COST Action Ca18135). https://firelinks.eu/. CITAB/UTAD funding: N/A

INTEGRAPE – Data integration to maximise the power of omics for grapevine improvement. CITAB coordinator: Ana Barros. Starting date: September 2018. Duration: 48 months (COST Action Ca17111). CITAB/UTAD funding: N/Ahttp://www.integrape.eu/index.php

BRESOV - Breeding for Resilient, Efficient and Sustainable Organic Vegetable production CITAB coordinator: Eduardo Rosa. Starting date: May 2018, duration: 60 months (H2020-SFS -GA 774244). CITAB/UTAD funding: 125.000,00€ https://bresov.eu

Clim4Vitis - Climate change impact mitigation for European viticulture: knowledge transfer for an integrated approach. Consortium coordinator: João Santos. Starting date: September 2018, duration: 42 months (WIDESPREAD-GA 810176). CITAB/UTAD funding: 374.163,75€ https://clim4vitis.eu/

Dairy-4-Future - Propagating innovations for more resilient dairy farming in the Atlantic area. CITAB coordinator: Henrique Trindade. Starting date: March 2018, duration: 54 months (INTERREG EAPA_304/2016). CITAB/UTAD funding: 211.481,00€ https://dairy4future.eu/

ALICE - Improving the management of Atlantic Landscapes: accounting for biodiversity and eCosystem sErvices. CITAB coordinator: Edna Cabecinha. Starting date: November 2017, duration: 68 months (INTERREG EAPA_261/2016). CITAB/UTAD funding: 250.177,38€ https://project-alice.com/

NASPA - Natural fungicides against air & soil borne pathogens in the Atlantic Area. CITAB coordinator: Berta Gonçalves. Starting date: December 2017, duration: 60 months (INTERREG_EAPA-451/2016). CITAB/UTAD funding: 290.000,00€ https://atlanticarea.eu/projects/55

TOTAL **17** INTERNATIONAL PROJECTS

NATIONAL PROJECTS

BE@T – Bioeconomy for Textiles and Clothing to Strengthen the National Bioeconomy. CITAB Coordinator: Eunice Bacelar. Starting date: July 2022. Duration: 42 months (Fundo Ambiental - PRR - Recovery and Resilience Plan). CITAB/UTAD funding: 202.884,38€

RN21 - Innovation in the Natural Resin Sector to Strengthen the National Bioeconomy. CITAB Coordinator: Maria Emília da Silva. Starting date: July 2022. Duration: 42 months (Fundo Ambiental - PRR - Recovery and Resilience Plan). CITAB/UTAD funding: 377.575,00€.

GREENValue - Valorisation of Resource Generation in Natural Space. CITAB Coordinator: José Laranjo. Starting date: July 2022. Duration: 29 months (COMPETE). CITAB/UTAD funding: 300.101,26€.

MULTI-CRASH - Multidimensional ecological cascades triggered by an invasive species in pristine habitats. CITAB Coordinator: Simone Varandas. Starting date: January 2022. Duration: 36 months (PTDC/CTA-AMB/0510/2021). CITAB/UTAD funding: 9.250,00€.

DMIMPT - Development of methods for the identification of mechanical properties in tissues of plant origin. CITAB Coordinator: Fábio Pereira. Starting date: December 2021. Duration: 18 months (EXPL/EME-APL/0587/2021). CITAB/UTAD funding: 49.955,94€.

Vine & Wine PT - Driving Sustainable Growth Through Smart Innovation. CITAB Coordinator: Raul Santos. Starting date: November 2021. Duration: 50 months (IAPMEI - PRR - Recovery and Resilience Plan / Mobilising Agendas - C644866286-00000011). CITAB/UTAD funding: 6.266.228,02€.

VIIAFOOD - Platform for the Agri-Food valorisation, industrialization and Commercial Innovation. CITAB Coordinator: Ana Barros. Starting date: October 2021. Duration: 51 months (IAPMEI - C64492945600000040). CITAB/UTAD funding: 166.951,19€.

TRANSFORM - Digital transformation of the forestry sector for a resilient and low-carbon economy. CITAB Coordinator: Maria Silva. Starting date: October 2021. Duration: 48 months (IAPMEI). CITAB/UTAD funding: 267.148,24€.

Honey+: New strategies to value honey from the Montesinho Natural Park: a bioindicator of environmental quality and its therapeutic potential. CITAB Coordinator: Irene Gouvinhas. Starting date: August 2021. Duration: 36 months (MTS/SAS/0077/2020). CITAB/UTAD: 49.982,12€.

SoilRec4+Health - Soil recover for a healthy food and quality of life. Project Coordinator: Ana Barros. Starting date: April 2021. Duration: 27 months (NORTE-01-0145-FEDER-000083). CITAB/UTAD: 499.999,00€.

TraDACa - Diagnosis and preventive treatment of hip dysplasia in dogs. CITAB Coordinator: Mário Ginja. Starting date: April 2021. Duration: 26 months (POCI–01 -0247 -FEDER -072229). CITAB/UTAD: 216.782,61€.

EdgeOmics - Freshwater Bivalves at the edge: Adaptation genomics under climate-change scenarios. CITAB Coordinator: Simone Varandas. Starting date: March 2021. Duration: 36 months (PTDC/CTA-AMB/3065/2020). CITAB/UTAD: 10.625,00€.

DrosuGreen - Controlling the quarantine pest Drosophila suzukii through epidemiological studies and new Green biocontrol techniques. CITAB Coordinator: Guilhermina Miguel Marques. Starting date: March 2021. Duration: 36 months (PTDC/ASP-PLA/4477/2020). CITAB/UTAD: 39.194,74€.

EnantioTox - Enantioselective ecotoxicity and bioaccumulation of psychoactive substances. CITAB Coordinator: João Carrola. Starting date: March 2021. Duration: 36 months (PTDC/CTA□AMB/6686/2020). CITAB/UTAD: 56.845,00€.

MultiCam - Low Cost Multispectral Camera. CITAB Coordinator: Pedro Pinto. Starting date: February 2021. Duration: 28 months (POCI-01-0247-FEDER-69271). CITAB/UTAD: 87.130,83€.

Fungi4Health - Valorization of agro-industrial residues in the production of mushrooms and in the development of functional foods and value-added products. CITAB Coordinator: Guilhermina Marques. Starting date: January 2021. Duration: 30 months (NORTE-01-0247-FEDER-070171). CITAB/UTAD: 276.778,71€.

ATLANTIDA - Platform for the monitoring of the North Atlantic Ocean and tools for the sustainable exploitation of the marine resources. CITAB Coordinator: Sandra Mariza Monteiro. Starting date: October 2020. duration: 36 months (NORTE-01-0145-FEDER-000040). CITAB/UTAD funding: 117.642,17€

AgriFood XXI – Development and consolidation of research in the agrifood sector in Northern Portugal. CITAB coordinator: Carlos Correia. Starting date: September 2020. Duration: 36 months (NORTE-01-0145-FEDER-000041). CITAB/UTAD funding: 180.000€.

CoaClimateRisk - Climate change impact assessment and adaptation measures for the main crops in the Côa Valley region. Project coordinator: Helder Fraga. Starting date: September 2020. duration: 36 months (COA/CAC/0030/2019). CITAB/UTAD funding: 150.000€ http://coaclimaterisk.utad.pt

T-Lamp - Turf Lighting Advanced Mobile Platform. CITAB coordinator: José Moutinho Pereira. Staring date: August 2020. Duration: 34 months (POCI-01-0247-FEDER-070057). CITAB/UTAD funding: 342.179,17€

rePlant - Implementation of collaborative strategies for integrated forest and fire management. CITAB coordinator: Maria Emília Silva. Starting date: July2020. duration: 34 months (POCI-01-0247-FEDER-046081). CITAB/UTAD funding: 215.255,41€ https://replant.pt/

cLabel Plus: Innovative natural, nutritious and consumer-oriented "clean label" foods. CITAB Coordinator: Ana Barros. Starting date: June 2020. duration: 36 months (POCI-01-0247-FEDER-046080). CITAB/UTAD funding: 173.844,10€ https://cleanlabelplus.pt/

Save Oxycedrus - Conservation and reproduction of threatened and high-value Juniperus oxycedrus populations. Project Coordinator: João Paulo F. Carvalho. Starting date: June2020. duration: 31 months (PDR2020-785-063781). CITAB/UTAD funding: 75.901,25€

FireSmart: Nature-based solutions for fire risk management and sustained provision of ecosystem services. CITAB Coordinator: João Santos. Starting date: July 2019. Duration: 36 months (PCIF/MOG/0083/2017). CITAB/UTAD funding: 30.742,50€

SCAPEFIRE - A sustainable landSCAPE planning model for rural FIREs prevention. CITAB Coordinator: João P. Carvalho. Starting date: March 2019. Duration: 48 months (PCIF/MOS/0046/2017). CITAB/UTAD funding: 25.965,00€.

ModFire - A multiple criteria approach to integrate wildfire behaviour in forest management planning. CITAB Coordinator: Paulo Fernandes. Starting date: March 2019. Duration: 36 months (PCIF/MOS/0217/2017). CITAB/UTAD funding: 24.115,00€ https://www.modfire.net/

MitiVineDrought - Combining "omics" with molecular, biochemical and physiological analyses as an integrated effort to validate novel and easy-to-implement drought mitigation strategies in grapevine while reducing water use. Consortium coordinator: Artur Conde. Starting date: October 2018. Duration: 48 months (POCI-01-0145-FEDER-030341). CITAB/UTAD funding: 197.476,60€

VALORIZEBYPRODUCTS: Preclinical efficacy of sulforaphane or Brassica whole extract: a strategy to fight obesity and valorize Brassica byproduct. Consortium coordinator: Eduardo Rosa. Staring date: June 2018. Duration: 48 months (POCI-01-0145-FEDER-029152). CITAB/UTAD funding: 194.423,90€

TO CHAIR: The Optimal Challenges in Irrigation. CITAB coordinator: Aureliano Malheiro. Starting date: June 2018. Duration: 48 months (POCI-01-0145-FEDER-028247). CITAB/UTAD funding: 32.537,50€

GO BioPest - Integrated strategies to fight against key pests in nut species. CITAB Coordinator: Luís Martins. Starting date: October 2017, duration: 63 months (PDR2020-101-0310972). CITAB/UTAD funding: 30 226,65 €

GO Preserve the quality of Arouquesa meat. CITAB coordinator: Carlos Venâncio. Starting date: October 2017, duration: 61 months (Operational Group). CITAB/UTAD funding: 227.178,66€

GO SustentOlive - Improvement of irrigation and fertilization practices at olive farms in Trás-os-Montes for its sustainability. Project coordinator: Anabela Silva. Starting date: October 2017, duration: 63 months (Operational Group). CITAB/UTAD funding: 193.496,98€ https://sustentolive.utad.pt/

GO Control and minimization of damages caused by invasive species Vespa velutina nigrithorax (Vespa velutina) in beekeeping. CITAB coordinator: José Aranha. Starting date: January 2018, duration: 66 months. Promotor: Dolmen CRL (PDR2020-101-032189). CITAB/UTAD funding: 98.021,09€ https://www.go-vespa.pt/

GO Phytosanitary protection strategies for sustainable apple production. CITAB coordinator: Maria Isabel Cortez. Starting date: January 2018. Duration: 60 months. Promotor: UTAD (PDR2020-101-031962) (Operational Group). CITAB/UTAD funding: 48.454,77€

GO ValorCast - Chestnut valorisation and optimization of its commercialization. CITAB Coordinator: Jorge Ventura. Starting date: September 2017. Duration: 64 months (PDR2020-101-032036). Promotor: RefCast (Operational Group). CITAB/UTAD funding: 67.250,00€

GO ClimCast - The new challenges for the chestnut orchards in the context of climate change. CITAB coordinator: Mário Pereira. Starting date: January 2018, duration: 60 months (PDR2020-101-032059). CITAB/UTAD funding: 74.650,85€

GO VITISHIDRI – Strategies for the management of water stress of the Douro Superior vineyards. CITAB coordinator: Aureliano Malheiro. Starting date: March 2017, duration:70 months (Operational Group). CITAB/UTAD funding: 100.603,83€

GO New management practices in rainfed olive orchards - strategies for mitigation and adaptation to climate change. CITAB coordinator: Carlos Correia. Starting date: January 2017, duration: 72 months (Operational Group). CITAB/UTAD funding: 103.513,41€

GO Valorization of the Resende cherry production and market positioning of the chain. CITAB coordinator: Berta Gonçalves. Starting date: March 2017, duration: 70 months (Operational Group). CITAB/UTAD funding: 166.850,59€

TOTAL **39** NATIONAL PROJECTS

RESEARCH CONTRACTS WITH PRIVATE AND PUBLIC STAKEHOLDERS

Penha Mountain Local Protected Landscape Management Plan. Contractor: Guimarães Municipal Council. Execution period: December 2021 to September 2022. CITAB/UTAD funding: 25,075.00€.

Studies on Characterisation and Strategic and Prospective Diagnosis within the Côa Archaeological Park Special Programme (PEPA-CÔA)". Contractor: Côa Parque - Fundação Para a Salvaguarda e Valorização do Vale Do Côa. Execution period: December 2021 to September 2022. CITAB/UTAD funding: 25.000€.

Monitoring of biological elements and characterisation of mesohabitats in the Vilariça Stream - Baixo Sabor Hydroelectric Plant (AHBS). Contractor: LABELEC - Estudos, Desenvolvimento e Atividades Laboratoriais, S.A. Execution period: Spring 2022. CITAB/UTAD funding: 4.040€.

Monitoring the elimination and eradication of invasive plants, in particular Haquea sericea". Contractor: ICNF/DRCNF under POSEUR-03-2215-FC-000124-RestAlvão. Execution period: December 2021 to December 2022. CITAB/UTAD funding: 8.122,11€

Assessmentof the impacts of Hakea sericea on vegetation and soil". Contractor: ICNF/DRCNF under POSEUR-03-2215-FC-000124-RestAlvão. Execution period: December 2021 to December 2022. CITAB/UTAD funding: 12.193,75€

Procurement of services under the "Guimarães Biodiversity Action Plan" (3-AQS-2021). Contractor: Laboratório Da Paisagem De Guimarães - Associação Para A Promoção Do Desenvolvimento Sustentável. Execution period: November 2021 to February 2023. CITAB/UTAD funding: 12.907,50€

Survey of mortality of avifauna and chiropterans in the context of the over-equipment project of the Fonte da Mesa II Wind Farm - Pre-Construction Phase. Contractor: Eólica do Alto Douro, S.A. Execution period: November 2021 to December 2022. CITAB/UTAD funding: 8.541,25€.

Biologist monitoring within the scope of the execution of MC12M.1 of the Integrated Programme for Environmental Monitoring (PIMA) of the Foz do Tua Hydroelectric Plant (AHFT) - Exploration Phase. Contractor: Movhera, Hidroelétricas do Norte, SA. Execution period: April 2021 to April 2022. CITAB/UTAD funding: 3.750,00€.

Water Quality Monitoring Services. Contractor: Trofa Municipal Council.Execution period: 2022 to 2025. CITAB/UTAD funding: 19.890,00€.

Rehabilitation and Stabilization Interventions on the Lizandro River Banks.(REACT/COMPETE 2020). Contractor: MafraMunicipal Council. Execution period: 2022-2023. CITAB/UTAD funding: 8.280,00€.

Physical-chemical characterization of the Almonda River. Contractor: Torres Novas Municipal Council. Execution period: 2022-2023. CITAB/UTAD funding: 1.043,00€.

PARADELA Reservoir -Characterization of the fishing community. Contractor: LABELEC – Estudos, Desenvolvimentos e Atividades Laboratoriais, S.A. Execution period: September 2022 to January 2023. CITAB/UTAD funding: 7.056,00€.

Alto Minho I (Melgaço and Monção) Wind Farm monitoring - Flora and Vegetation, including exotic species, Avifauna. Contractor: Ventominho – Energias Renováveis, S.A. Execution period:August 2022 to March 2023.CITAB/UTAD funding: 20 032,50€.

Impact of the Tâmega Wind Farm Project on the Integrity of the Alvão-Marão ZEC. Contractor: Quadrante – Engenharia e Consultoria, S.A..Execution period:July to September 2022. CITAB/UTAD funding: 12.000,00€.

REACTivar – Guimarães: Renaturalization of the Green Corridors of the Ave, Selho and Vizela rivers. Contractor: Laboratório da Paisagem de Guimarães - Associação para a Promoção do Desenvolvimento Sustentável.Execution period:June to October 2022. CITAB/UTAD funding: 19.975,00 €.

A. H. Belver -Monitoring the effectiveness and optimization of the fish lock (Process SINERGIE N.° 900960122). Contractor: EDP Global Solutions – Gestão Integrada de Serviços, S.A, em representação da EDP – Gestão da Produção de Energia, S.A. Execution period:June 2022 to May 2024. CITAB/UTAD funding: 24.148,00€.

Monitoring the effectiveness of power line correction, in the scope of Compensatory Measure (MC) 46C of the Foz Tua Hydroelectric Power Plant (Processo SINERGIE N.° 921121121). Contractor: EDP – Gestão da Produção de Energia, S.A./Movhera, Hidroelétricas do Norte, SA. Execution period: May 2022 to April2025. CITAB/UTAD funding: 113.053,80 €.

Baixo Sabor Hydroelectric Exploitation (AHBS) - Minimization Measure 1 - Minimization of the barrier effect on fish communities (Mm1). Contractor: EDP – Gestão da Produção de Energia, S.A./Movhera, Hidroelétricas do Norte, SA. Execution period: Mayto December 2022. CITAB/UTAD funding: 5.280,00 €.

Characterization and preparation of REACT application for the rehabilitation of the hydrographic network in the Paiva river section, in the limits of the municipality of Vila Nova de Paiva. Contractor: FRM – Projetos e Construções Unipessoal Lda. Execution period: April to June 2022. CITAB/UTAD funding: 13.950,00 €.

Bird and bat monitoring work on the Alto do Marco wind farm equipment - 1st year of operation phase. Contractor: Parque Eólico de Gevancas, S. A. Execution period:April 2022 to March 2023. CITAB/UTAD funding: 11.705,00€

Baixo Sabor Hydroelectric Plant (AHBS) - Integrated Environmental Monitoring Program (IEMP), Exploration Phase. Contractor: EDP – Gestão da Produção de Energia, S.A./Movhera, Hidroelétricas do Norte, SA. Execution period: January to December 2022. CITAB/UTAD funding:378.796,22€

RESEARCH CONTRACTS WITH PRIVATE AND PUBLIC STAKEHOLDERS

Entire - Emergence Analysis of Tailings Impacts for a Restored Aquatic Environment. Contractor: Vale S.A. (Brazil). Execution period: October 2020 to November 2023. CITAB/UTAD funding: 177.845,84€.

Foz do Tua Hydroelectric Plant (AHFT) - Integrated Environmental Monitoring Program (IEMP), Exploration Phase (Process SINERGIE nr 008011219). Contractor: EDP – Gestão da Produção de Energia, S.A./ Movhera, Hidroelétricas do Norte, SA. Execution period: September 2020 to August 2023. CITAB/UTAD funding: 483.381,03 €.

Red Book of Fishes. Contractor: FCiencias/POSEUR. Execution period: January 2018 to July 2023. CITAB/UTAD funding: 39.980,00€

TOTAL **24** RESEARCH CONTRACTS

ORGANIZATION OF CONFERENCES

CITAB Webinars

CITAB Webinars welcomed, on the 14th of January, Dr. Glauco da Sousa Rolim from the Paulista State University (Brazil). Dr. Rolim presented the talk "Machine Learning in Agriculture with Python". The focus was on Machine Learning and Deep Learning techniques, using Python, a high-level programming language, and its application to Agriculture related studies and emphasized examples of its use on Agrometeorology, Climate Change and Agriculture, Water Balance, Bioclimatology and Micrometeorology.

Cherry Operational Group

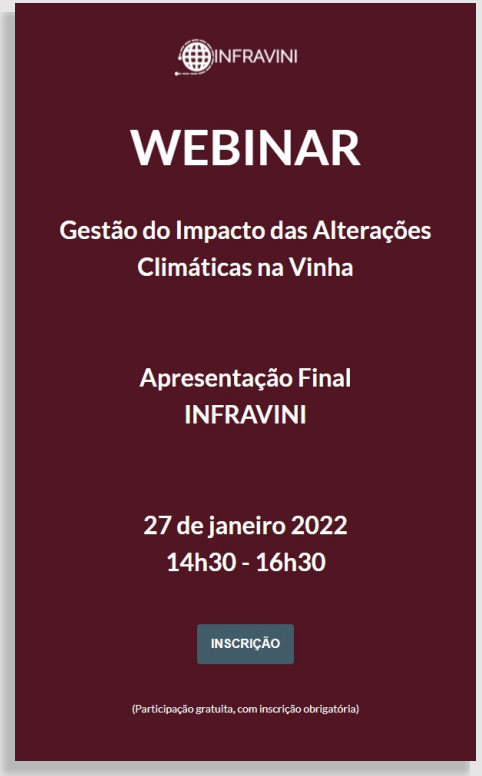
The Cherry Operational Group, coordinated by CITAB, organized and promoted two online events. The first event, on the 5th of January was the annual Open day and joined once more researchers with Cherry stakeholders. During the day, talks on control of cherry pests and diseases, Resende cherry characterization and irrigation management in Mediterranean cherry orchards were presented.
The second event, that took place on the 25th of February, was the first International Cherry Conference and joined speakers from Czech Republic, Croatia, Chile and Portugal.

ZEBREFINE project

The ZEBREFINE project, that gathers researchers from CITAB and i3S, organized an online meeting on the 27th of January. During the day the project results regarding aspects of zebrafish anaesthesia refinement were presented. The meeting also included the participation of international invited researchers (Univ. of Gothenburg-Sweden, Univ of Bath and DanioVet-UK, Federal Univ. of Santa Maria-Brazil) that develop work on zebrafish anaesthesia and promote the refinement of animal experiment and research protocols.

INFRAVINI

The project IFRAVINI promoted a final webinar to present its main results on the 27th of January. The webinar "Gestão do Impacto das Alterações Climáticas na Vinha" joined researchers with wine and vine stakeholders. The developed innovative decision platform, a digital infrastructure that gathers geospatial data from the Douro region, was presented and its utility as a tool for decision making and application to the Douro wine and vine sector was highlighted.



BRESOV

The CITAB project BRESOV hosted the online worshop "Demonstração do uso de plástico biodegradável Agrobiofilm® na cultura de brócolo em modo de produção biológico". The workshop was performed on the 11th of February and was open to producers, distributers, trainers and the general public interested in organic farming. The workshop aimed to present a bioplastic made from corn starch and vegetal oils, biodegradable and suitable for organic farming, as an alternative to currently used plastics. The event had the participation of CITAB researchers, Biobrassica, a company dedicated to organic farming products and Silvex, the main Portuguese company of plastic and paper houseware.

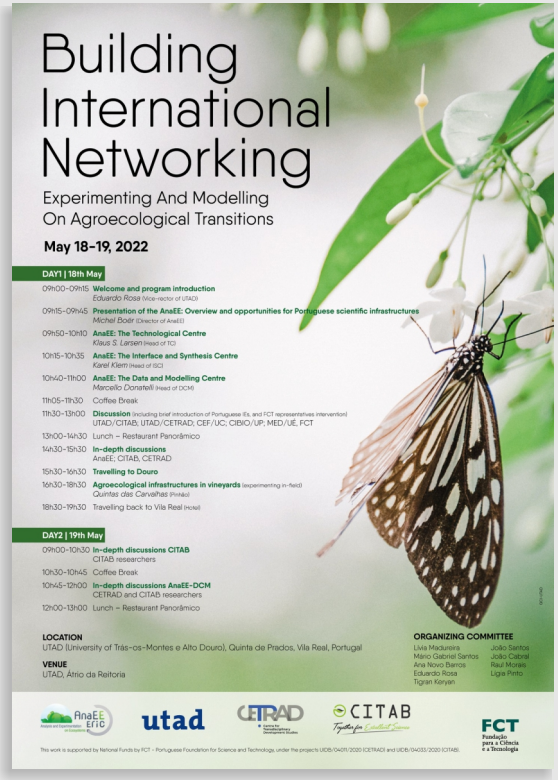
Smart and Circular Agriculture towards Sustainability

The "Smart and Circular Agriculture towards Sustainability" Congress was the first event of Inov4Agro, the Associate Laboratory that joined CITAB with GreenUp, and took place in Porto (21st and 22nd of July). During the meeting present and future challenges faced by agriculture were highlighted during four sessions: 1-Research, Innovation & Training in Agriculture 4.0; 2-Circular Agriculture and Food Systems; 3-Vertical Farming and protected cultivation: where do we stand? and 4-Pest and disease control in sustainable agriculture: the challenging 2030 targets. The Congress program included more than 20 oral communications and over 75 posters presentations and representants from 8 countries.

Smart and Circular Agriculture towards Sustainability 2022

Building International Networking-Experimenting and Modelling on Agroecological Transitions

CITAB was one of the research centers to participate of the "Building International Networking-Experimenting and Modelling on Agroecological Transitions" meeting promoted by UTAD, on 18th-19 of May. This international event was attended by the General Director of the European Research Infrastructure AnaEE-Analysis and Experimentation on Ecosystems, Michel Böer. The two days meeting included the general presentation of the AnaEE and of its units (Interface and Synthesis Centre; Data and Modelling Centre and Technology Centre), followed by an in-depth discussion and a visit to Douro region.

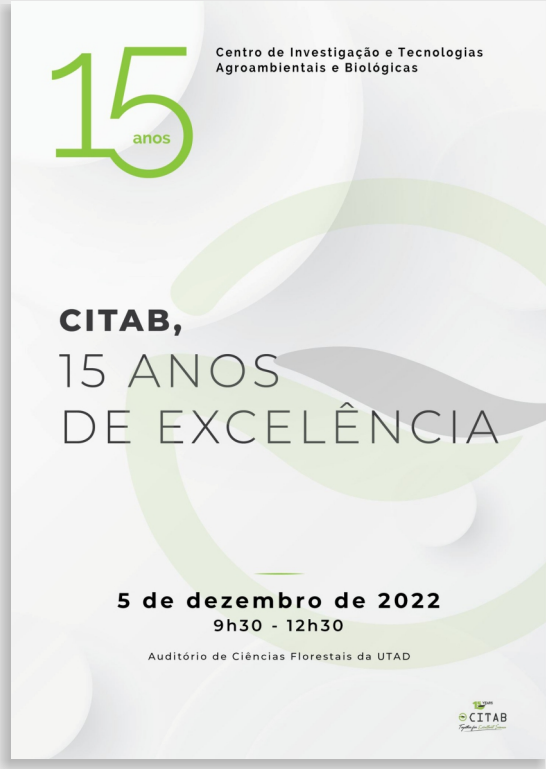


International Webinars on Trends in Food Science, Technology & Health

The international webinar on Trends in Food Science, Technology & Health co-organized by CITAB and the Univ. of Limerick (Ireland) hosted two events. The first "Circular Solutions in Food Systems" on he 27th of May focused different and new uses for agricultural products in order to reduce nutrients waste and the second "Healthy ngredients" on the 1st of July presented new insights on natural products.

CITAB 15 years of Excellence

"CITAB 15 years of Excellence"on the 5th of December was attended by the Secretary of State for Higher Education, Professor Pedro Nuno Teixeira and the Rector of UTAD, Professor Emídio Gomes. The event that joined CITAB researchers and was open to the academy received as invited speaker Professor Alexandre Quintanilha. The recognized researcher captured the audience with the lecture "Knowledge: Pillar of democracy" ending the 15 years celebration with a golden key. The event was followed by lunch and cake to all that gather to finish the celebration.



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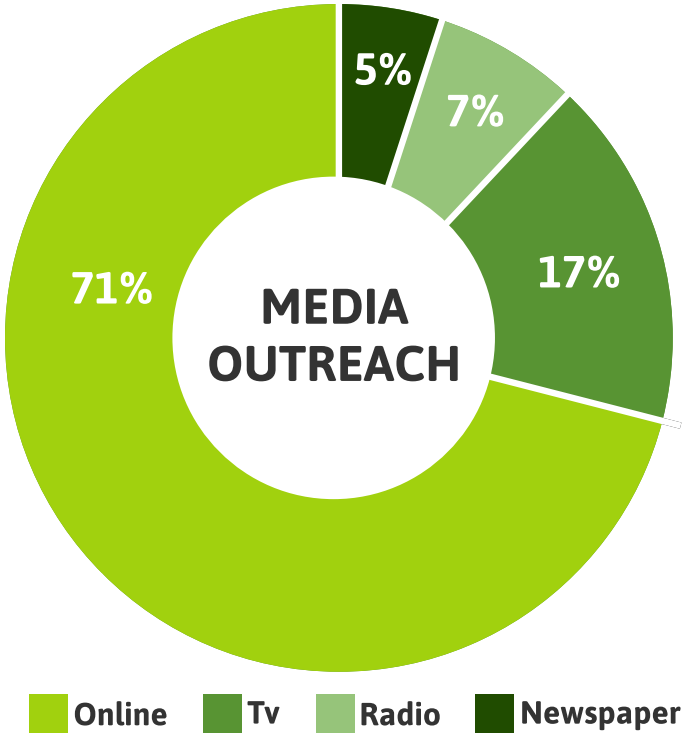

CITAB has been the subject of significant attention, by the media, over the past year, with more than 130 news articles being published regarding its achievements and advancements. These articles were sourced from a variety of media outlets, with the majority being web news, accounting for 71% of the total. Television sources constituted 17% of the sources (e.g. RTP, SIC, TVI, CNN, BBC News, France24) radio sources accounted for 7% (e.g. TSF, Antena 1), and print newspapers constituted 5% (e.g. Expresso, Visão, Público). The diversity of sources used in covering CITAB highlights the level of interest and significance of its work and achievements.The media is essential in increasing the notoriety of a research centre, such as CITAB. The research centre's work is often highly technical and complex, which can make it difficult for the general public to understand its importance and impact. By using various media channels, such as newspapers, radio, television, and social media, research centres can communicate their work in a way that is accessible and understandable to a broader audience. Additionally, media coverage can serve as a third-party endorsement, increasing the credibility and reputation of the research centre. In an increasingly competitive and globalized research landscape, media exposure is crucial for research centres like CITAB to stay relevant and achieve their goals.


CITAB
ECOTOXICOLOGIA
TOXICOLOGIA AQUATICA
EnsaiosTox
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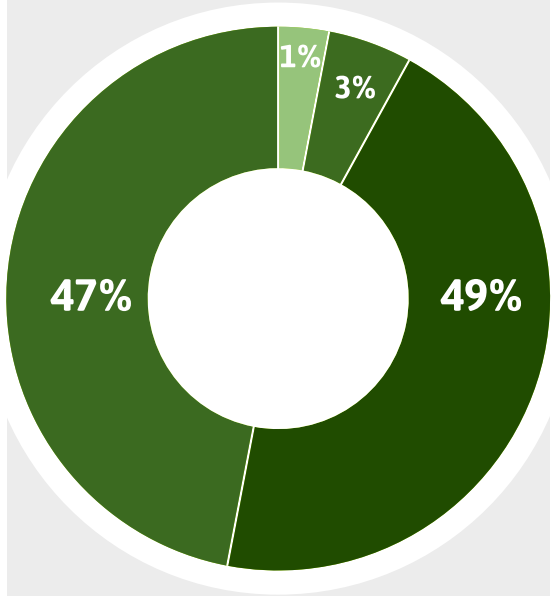
CITAB
Ambiente e Sustentabilidade


NEW YORK
CITY

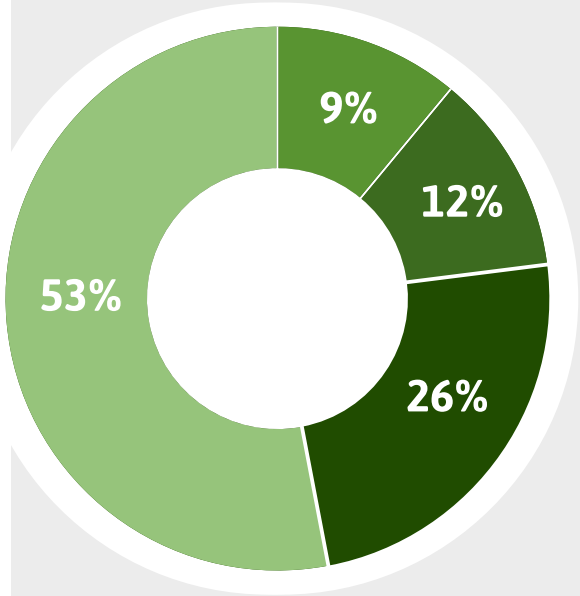
PRODUCTIVITY METRICS

SCIENTIFIC PUBLICATIONS

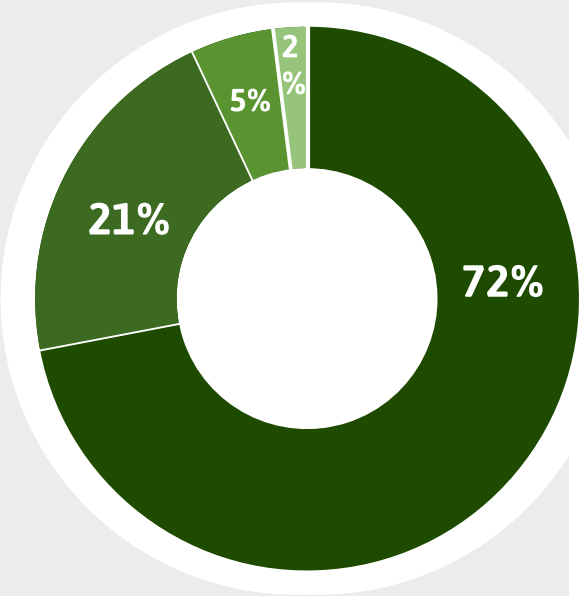


PUBLICATIONS IN PEER REVIEWED JOURNALS

SUBJECT AREAS DISTRIBUTION



QUARTILE DISTRIBUTION



The CITAB's scientific productivity experienced a significant increase in 2022. The number of scientific publications was **593**, with **288** SCOPUS-indexed articles. This leads to a ratio of more than **2.5 SCOPUS-indexed articles per Integrated Member**, a record-breaking value for the Unit. According to SCOPUS, the leading scientific domains of the indexed articles are the following three: 1) Agricultural and Biological Sciences, 2) Environmental Science, and 3) Biochemistry, Genetics and Molecular Biology, which are aligned with the CITAB's thematic strands. These three domains represent about one-half of all articles. The strong increase in the number of articles published in Q1 journals (journals with an impact factor of the first quartile) is remarkable, corresponding to **72%** of all articles. When considering Q1 and Q2 journals together, this value rises to **93%**, a record high value and a major achievement of CITAB that demonstrates the high scientific quality of its research.

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Acuña-Alonso, C., Novo, A., Rodríguez, J. L., Varandas, S., Álvarez, X. (2022). **Modelling and evaluation of land use changes through satellite images in a multifunctional catchment: Social, economic and environmental implications.** Ecological Informatics, 71. https://doi.org/10.1016/j.ecoinf.2022.101777

Afonso, S., Oliveira, I., Meyer, A. S., Gonçalves, B. (2022). B**iostimulants to Improved Tree Physiology and Fruit Quality: a Review with Special Focus on Sweet Cherry.** Agronomy, 12(3). https://doi.org/10.3390/agronomy12030659

Almeida, A. C., Carlos, C., Salvação, J., Ferreira, A. R., Oliveira, I., Nave, A., Torres, L., Gonçalves, F. (2022). **The European grape moth, Lobesia botrana, in the Douro Demarcated Region: Effect of sub-region, year, generation and grapevine cultivar in the intensity of pest infestation.** Ciencia e Tecnica Vitivinicola, 37(2), 126–138.https://doi.org/10.1051/ctv/ctv20223702126

Almeida, D., Quirino, J., Matos, P., Esteves, F., Cruz, R., Vala, H., Mesquita, J. R. (2022). **Prevalence of Toxoplasma gondii Antibodies in Individuals Occupationally Exposed to Livestock in Portugal**. Pathogens 11 (5) http://doi.org/10.3390/pathogens11050603

Almeida, M., Garcia-Santos, S., Carloto, D., Arantes, A., Lorenzo, J. M., Silva, J. A., Santos, V., Azevedo, J., Guedes, C., Ferreira, L., Silva, S. (2022). **Introducing Mediterranean Lupins in Lamb Diets: Effects on Carcass Composition, Meat Quality, and Intramuscular Fatty Acid Profile.** Animals, 12(14). https://doi.org/10.3390/ani12141758

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Severino P., Dias-Ferreira J., Andrade L.N., Lima D.M., de Hollanda L.M., da Silva C.F., Chaud M.V., Carbone C., Silva A.M., Lucarini M., Durazzo A., Capasso R., Santini A., Souto E.B., (2022) Toxicological screening of nanoparticles for biological applications: Drosophila melanogaster as a representative toxicological model. NANOTECHNOLOGY AND REGENERATIVE MEDICINE: HISTORY, TECHNIQUES, FRONTIERS, AND APPLICATIONS:551-573.doi: 10.1016/B978-0-323-90471-1.00007-4.

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TOTAL **13** book / book chapters

COMPLETED PhD THESES

Augusto, Diana. Grapevine biodiversity conservation strategies. Supervisors: Ana Lúcia Pinto-Sintra (CITAB-UTAD), Fernanda Santos (CITAB-UTAD) and Isaura Castro (CITAB-UTAD). Doctoral programme/degree:Comparative Molecular Genetics. Date:April2022 http://hdl.handle.net/10348/11298

Fernandes, António. Statistical Modeling of Surface Water Quality in the Ave River Basin. Supervisors: Luís Filipe Sanches Fernandes (CITAB-UTAD) and Fernando António Leal Pacheco. Doctoral programme/degree:Agronomic and Forestry Sciences. Date: January2022 http://hdl.handle.net/10348/11224

Ferreira, Sandrine. Evaluation of the potential health benefits of *Sambucus nigra* L. Supervisors: Fernando H. F. Milheiro Nunes (UTAD) and Amélia M. Lopes Dias da Silva (CITAB-UTAD). Doctoral programme/degree: Agricultural Production Chains: from fork to farm (AgriChains). Date: May 2022

Frazão, David. Valorisation of Cistusladanifer L.: from production to evaluation of raw materials. Supervisors: Amélia Maria Lopes Dias da Silva (CITAB-UTAD), José Carlos Dias Duarte Gonçalves (IPCB) and Fernanda Maria Grácio Delgado Ferreira de Sousa (IPCB). Doctoral programme/degree: Agricultural Production Chains: from fork to farm (AgriChains). Date:September2022 http://hdl.handle.net/10348/11379

Gomes, Véronique. Spectroscopy Data-Driven Models for Grape Quality Assessment in Precision Viticulture. Supervisors: Pedro Melo-Pinto (CITAB-UTAD), Marco Reis (U. Coimbra) and Francisco Rovira-Más (UP Valencia).Doctoral programme/degree: Agricultural Production Chains: from fork to farm (AgriChains). Date: April 2022 http://hdl.handle.net/10348/11335

Lopes, João. New options of soil amendment for sustainable management of rain fedolivegroves. Supervisors: Carlos M. Correia (CITAB-UTAD), Manuel Ângelo Rodrigues (CIMO-IPB) and Margarida Arrobas (CIMO-IPB).Doctoral programme/degree: Agronomic and Forestry Sciences. Date: November 2022.

Mady, Francisco. Dendrochronological analysis of adult trees in a forest fragment in Manaus, Amazonas. Supervisors: José Luís Louzada (CITAB) and Maria Emília Silva (CITAB). Doctoral programme/degree: Agronomic and Forestry Sciences. Date: September2022 http://hdl.handle.net/10348/11377

ManyouYu. Phenolic composition and antioxidant activity of *Punicagranatum* L. (pomegranate) leaf for medicinal infusion with potential health benefits. Supervisors: Ana Isabel Novo de Barros, Irene Gouvinhas and Paula Oliveira (CITAB-UTAD). Doctoral programme/degree: Agricultural Production Chains: from fork to farm (AgriChains). Date: July2022 http://hdl.handle.net/10348/11382

Menezes, Tomás. Fire regime in the Iberian Peninsula: links with current and future climate. Supervisors: João Pedro Nunes (FCUL), João Silva (ISA-UL)and Mário Gonzalez Pereira (CITAB-UTAD). Doctoral programme/degree: Climate Change and Sustainable Development Policies Date:February 2022

Monteiro, Ana. Study of bud fertility in three white grape varieties from the Vinhos Verdes Demarcated Region. Supervisors: Eunice Areal Bacelar (CITAB-UTAD) and Aureliano Natálio Coelho Malheiro (CITAB-UTAD). Doctoral programme/degree: Agronomic Sciences and Forestry. Date: March2022 http://hdl.handle.net/10348/11299

Neto, Thayanne. Sensitivity of the species *Terminaliacatappa* L. grown in an urban environment of intense steel making activity. Supervisors: João Latorraca (UFRRJ, Brasil)and José Luís Louzada (CITAB). Doctoral programme/degree: Agronomic Sciences and Forestry (Federal University of Rio de Janeiro). Date: August 2022

Santos, Dércia. Interaction between microplastics and copper: toxicity assessment in zebra fish (Daniorerio) and black spot seabream *(Pagellus bogaraveo*). Supervisors: Sandra Mariza Veiga Monteiro (CITAB-UTAD)andJuan BellasBereijo (IEO-UVigo). Doctoral Program/degree: Marine Science, Technologyand Management (DO*MAR). Date: September2022 http://hdl.handle.net/10348/11381

Santos, Rafaela. Sporeformers Quorum-Quenching Molecules for Fish Bacterial diseases control. Supervisors: Maria José Saavedra (CITAB-UTAD), Cláudia Serra and A. Oliva-Teles (CIIMAR-UP). Doctoral programme/degree: Doctoral Programme on Biology (Universityof Porto). Date:May2022

Santos, Tânia. Impact of a Randomized Controlled Trial with Salt Control H in dietary salt intake, dietary behavior and blood pressure. Supervisors: Carla Gonçalves (CITAB-UTAD / UP) and Pedro Moreira (FCNAUP). Doctoral programme/degree: Sciences of Food Consumption and Nutrition (University of Porto). Date: June 2022.

Silva, Ermelinda. The role of mineral nutrition in olivetree physiology, metabolism, and yield under rain fed conditions. Supervisors: Carlos M. Correia (CITAB-UTAD), José Moutinho Pereira(CITAB-UTAD) andManuel Ângelo Rodrigues (CIMO-IPB). Doctoral programme/degree: Agricultural Production Chains: from fork to farm (AgriChains). Date:December 2022

TOTAL **15** PhD theses

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