

ACTIVITIES REPORT

2023



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



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



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• Publications in peer reviewed journals (JCR & Scopus)	
• Book Chapters	
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698

PUBLICATIONS

293 JCR/Scopus papers
15 PhD Theses
37 Books / Book chapters
353 Communications

76

ONGOING PROJECTS

23 International
41 National
12 Research contract

321

111 Full Members
124 Collaborators
86 Fellows

42% Men
58% Women

4.5M€

FUNDING

with stakeholders **2.26M€**
fundamental science **2.24M€**

12

CONFERENCES

2

SPECIALIZED LABORATORY



In 2023, the CITAB Activity Report continues to demonstrate our strong commitment to the internationalization of our research. **The new General Regulation, approved by our Scientific Council this year, warrants the high scientific level and internationalization of our team, placing CITAB on the track for EXCELLENCE.** This revision led to a slight decrease in the number of members, as we envisioned a more coherent team, better aligned with our lines of research. At the end of 2023, the CITAB team comprised 100 Integrated PhD members, 80 Collaborators and more than 70 Scholarship members. In 2023, the CITAB scientific productivity reached nearly **3.0 SCOPUS-indexed publications per Integrated Member**, the highest ratio on record, with 94% 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 23 European and international competitive projects. In 2023, CITAB also participated in more than 41 national projects and 12 research contracts.

Regarding funding, as in previous years, almost 0.5 M€ of direct public funds were provided by the Portuguese Science & Technology Foundation (FCT), through the CITAB Strategic Plan 2020-2023 and within the framework of the Pluriannual funding of R&D units. **This direct public funding (Base and Programmatic funding) is critical to support the most essential activities of the unit**, which include maintaining key human resources for operational management and communication, promoting outreach activities, capacity-building actions, funding publication fees, acquisition of laboratorial materials and equipment and scholarship grants. Besides the aforementioned structural funding, and thanks to the huge efforts carried out by CITAB members, significant additional resources for our research activities were obtained from a wide range of entities, including vital support from the private sector. **The proactivity of CITAB in seeking co-financing can be demonstrated by the total funding obtained from all projects in 2023, which reached a record-breaking amount of approximately 4.5 M€.**

In 2023, R&D funding with CITAB's stakeholders achieved a record high value of 2.3 M€, which represents a noteworthy increase in the share of our funding with the private sector, from 45% in 2022 to 50% in 2023. The consistency of this trend is also clear when compared with previous years (e.g., 35% in 2020). This is a remarkable landmark for the long-term sustainability of CITAB, thanks to the hard work of our members and their consolidated relationships with stakeholders, based on several years of collaboration, trust and merit recognition.



Nonetheless, we are also aware that the share of private funding is expected to stabilise in the next years, while **public support for our R&D activities should be reinforced to warrant the sustainability of our mission towards increasing internationalization, reputation and attractiveness**. This is particularly important for maintaining not only fundamental science within CITAB but also for leveraging applied science solutions to higher TRLs. The network of CITAB's research laboratories, 2 of them specialized labs under final accreditation processes, requires a continuous effort to sustain their operationality.

This report highlights that Communication, Dissemination and Exploitation played a central role at CITAB in 2023. A vast number of actions were carried out to exchange knowledge within the academia (researchers, teachers and students), with stakeholders and decision-makers, but also extending to the general society (outreach activities) and promoting capacity-building. Twelve events were organized, or co-organized, by CITAB.

Under the framework of the **Inov4Agro Associate Laboratory (Institute for Innovation, Capacity Building and Sustainability of Agri-food Production)**, a strategic partnership between CITAB and GreenUPorto (University of Porto), several key activities were implemented in 2023. As an illustration, we can mention the Inov4Agro Open Day, which showcased our research to stakeholders and decision-makers, the Inov4Agro Scholarship's Day or the Cycle of Seminars for PhD students, with awards for the best communications, which engaged young researchers in Inov4Agro and steered collaboration between both units, a successful application to FCT (Institutional CEEC) that will allow hiring five researchers in the short-term, four of them with permanent contracts, the approval of an important Horizon Europe project, with a vast consortium of partners throughout Europe and the establishment of a unique living lab network in soil protection and conservation.

CITAB is strongly aligned with the UN 2030 Agenda and the EU Green Deal. Our activities are focused on the sustainability of natural resources, biodiversity and agroecology (**clean water, life below water, life on land**), climate change adaptation and mitigation (climate action), circular economy (**responsible consumption and production**), and valorization of agrarian value chains (**industry innovation**) for food security (**zero hunger**) and health promotion (good-health and well-being), fostering socioeconomic development, particularly of rural, depopulated and economically fragile areas (**no poverty, reduced inequalities, decent work and economic growth**). Our ongoing projects are examples of **partnerships for the goals**, while our training and scholarships promote **quality education**.

We strongly believe that CITAB's activities in **2023 enhanced our international reputation in the fields of Agrarian, Biological and Environmental Sciences, particularly on research devoted to the sustainability and valorization of agrarian value chains.**



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.



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.



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

Task 1.1

Task 1.2

Task 2.1

Task 2.2

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)



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 Bioeconomy

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.





Thematic Strand 1- Sustainability of Agri-Food and Forestry Ecosystems in a Changing Environment



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

One of the significant accomplishments achieved in 2023 for task 1.1 included the comprehensive assessment of climate change impacts on crops and plant species. Utilizing advanced remote sensing technology, the changes occurring in agricultural systems effectively were monitored and analysed, providing valuable insights with practical applicability. Furthermore, extensive evaluations were implemented on the effects of climate change on plant physiology and growth, shedding light on the potential consequences for global food security. Another significant accomplishment has been the development and implementation of long-term sustainable practices for agriculture and forestry, integrated into the strategies to mitigate and adapt to climate change. Additionally, efforts have led to the assessment of the impacts of invasive species on ecosystems and biodiversity, highlighting the need for effective management strategies. Evaluations on the effects of pollutants and chemicals on aquatic ecosystems and fish populations provided valuable insights for conservation and restoration efforts. Overall, these achievements have contributed to a better understanding of the complex interactions between climate change, ecosystems, and human activities, ultimately guiding the development of future strategies for more sustainable and resilient biosystems.



1.1.1 - List of main achievements in task 1.1

Viticulture sustainability under changing environmental conditions

- Assessment of the performance of seasonal weather forecasts for grapevine phenology of two major varieties and its applicability as a decision support tool for winemaking sector.
- Production of a digital atlas with the exposure of Portuguese viticulture to weather extremes under different climate change scenarios.
- Analysis of the possible relocation of bioclimatic niches of Portuguese grapevine varieties over Europe under a set of climate change scenarios.
- Assessment of grapevine sap flow and trunk diameter variations in Mediterranean climate using a novel approach of time series decomposition, enabling a better understanding of the sap flow diurnal changes and the use of trunk diameter as a proxy.
- Development and application of different optimization algorithms for the calibration of grapevine phenology.
- Assessment of the side effects of European eco schemes and agri-environment-climate measures on endangered species conservation in mountain vineyard landscapes.
- Integration of automated and conventional techniques to monitor water status in vineyards to sustain yield and quality in hot and dry conditions.
- Development of an exploratory model based on machine learning approaches to predict Vintage Port years and assess potential climate change impacts.
- Assessment of the influence of micro and mesoclimatic conditions on grapevine survival strategies.
- Assessment of physiological biomarkers in several *Vitis vinifera* varieties in the same edaphoclimatic conditions to identify varieties more resistant to summer stress.
- Implementation of an operational toolbox of sustainable agroecological practices specific to local vineyard conditions, increasing Mediterranean vineyards' resilience to climate change and diseases, reducing the use of agrochemicals, and promoting local circular agriculture.
- Evaluation of the toxicity induced by heavy metals commonly used in viticulture.
- Understanding of the role of tree shape in agroforest systems, by the development and use of coupled ecophysiological and meteorological models for the grapevine simulation under agroforestry conditions.
- Demonstration of seaweed-based extract and glycine betaine foliar sprays as biostimulants enhancers of physiological and biochemical performance in 'Touriga Franca' grapevines, improving berry quality and antioxidant activity under summer stress conditions in the Douro Demarcated Region.

Permanent crop resilience and adaptation

- Evaluation of historical and future thermal conditions for almond trees and revision of the corresponding adaptation measures.
- Development of a warning network for chestnut ecosystems, consisting of 8 monitoring points, which effectively simulates and estimates future chestnut production under diverse edaphoclimatic conditions.
- Development of a smart irrigation system for chestnuts, integrating tree water potential, soil humidity sensors, and remote sensing technology.
- Optimization of silicon nutrition to enhance chestnut tree resilience against the combined stresses of drought and heat.
- Understanding of almond tree physiology and biochemistry by investigating the impact of deficit irrigation, with valuable insights to improve water management strategies in almond cultivation.
- Exploitation of the impact of kaolin and seaweed-based extracts as effective middle and long-term strategies to alleviate the adverse effects of climate change on the physiological performance and nut quality of hazelnut trees.
- Identification of key genetic factors and pathways influencing cherry cracking, offering insights for molecular breeding programs to develop cracking-resistant varieties under adverse environmental conditions.





Aquatic ecosystem's biodiversity and integrity

- Understanding yeast and mould distribution along European shores by investigating the influence of environmental factors through a species distribution modelling approach.
- A long-term comparison of freshwater mussel assemblages in the Mediterranean hotspot reveals a widespread (but silent) decline of freshwater mussels across Portugal and draws attention to the importance of effective monitoring and conservation actions for freshwater species exposed to multiple threats and a rapidly changing environment, including habitat destruction and fragmentation, invasive species, and climate change.
- Highlighting the alarming and rapid decline of mussel species, emphasizing the ineffectiveness of current legislation and conservation measures, necessitating urgent attention to prevent their extinction.
- Development and application of an innovative framework for analysing the ecological impacts of Invasive Alien Species (IAS) in pristine rivers, incorporating multi-trophic and multidimensional spatial levels. This framework provides crucial information to inform managers and guide effective measures to address the invasion of IAS in these ecosystems.
- Assessment of groundwater resources and evaluation of their sustainable use, 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.
- Comprehensive analysis of crucial topics such as flood control and innovative solutions, like the payment for water services to landowners, within the scope of water security problems. Through this research and efforts, substantial progress was achieved in addressing these significant challenges and ensuring a sustainable water future.



- Development of mitigation measures related to river damming, particularly at the level of fish populations, like the development of fish behavioural barriers designed to improve the efficiency of transposition of fishes in these dammed rivers to mitigate connectivity loss. (The team has been focused on the consequences of the rupture dam of Brumadinho, Minas Gerais, Brazil).
- Assessment of the toxicological effects of microplastics and waterborne copper on various aquatic species has yielded novel insights into the environmental impacts of microplastics in both freshwater and marine ecosystems.
- Evaluation of glyphosate-based herbicides on aquatic communities, with a focus on fish, has revealed that environmentally relevant levels of these herbicides induce harmful effects, providing valuable insights into the potential ecological impacts of glyphosate in aquatic ecosystems.
- Determination of the effects of environmentally relevant concentrations of Metformin on zebrafish reveals alterations in key biological functions, supporting the urgent need to revise the proposed Predicted No-Effect Concentration (PNEC) and the Environmental Quality Standard (EQS) for metformin.

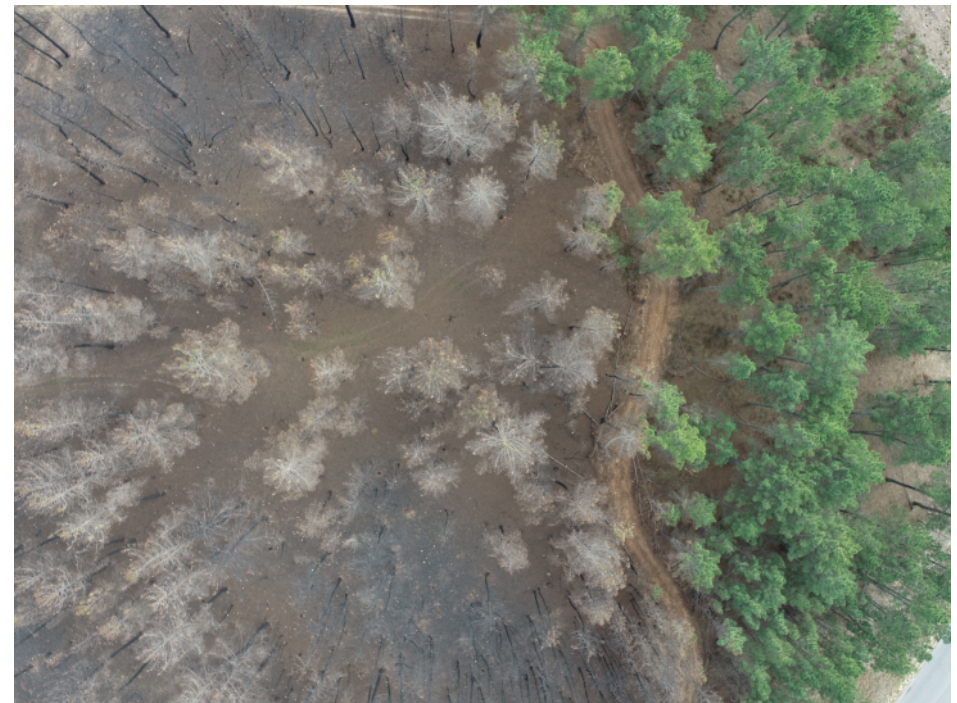


Climate change and weather effects on ecosystems

- Identification of the dynamic and thermodynamic drivers of severe sub-hourly precipitation events in Portugal and the integration of this information into the Portuguese Weather Service forecasts.
- Study of the climate change impacts on grassland vigour and outline of potential adaptation measures.
- Development of a new high-resolution analysis, over an extended historical period, for assessing the susceptibility of the Iberian Peninsula to extreme precipitation and aridity and a critical analysis of their historical trends.
- Analysis of the future of relict Mediterranean mountain peatlands by integrating the potential response of ecological indicators with environmental suitability assessments under climate change projections.
- A first-time inspection of the relationship between satellite data of land surface temperature and gridded air temperature from weather stations in the Douro Demarcated Region, Portugal, with identification of biases and quantification of the impact of thermal inversion situations on these biases.
- Evaluation of the exposure of different Mediterranean regions to climate change and discussion of their ongoing and planned adaptation measures.
- Assessment of the influence of climate on the effect of tree species-mixing, particularly on tree growth-climate relationship and drought resistance.

Forest Ecology

- Achievement of a significant increase in the growth of *Quercus suber*, *Quercus ilex*, and *Pinus pinaster*, along with the successful regeneration of 70 hectares of forest land at risk of desertification, through the inclusion of by-products, treated sludges, and treated wastewater from ETAR during plantation.
- Successful investigation and demonstration of the impact of crown and canopy structure on light absorption, light use efficiency, and growth in both mixed and pure stands of *Pseudotsuga menziesii* and *Fagus sylvatica* forests, providing valuable insights into the intricate relationships between forest composition and ecosystem processes.
- Study of leaf morphological traits as a plant protection mechanism against extreme weather events.
- Demonstration that drought-related mortality modifies mixing effects on light absorption and growth in mono-specific and mixed stands of *Fagus sylvatica*, *Alnus glutinosa*, and *Betula pendula*.
- Contribution to the current understanding of the drought regime in Southern Africa using Remote Sensing Vegetation.





Task 1.2 – Sustainability in agri-food and forestry ecosystems

The main achievements of task 1.2. were supported by innovative techniques such as hyperspectral imaging, computational intelligence, and spatial decision support systems that contributed to understanding the impacts of habitat and land use changes on terrestrial and aquatic environments. Using cutting-edge methods, the team modelled the impacts on ecosystem services, including water and soil quality, biodiversity, and temperature regulation. The team's achievements in chestnut yield, agroforestry studies and soil management practices demonstrate the successful development and application of analytical tools for dynamic spatial-temporal forecasting. The influences of weather, climate, and other factors on agroforestry, and the review of drought regimes, demonstrate great concern for understanding the natural and anthropogenic changes that have been impacting the integrity of ecosystems. In addition, studies dedicated to sustainable agriculture and biodiversity conservation have made it possible to deepen the knowledge of genetic diversity, metagenomics, and the evaluation of multiple model ecological frameworks. These initiatives contributed directly to the goal of making a sustainable agricultural intensification, demonstrating a commitment to stakeholders of compatibility with biodiversity conservation.



1.2.1 - List of main achievements in task 1.2

Sustainable Agriculture Practices

- *In vitro* induction of water and salt stresses and selection of resilient genotypes to face climate change and thus suitable for a more sustainable agriculture.
- Molecular characterization of genetic diversity in cowpea (*Vigna unguiculata* L.) landraces and other *Vigna* species.
- Genotyping of old grapevines in ancient vineyards to raise knowledge of the national genetic heritage.
- Use of metagenomics to monitor the impact of different herbicide formulations on soil microbial communities.
- Assessment of the effects of plant extracts as putative natural fungicides through transcriptomic analysis of plant defence-related genes.
- Holistic understanding of agrodiversity, focusing on crops like banana and corn, alongside in-depth investigations into soil microbiomes and pest occurrences through intelligent monitoring initiatives.
- Identification of functional bacterial groups, including nitrogen fixers, sulfur oxidizers, and potassium solubilizers.
- Utilization of metabarcoding for fungal community analysis.
- Testing microbial isolates for the presence of functional genes linked to carbon and nitrogen cycles.



- First-ever quantitative and qualitative analysis of the banana production cycle.
- Monitoring data utilized to model and analyse the introduction, propagation, and potential areas of establishment for *Drosophila suzukii*, providing valuable insights into the impact of climate change on the pest's dynamics.
- Successful testing of potassium phosphonate and Prestop® (*Gliocladium catenulatum*) against rot chestnut nut (*Gnomoniopsis castaneae*).
- Characterization of *Gnomoniopsis smithogilvyi* strains confirms that this species is the causal agent of brown rot disease in Portuguese chestnut varieties (*Castanea sativa* Miller) and shows high adaptability to chestnut substrates.
- Successful drone and sensor technology utilization to assess and enhance the development and productivity of vine and vegetable crops, showcasing the effective integration of cutting-edge tools for agricultural monitoring.
- A comprehensive investigation of the impact of various soil additives yields valuable insights and contributes to a better understanding of their influence on soil dynamics.
- Assessment of the effects of the use of composts to recover the fertility of soils from horticultural greenhouses.
- Development of studies that significantly contributed to agrodiversity phenotyping through comprehensive inventorying and phenotyping approaches, bringing forth insights and advancements in sustainable crop practices.
- Comparative analysis reveals no significant differences in fresh market appearance or storage capacity between mechanically and manually harvested chestnuts.
- Obtention of the first plants of the rooting program of ColUTAD F2 chestnut rootstock within the COLUTAD protocol (UTAD | Serviruri).
- Publication of a comprehensive guidebook, titled "ValorCast – Enhancing Chestnut Valorization and Optimizing its Commercialization," succinctly summarizes the key achievements of the ValorCast Operational Group.

Agroecological Transition and Sustainable Farming

- Study of the impact of soil interrow management practices on water stress, grape production and quality, and soil functional biodiversity.
- Development of studies evaluating the effect of using common beans (*Phaseolus vulgaris*) and soybeans (*Glycine max*) in intercropping with maize for forage production, which showed the potential of the legumes to improve the yield and the protein value of the forage, and reduce the need of mineral N fertilizer applications.
- Advanced agroforestry research and guidelines for sustainable agriculture, promoting the integration of trees and shrubs to enhance biodiversity and ecosystem resilience.
- Assessment of the impact of composting and biochar application in Douro vineyards for sustainable winemaking waste management.
- Study of the sustainable control of the European grape moth, *Lobesia botrana*, using pheromone-mediated mating disruption with biodegradable dispensers.
- Development and demonstration of the efficacy of a novel biocontrol agent (CIMO-BCA1) isolated from chestnut, significantly reducing the growth of *Gnomoniopsis smithogilvyi*, outperforming both a chemical fungicide (Horizon®) and a commercial biofungicide (Serenade® ASO).





Ecosystem Modelling, Biodiversity Conservation, and Management

- Development of holistic models to analyse species, community, and ecosystem responses to combined impacts of invasive species, climate change, and socio-ecological trends, contributing to sustainable ecosystem management.
- Design of a multi-model platform to produce climate change scenarios, to understand the impact of implementing NbS projects for biodiversity conservation and Ecosystem services (ES). A co-design participatory approach was developed with key stakeholders, for a more sustainable and integrative landscape management.
- Research and assessment of species extinction risks for the revision of the Red Books of Fish and Red Book of Mammals for the International Union for Conservation of Nature's Red List of Threatened Species.
- Development of innovative ecological multi-model frameworks integrating ecology, economics, and remote sensing technologies for the conservation of endangered species, habitats, and ecosystem services.
- Improved characterisation and understanding of pastoral burning in Portuguese mountains: a high-frequency, low-severity sustainable fire regime.
- Conduction of a 5-year evaluation of dense shrubland focusing on labdanum resin, seeds, and biomass productivity.
- Implementation of different non-destructive harvest periodicities (annual and biennial) and seasons to increase value, control *Cistus ladanifer* L. shrublands, minimize fire risks, disrupt vegetation auto-succession, and boost profits from non-productive lands.
- Utilization of machine learning techniques on UAV imagery for the successful detection of the *Acacia dealbata* invasive species.
- Employment of UAV multispectral data to estimate post-fire severity, contributing to a comprehensive understanding of the impact of fires on ecosystems.

Biodiversity, Nature Connection, and Human Well-being

- Exploitation of the link between nature connection, biodiversity stimulus, and human well-being, highlighting the positive impact of nature engagement on human health, emphasizing the importance of preserving biodiversity for the benefit of both ecosystems and individuals.

Environmental Impact of Large Infrastructures

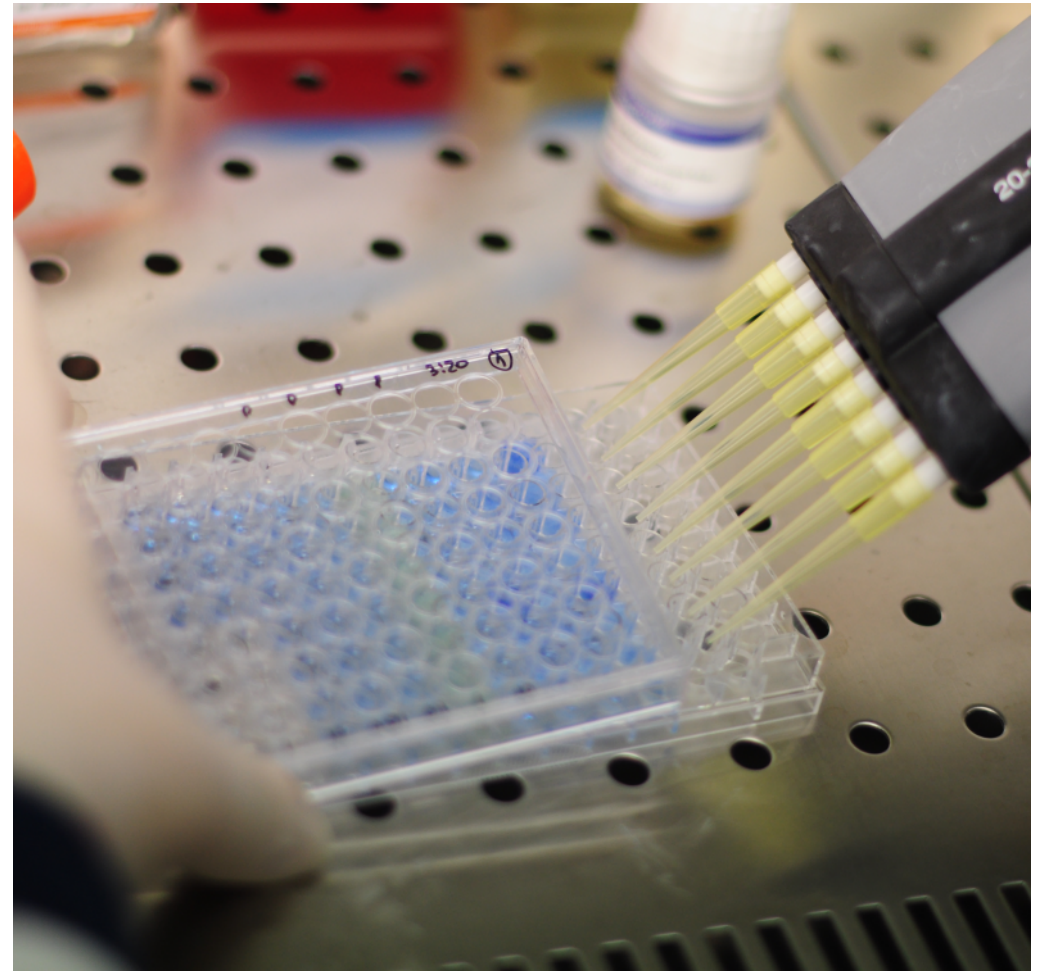
- Conduction of in-depth research on the environmental impacts of large infrastructures, specifically focusing on water, wind, and solar installations, providing insights into the effects of human-made structures on terrestrial and aquatic ecosystems, and facilitating informed decision-making for sustainable infrastructure development.



Thematic Strand 2 -Technology in Agro-food and Forestry chains for a more competitive bioeconomy

Task 2.1 – Innovative technologies and processes

The collection of achievements represents a remarkable stride in agricultural research and innovation, with each accomplishment contributing significantly to the enhancement of sustainable practices and understanding across diverse sectors. These achievements collectively represent our commitment to pushing the frontiers of agricultural knowledge and technology, fostering sustainability, resilience, and efficiency in the face of contemporary challenges. The impact of these innovations extends beyond the laboratory, influencing the practices and decisions that shape the future of agriculture. Our integrated innovations in crop management encompass advancements in grapevine cultivation, strategic adaptation strategies, revolutionary orchard net cover technology, and the development of environmentally conscious pesticide solutions. These achievements collectively signify a commitment to addressing challenges in modern agriculture while promoting sustainability, efficiency, and the well-being of both crops and the environment.





2.1.1 - List of main achievements in task 2.1

Advancements in Agricultural Innovation

- Development of a deep learning-based methodology for image-based root architecture phenotyping, facilitating the identification of water deficit resilient genotypes.
- Development of a novel method using Digital Image Correlation and finite element simulations to identify the constitutive law of apple skin, confirming the suitability of Yeoh's model. This contributes significantly to understanding apple skin's mechanical behaviour, impacting apple variety selection across various industries.
- Creation of a technological, open-access platform for stakeholders to measure and monitor Food Loss and Waste. The platform will provide solution abstracts properly classified accordingly thus providing a dashboard of the environmental and socio-economic impacts on consumers and civil society.
- Within the scope of the tasks and mission of the PRISM remote sensing laboratory, the following products and services have been achieved:
 - i. Integration of multiple intelligence services on agrometeorological data within the UTAD/mySense IoT platform, specifically for the notification of alerts regarding forecasts of pests and diseases in agriculture, and other metrics of interest to the agricultural community in northern Portugal;
 - ii. Installation and integration of sensors for meteorological and soil data acquisition in vineyards using the UTAD/mySense platform;
 - iii. Semi-automatic detection of vine rows in steep-slope vineyards using UAV imagery;
 - iv. Monitoring vineyards during the growing season through multiple UAV sensors;
 - v. Automatic identification of malfunctions in vineyard drip irrigation systems through thermal UAV data;
 - vi. Acquisition of UAV hyperspectral data for detection of grapevines affected by leaf roll disease;
 - vii. Use of thermal and multispectral UAV imagery to estimate water status and leaf pigment content in olive trees.



Integrated Innovations in Crop Management

- Optimization of synthetic compound dosages for grapevine ecosystem through cytogenomic and *in vitro* culture assays, enhancing product selection in R&D projects.
- Understanding of vine response under challenging conditions by developing strategic adaptation strategies, particularly utilizing kaolin and silicon as foliar protector/biofertilizer agents for grapevines facing water stress, intense light, and high temperatures.
- Implementation of orchard net cover technology demonstrated a significant reduction in natural cherry cracking and enhancement of fruit quality and yield.
- Patent Grant, N/ Ref. PAT373 (Order number in Portugal: 116935), Title: "Pesticide Compositions, Their Methods and Uses" (Applicant: UTAD-CITAB and FCUP-GreenUP); published in the Industrial Property Bulletin at 20-02-2023. Describes new methods and technologies to produce and deliver pesticides aiming to reduce the pesticide concentration in the environment.



Task 2.2 - Valorisation of bio-based products and co-products

Task 2.2 is dedicated to exploring the untapped potential of agricultural and forestry residues (AFFR), native flora, and aromatic and medicinal plants (AMP) to develop cutting-edge, high bio-based value products. Through this task, innovative processes are devised to create products of biological significance with industrial applications. The comprehensive studies on the application of AFFR and AMP are supported by meticulous extraction, purification, and isolation of highly bioactive compounds. Protocols tailored to specific cases are employed to assess the biochemical and biological activities of these compounds, alongside thorough evaluations of toxicological and phytotherapeutic properties. The ultimate objective is to ensure the safety of extracts and fractions, while also validating their pharmacological and nutraceutical properties. Task 2.2 represents a forward-looking initiative aimed at harnessing the rich potential of natural resources for the development of valuable, bio-based products with diverse applications.

2.2.1 - List of main achievements in task 2.2

Investigations into Phytochemical Profiles and Bioactivities

- Investigation of the stability of *Thymus carnosus* phytochemical profile over three years, revealed the impact of annual variation and geographic location on antioxidant, antidiabetic, antiaging, and neuroprotective activities in aqueous decoction and hydroethanolic extracts, providing novel insights into the plant's dynamic bioactivity.
- Pioneered characterization of the maturation process in elderberries (*Sambucus nigra*) by tracking the evolution of simple sugars and phenolic compounds over two years. Analyzed fruits from three key Portuguese varieties, Sabugueiro, Sabugueira, and Bastardeira, grown at the same location, uncovering the impact of climatic conditions and varieties on fruit development and quality across different harvesting seasons.
- Evaluation of phytochemical composition in diverse food products, including honey, bread wheat seeds, beers, strawberries, pomegranates, and Mediterranean traditional foods, along with agro-food co-products like pomegranate leaves, spent mushroom substrates, and wine industry by-products.
- Investigation of winery by-products, specifically pruning firewood and stem extracts from the Dão Region, for their potential to inhibit bacterial growth in diabetic foot wounds. Some varieties exhibited high phenolic compound levels with significant antioxidant capacity. Pruning firewood extract showed inhibition of Gram-positive bacteria, indicating its potential as a natural alternative to address antibiotic resistance.
- Exploitation of potential sources of bioactive compounds, such as pomace, stems, seeds, wine lees, and grapevine shoots, using ethanol as an extracting agent. Stems' hydroethanolic extracts (50:50, v/v) showed favourable phenolic content and antioxidant capacity, with the Tinta Roriz variety exhibiting the highest diversity of (poly)phenols. Optimal conditions for effective polyphenol extraction from grape pomace were determined using response surface methodology.
- Valorization efforts include incorporating pomace from the Douro region into muffin formulations and demonstrating good technological and sensory properties as sustainable and healthy food ingredients.





MAIN ACHIEVEMENTS

- Development of a cowpea immature pod ready-to-eat purée for the elderly to support muscle mass maintenance and neurotransmitter synthesis.
- Disclosure of nutraceutical properties of shiitake cultivation by-products, specifically spent mushroom substrate, such as significant phenolic content, antioxidant capacity, and potential antibacterial activity. This highlighted its potential as a valuable dietary supplement with prebiotic properties.
- *In vivo* studies on pomegranate leaf infusion (PLI) using the K14-HPV16 transgenic mouse model showed low-dose PLI consumption to be safe, potentially reducing neoplastic lesions and oxidative stress. This suggests potential therapeutic applications against HPV16-induced organ and skin injuries.
- A study of honey derived from *Pittosporum undulatum* Vent., an invasive species in the Azores, revealed significant phenolic content, antioxidant capacity, and anti-ageing properties, opening possibilities for valorization in various industries.
- Exploration of *Prunus lusitanica* L. fruits, a promising yet endangered species, identified abundant phytonutrients, highlighting the need for further study to unlock its full potential for the food and nutraceutical sectors.
- A comprehensive review of the current research, highlights the robust evidence supporting the health benefits of nut consumption, such as the positive correlation between nut intake and a reduced risk of key chronic diseases, emphasizing the nutritional value of nuts in providing fibre, minerals, vitamins, and phytochemicals with antioxidant, anti-inflammatory, and protective properties.
- Hydropriming and nutripriming of bread wheat seeds with $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ and/or $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ for wheat biofortification indicated higher nutritional value in unprimed S1 offspring, emphasizing the potential transgenerational impact on biochemical improvements.
- Implementation of medicinal and aromatic plant-based coatings, specifically aqueous extracts of *Satureja montana* L. and *Thymus vulgaris* L., demonstrates significant reduction in weight and firmness loss, delayed ripening, and enhanced antioxidant activity in sweet cherries during postharvest storage, providing a promising and innovative approach for improving shelf life and maintaining fruit quality.
- Assessment of the nutraceutical, therapeutical, and toxicological properties of bio-based products throughout invertebrate and vertebrate models.
- Evaluation of Portuguese isolates of *Gnomoniopsis smithogilvyi* has shown morphological and genetic similarities to those from other countries, even though the



research identified some physiological variability among the Portuguese isolates, contributing to a comprehensive understanding of the pathogen's characteristics and behaviour in the specific context of Portuguese chestnut varieties.

- Uncover the potential health risks associated with *Gnomoniopsis smithogilvyi* through the identification of two mycotoxins (3-nitropropionic acid and diplodiatoxin), highlighting the importance of carefully managing the application of *B. amyloliquefaciens* strains to effectively mitigate the hazard and reduce the fungus growth.
- A national patent registration (Patent pending number 118816 R) is pending: “Marine *Streptomyces* as Natural Antifungal Agents to Combat the Chestnut Brown Rot Fungus *Gnomoniopsis smithogilvyi*”. Control of *G. smithogilvyi* growth, the causal agent of chestnut brown rot that damages the fruit after harvest, and of wood cankers in the chestnut tree, by marine *Streptomyces* spp. strains (Applicants: CIIMAR and UTAD/CITAB).
- Development of strategies for recycling and valorising urban and agri-food residues, namely by study of new biofertilizer formulations.

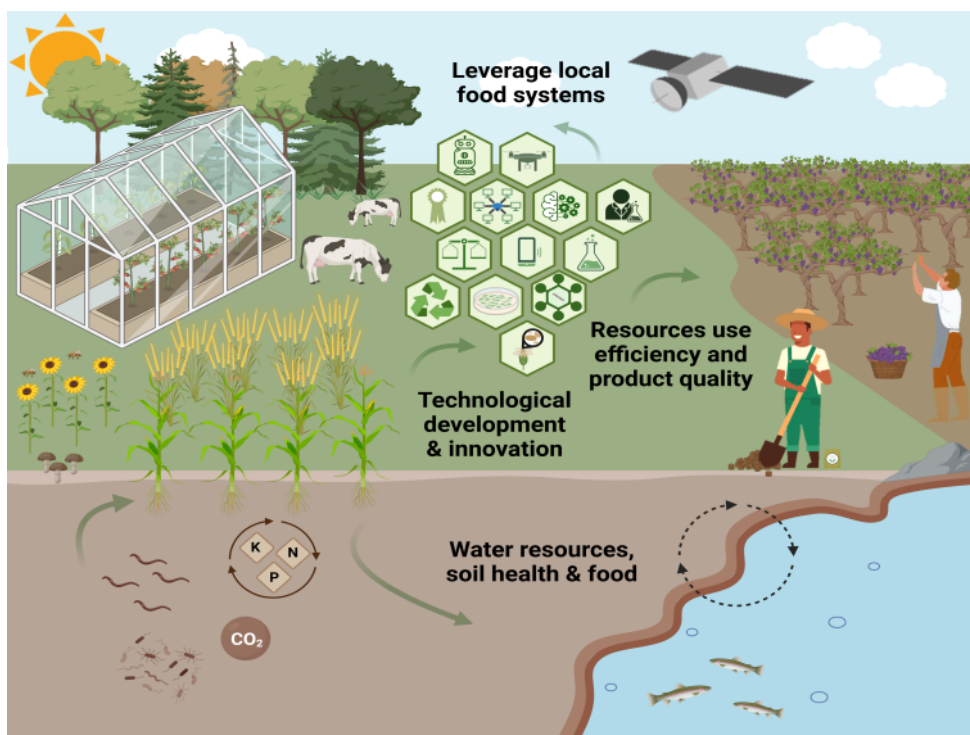


**ASSOCIATE
LABORATORY**



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

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. Aiming to strengthen CITAB and GreenUPorto collaborations, Invo4Agro promoted the workshop “Innovation towards a more sustainable agri-food production”, held at UTAD (University of Trás-os-Montes e Alto Douro) on February 16th, addressed to all members of the associated laboratory. On



November 17th, UTAD hosted the Inov4Agro Scholarship Researchers Day, where scholarship holders from CITAB and GreenUPorto were able to share their research within the scope of Inov4Agro thematic lines. Inov4Agro initiated the seminar series “Sustainable Agrifood Production” on December 13th, a monthly seminar counting with presentations by PhD students from CITAB and GreenUPorto designed to showcase the research that has been developed. This was an opportunity for students to improve their communication skills and promote cooperation among young researchers. On December 15th, Inov4Agro Open Day promoted the interaction between researchers and stakeholders, in an event hosted at UTAD, with the presence of members of CITAB and GreenUPorto, as well as representatives of stakeholders from major agri-food chains in the Northern region of Portugal. The event focused on identifying the key challenges in the sector and the development of potential collaborations.

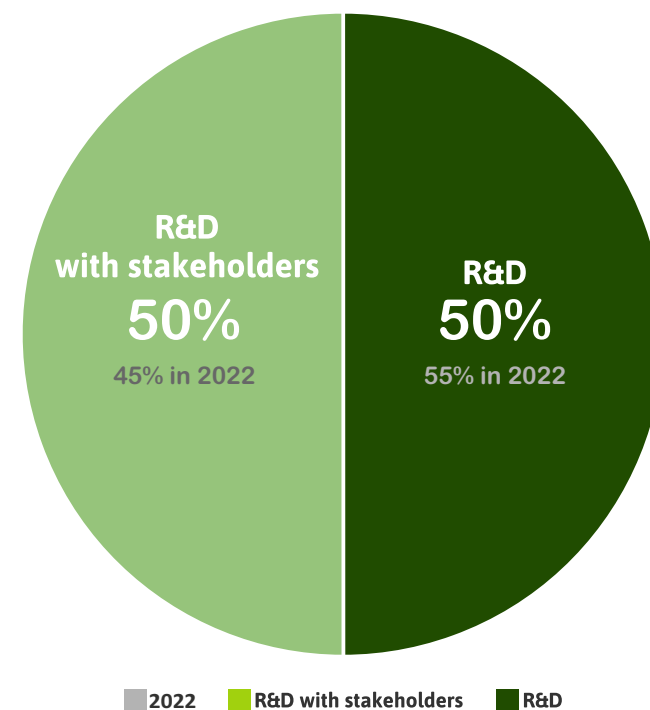
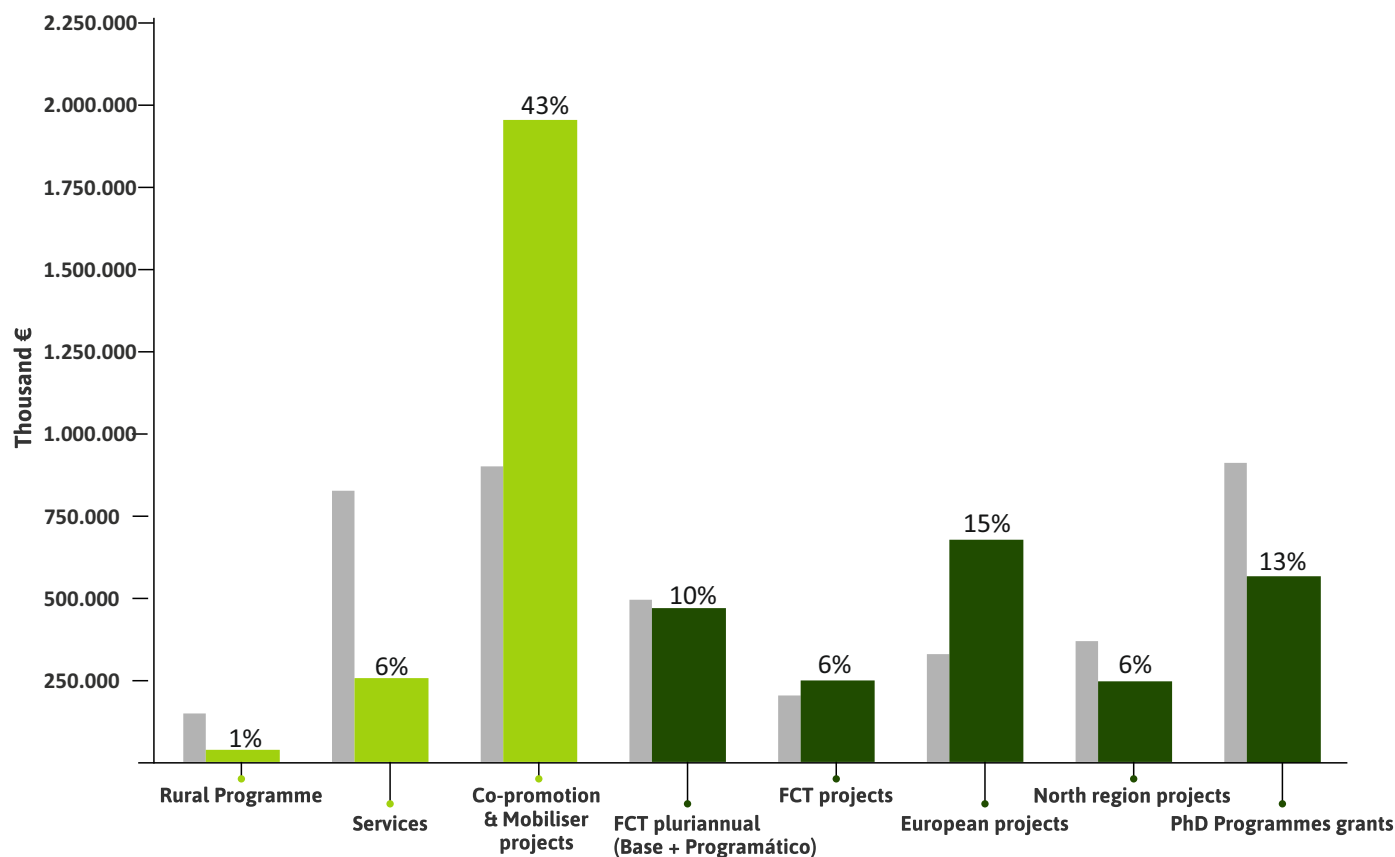


**COMPETITIVE FUNDING
& RESEARCH PROJECTS**



COMPETITIVE FUNDING

In 2023, the CITAB's total funding achieved 4.5 M€, an unparalleled amount since its creation. While direct public funding globally represented 50% of this value, the lowest share ever, the increasingly stronger connection with our stakeholders warranted a sustained growing share of our funding from partnerships with the private sector. The co-promotion and mobilizer projects under the Portuguese Plan for Recovery and Resilience (PRR) represented 43% of the total funding. On top of that, consulting services to private companies, such as environmental impact assessments, contributed with 6%, whereas rural development projects with 1%. Concerning public funding, the FCT Pluriannual funding (Base plus Programmatic) corresponds to 10% of the total budget. FCT R&D projects remain at approximately 6% of the total funding, while the contribution of European projects is fastly growing (15% of the total funding against 8% in 2022). The North Region projects continue to represent an important resource (6% of the total funding). FCT scholarship grants correspond to 13% of the total funding, hinting at CITAB's ability to attract new young scientists, nurturing regeneration and upskilling.





ORGANIZATION OF CONFERENCES

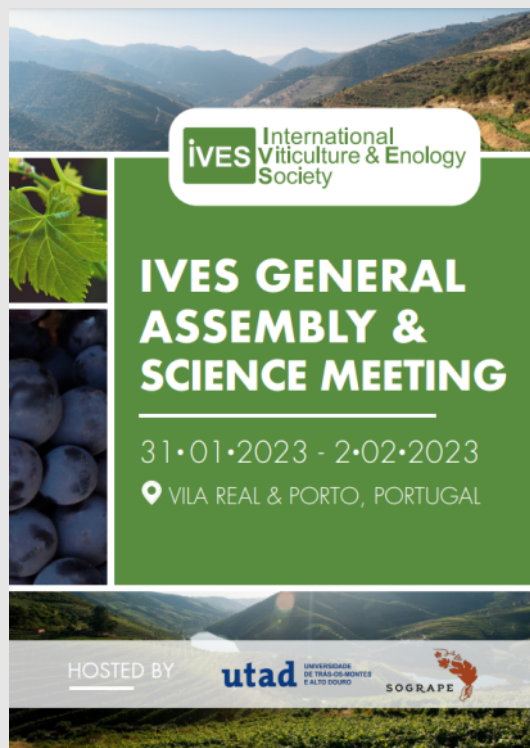


IVES - International Viticulture & Enology Society Meeting

"Understanding vine response to Mediterranean summer stress for the development of adaptation strategies - the kaolin case" was the topic of the presentation that researcher Sara Bernardo from CITAB shared with members of the IVES - International Viticulture & Enology Society. This international society of experts gathered in the Douro region.

Innovation towards a more sustainable agri-food production

On February 16th, UTAD (University of Trás-os-Montes e Alto Douro) hosted the workshop "Innovation towards a more sustainable agri-food production" This event brought together members of Inov4Agro, the associated laboratory that combines CITAB (UTAD) and GreenUPorto (University of Porto).





International Seminar on Air Quality

CITAB was part of the organization of the International Seminar on Air Quality, which took place at UTAD. On the first day, the students of researcher Margarida Correia Marques had the opportunity to conduct measurements of black carbon, inhalable particles, and CO₂, using equipment provided by María Piñeiro Iglesias and Javier Andrade Garda, professors from the University of Coruña. The next day, the seminar continued with the presentation of oral communications by the participants.



PEPAC

The presentation of the PEPAC at the University of Trás-os-Montes e Alto Douro was performed by the Secretary-General of CAP, Luís Mira. The invitation came from CITAB, which organized the event, aiming to clarify the Strategic Plan for the Common Agricultural Policy for Portugal in the period 2023-2027.





Horizon Europe Soil Mission

The CITAB was part of the organization of the Regional Workshop: Horizon Europe Soil Mission - Implementation of Living Labs in Portugal. The event was divided into a plenary session and several parallel sessions related to vineyards, dried fruits and olive groves, forests and agro-silvo-pastoral systems, as well as urbanization, soil impermeabilization, and post-industrial soils.

Coa Climate Risk Symposium

The impact of climate change and adaptation measures for the main agricultural crops in the Vale do Côa region were discussed in May at the Côa Museum. Those who had the opportunity to participate in this symposium learned about the research that CITAB is conducting in Côa area, which holds dual UNESCO World Heritage status (Alto Douro Vinhateiro and Vale do Côa).





CITAB Stakeholders Day

The "CITAB Stakeholders Day" was an opportunity for businesses, associations, and other strategic partners to explain and share their expectations regarding the science and research produced at CITAB. António Graça (ADVID), Braz Costa (CITEVE - Technological Center for Textiles and Clothing), Carlos Ribeiro (Laboratório da Paisagem), Gonçalo Andrade (Portugal FRESH), Luís Rochartre (Greenlab), Nuno Calado (SONAE), and Tiago Pinto (Anpromis) were the stakeholders present at UTAD with the mission of representing a wide number of partners and explaining how CITAB has been useful to them over the past years.

CITAB STAKEHOLDERS DAY
Programa
19 de Junho 2023
Auditório de Geociências

11h00	Visita aos Laboratórios do CITAB
12h30	Almoço (Restaurante Panorâmico)
14h15	Sessão de Abertura
15h00	Oportunidades de I&D no Horizonte Europa para o agroalimentar Margarida Santos (ANI)
15h30	Mesa redonda com Stakeholders do CITAB moderada pela Jornalista Teresa Silveira António Graça (ADVID) Braz Costa (CITEVE) Carlos Ribeiro (Laboratório de Paisagem) Francisco Pavaio (APPITAD) Gonçalo Andrade (Portugal Fresh) Luís Rochartre Álvares (WBCSD) Nuno Calado (SONAE) Tiago Silva Pinto (CNCACSA e ANPROMIS)
17h00	Coffee Break
17h15	Comissão Externa de Aconselhamento Científico do CITAB com moderação de Edna Cabecinha David Lindsay Isabel Pardo Gamundi Marco Bindi Uta Berger
18h00	Encerramento
20h00	Jantar (Quinta do Paço)

Inscrição

CITAButad

Sustainable Development in Trás-os-Montes and Alto Douro Seminar

The Seminar "Sustainable Development in Trás-os-Montes and Alto Douro," organized by CITAB and CETRAD, took place on October 28th. During this event, a Protocol of Scientific and Technological Cooperation was signed between UTAD and the Caixa de Crédito Agrícola Mútuo de Trás-os-Montes e Alto Douro. This protocol aims to award students who have successfully completed their master's dissertations or doctoral theses at UTAD, particularly those related to agricultural sciences, economics, management, and regional development.

Seminário
Desenvolvimento Sustentável em Trás-os-Montes e Alto Douro
27 out 2023

Programa:

9h00 - Sessão de abertura
 Eduardo Rosa, vice-reitor para a Investigação da UTAD
 João Seixas, presidente da Caixa de Crédito Agrícola Mútuo de Trás-os-Montes e Alto Douro (CCAM TMAD)
 Lúcia Madureira, diretora do Centro de Estudos Transdisciplinares para o Desenvolvimento (CETRAD)
 João Santos, diretor do Centro de Investigação e Tecnologias Agroambientais e Biológicas (CITAB)

9h15 - Desafios e oportunidades da sustentabilidade nas organizações e na região TMAD
 Carlos Rocha, CCAM TMAD
 José Luís Ferreira, Fundação Casa de Mateus
 Rui Soares, Real Companhia Velha
 Paula Melo Pinto, NERVIR - Associação Empresarial de Vila Real
 Cláudia Carreira, Associação de Paralisia Cerebral de Vila Real (APCVR)
 Célia Marques, CETRAD

10h30 - Pausa

10h45 - PhD Thesis Showcase

12h30 - Assinatura de Protocolo de Cooperação Científica e Tecnológica
 Erydio Gomes, reitor da UTAD
 João Seixas, presidente da CCAM TMAD

Local: Auditório B0.2 Complexo Laboratorial, campus da UTAD, Vila Real

INSCRIÇÃO

CETRAD **CA** **CITAB** **fct** **utad**

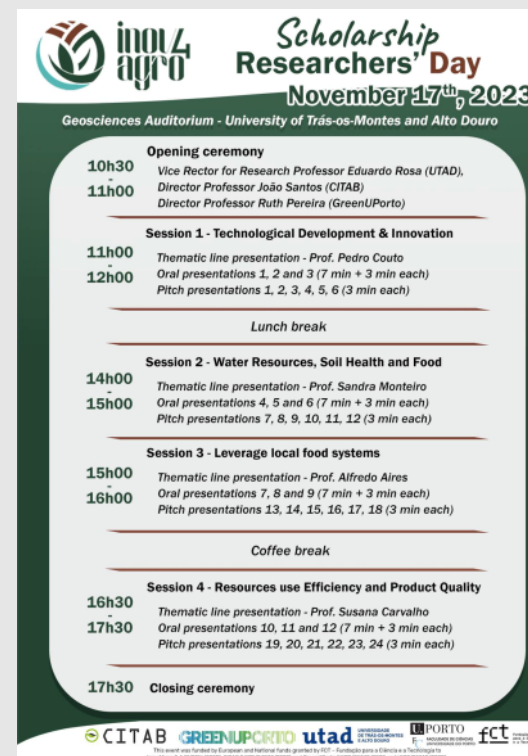


New approaches in the wine production sector

The lecture on the adaptation of viticulture to climate change, presented by Lia-Tânia Dinis from CITAB, was one of the various highlights of the seminar "New approaches in the wine production sector," which took place at the University of Trás-os-Montes e Alto Douro. The event was co-organized by CITAB and Mérieux NutriSciences - Portugal.

Inov4Agro Scholarship Researchers' Day

The "Inov4Agro Scholarship Researchers' Day" was a resounding success, an event endorsed by the Inov4Agro Associated Laboratory, providing scholars from CITAB and GreenUPorto the opportunity to share their research endeavours. The event received a total of 54 abstract submissions, which were organized into 12 oral presentations, 24 pitches, and 18 posters, covering the four thematic lines of Inov4Agro.





Sustainable Agrifood Production Seminar

In December 2023, the “Sustainable Agrifood Production” Seminar kicked off. This series will extend over 6 months, and to participate, one must be a doctoral student affiliated either to CITAB or GreenUPorto. This serves as an excellent platform for presenting research, honing communication and science dissemination skills. The speakers, PhD students, are competing for awards that will finance the dissemination and development of their works!

Inov4Agro Open Day

The Associated Laboratory Inov4Agro has fostered close dialogue with stakeholders from the main agricultural value chains in the Portugal Northern region. This event was the result of work that has focused on identifying the main challenges and opportunities for research and collaboration in the areas of vineyards and wine, olive groves and olive oil, chestnuts and chestnut trees, fruit cultivation, horticulture and small fruits, aromatic and medicinal plants, bee products, mushrooms, natural areas, biodiversity, and forests.

SUSTAINABLE AGRIFOOD PRODUCTION SEMINARS

GET TO KNOW OUR RESEARCH WITH CERTIFICATE & AWARDS!

DECEMBER 13 | GreenUPorto, Vairão, Room 11 | Zoom

OPENING 14h

RUTH PEREIRA | DIRECTOR GREENUPORTO
 SUSANA CARVALHO | VICE DIRECTOR GREENUPORTO
 LUÍS M. CUNHA | RESEARCH LINE COORDINATOR GREENUPORTO
 JOÃO SANTOS | COORDINATOR INOV4AGRO, DIRECTOR CITAB

SOFIA MACHADO 14h30
 PhD Student in Biology
 ENVIRONMENTAL SAFETY EVALUATION OF CHITOSAN NANOPARTICLES LOADED WITH ESSENTIAL OILS AS NEW BIOPESTICIDES

SUSANA BARROS 14h45
 PhD Student in Marine Science, Technology & Management
 HOW DO ENVIRONMENTAL CONCENTRATIONS OF METFORMIN IMPACT DANIO RERIO?

SAVE THE DATE! 13 DECEMBER, 2PM @ Vairão

Logos: GreenUPorto, CITAB, Sustainable Agrifood Production Research Centre

inov4agro OPEN DAY

VALORIZAÇÃO & SUSTENTABILIDADE DAS CADEIAS DE VALOR AGRÁRIAS

15 DEZEMBRO

14 H Sessão de Abertura

14H 30 Cadeias de valor Inov4Agro

- Vinha & Vinho
- Olivar & Azeite
- Castanheiro & Castanha
- Fruticultura
- Horticultura & Pequenos Frutos
- PAM, Produtos Apícolas & Cogumelos
- Áreas Naturais, Biodiversidade & Floresta

16H Pausa para Café

16H 30 Painel de discussão

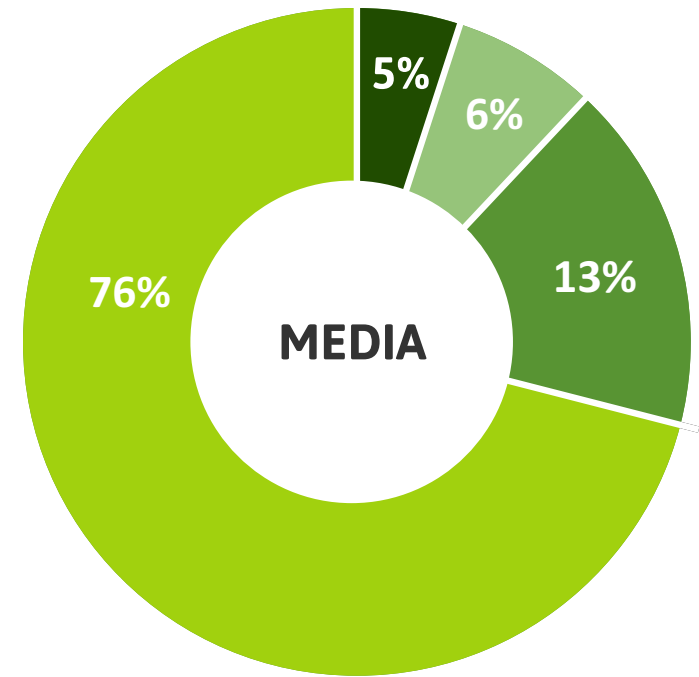
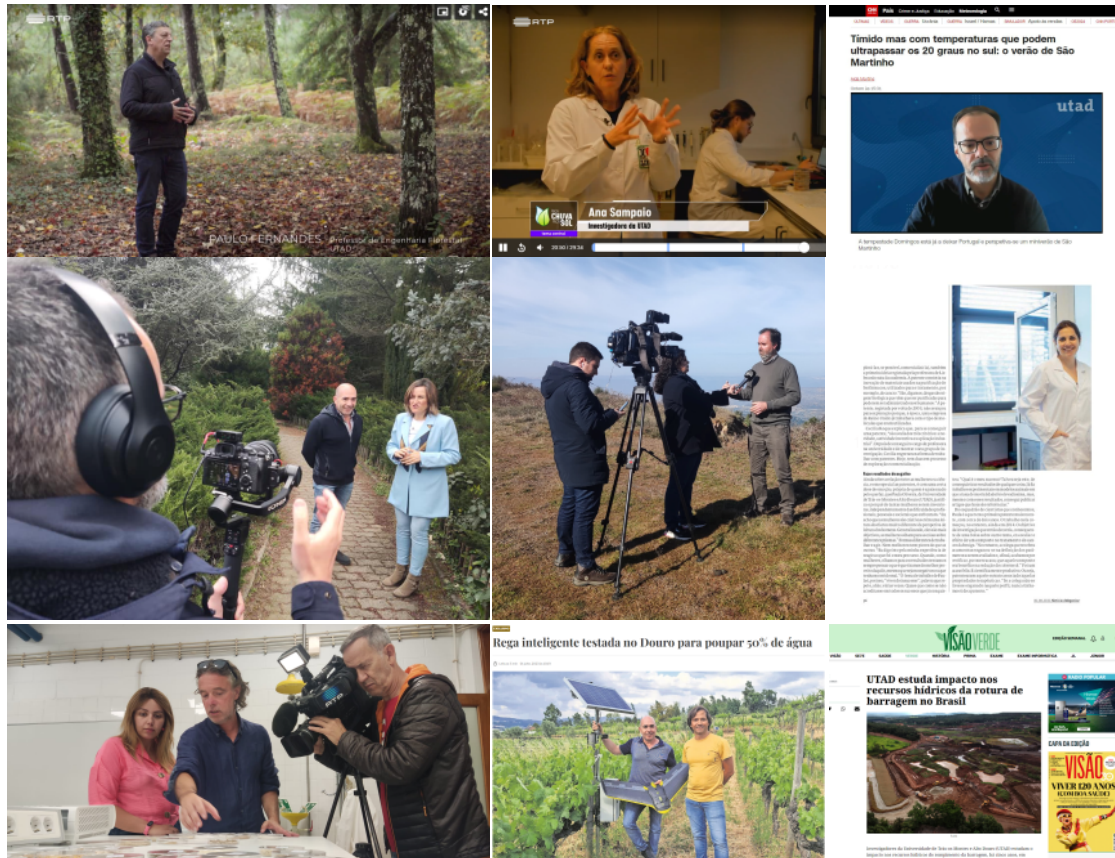
17H 45 Encerramento

AUDITÓRIO DE GEOCIÊNCIAS
 CAMPUS UTAD • VILA REAL

Logos: CITAB, GreenUPorto, Instituto de Investigação e Inovação em Tecnologia Agroalimentar e Biotecnologia



CLIPPING & OUTREACH



■ Online
 ■ Tv
 ■ Radio
 ■ Newspaper

Throughout the past year, CITAB has emerged as a focal point of interest, with a total of 194 news articles shedding light on its notable achievements and advancements. These articles were sourced from various media platforms, showcasing a diverse array of perspectives. Web news articles dominated the coverage landscape, constituting 76% of the total, underscoring the digital era's influence on information dissemination. Television coverage, comprising 13% of the media sources, provided a visual dimension to CITAB's narrative, captivating audiences with dynamic storytelling. Radio sources, accounting for 6% of the coverage, reaching listeners across diverse demographics. Additionally, print newspapers contributed 5% of the coverage, offering a tangible representation of CITAB's impact within traditional media. All these varied media sources underscore the widespread interest and recognition of CITAB's contributions to the scientific community, highlighting its pivotal role in driving forward research and innovation.



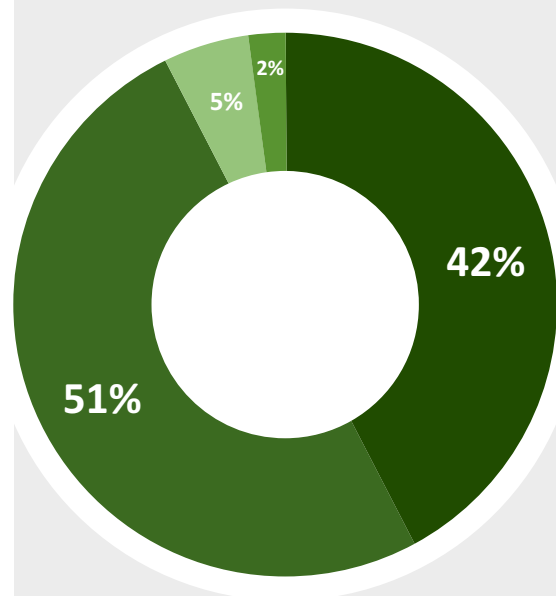
Researchers from CITAB actively engage with communities and promote scientific awareness through a variety of initiatives. For instance, Maria José Saavedra visited the Pedrouços School Group on World Hand Hygiene Day, focusing on the theme established by the World Health Organization. Cristina Morais contributed to #SEI2023, emphasizing invasive species through field actions in forests. LEFT-CITAB researchers organized an environmental water awareness campaign in Chaves, involving children to foster environmental consciousness. A research group lead by José Moutinho-Pereira also made a significant impact on European Researchers Night in Coimbra, Évora, and Armamar, inspiring young minds. Sílvia Afonso encouraged children on the International Day of Women and Girls in Science, nurturing curiosity and advocating for gender equality in STEM fields. Two students from Leiria and Vila Real also participated in a scientific activity led by Isaura Castro and Márcia Carvalho, which included visits to UTAD's laboratories and germplasm bank where students conducted experiments on cereal seed germination, DNA extraction, among other activities. Additionally, CITAB researchers delivered approximately 80 invited presentations, showcasing CITAB's scientific contributions across various locations.



PRODUCTIVITY METRICS



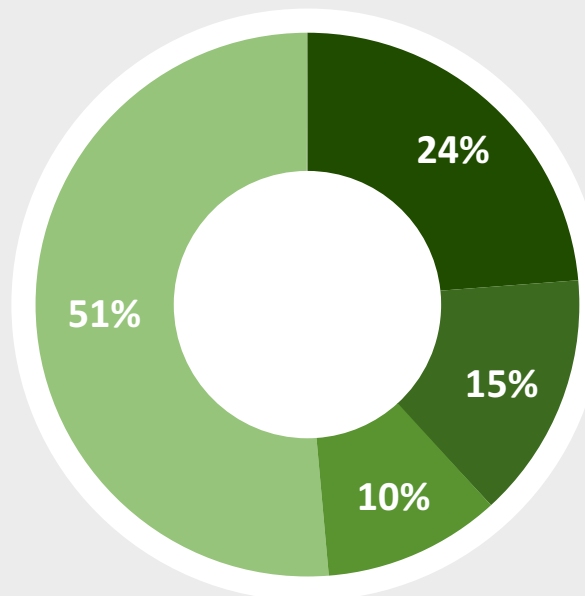
SCIENTIFIC PUBLICATIONS



- 293 peer reviewed articles published
- 353 communications in events
- 15 completed PhD theses
- 37 books and book chapters

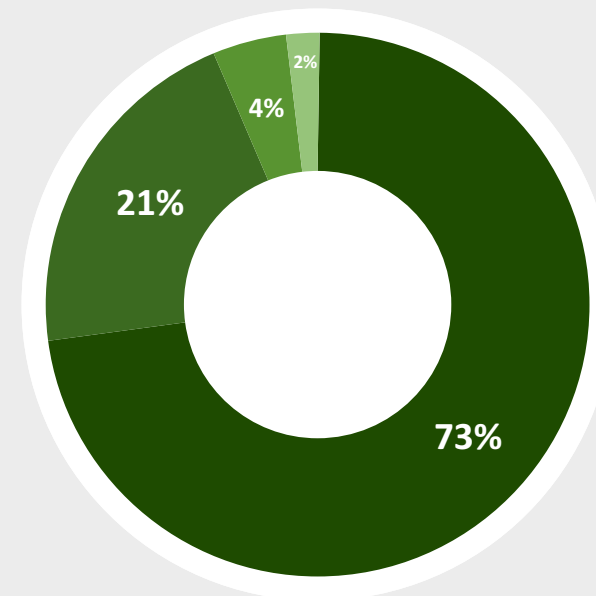
PUBLICATIONS IN PEER REVIEWED JOURNALS

SUBJECT AREAS DISTRIBUTION



- Agricultural and Biological Sciences
- Environmental Science
- Biochemistry, Genetics and Molecular Biology
- Others

QUARTILE DISTRIBUTION



- Q1
- Q2
- Q3
- Q4

In 2023, the CITAB's scientific productivity underwent a noteworthy growth. The number of scientific publications was 698, with 293 SCOPUS-indexed articles. This leads to a ratio of approximately 3.0 SCOPUS-indexed articles per Integrated Member, the highest value since CITAB's creation. Following the scientific areas of the SCOPUS database, the leading scientific domains of the indexed articles are 1) Agricultural and Biological Sciences, 2) Environmental Science, and 3) Biochemistry, Genetics and Molecular Biology, demonstrating the alignment of our scientific production with the CITAB's strategic plan. Jointly, these three domains correspond to one-half of all articles. The number of articles published in first-quartile journals corroborates the upward trend, corresponding to 73% of all articles, which is a major achievement. When considering first and second-quartile journals together, this value rises to 94%, thereby showing the high scientific standards and internationalization of CITAB. The publication of 37 books/book chapters demonstrates the recognition by the scientific community of the CITAB research merit. The conclusion of 15 PhD Theses is also noteworthy, revealing the CITAB's role in the training of young and highly qualified researchers.

VISIT US

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