2023
Activities Plan

CITAB

Together for Excellent Science

This Activity Plan is in strict agreement with the 2015-2020 Strategic Programme

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PRODUCTIVITY METRICS

Summary of the projected scientific production for 2023:

ITEM	**2023**
Publications	
Books/Book Chapters	**5**
ISI Publications	**215**
Publications in national journals	**10**
Communications	
Oral communications in international conferences	**100**
Oral communications in national conferences	**30**
Reports	**0**
Organization of seminars and conferences	**0**
Advanced training	
Doctoral thesis	**15**
Master thesis	**40**
Patents	

ACTIVITIES

Thematic Strand 1- Sustainability of Agri-Food and Forestry Ecosystems in a changing environment

Thematic Strand 1 aims to deliver integrated frameworks to anticipate, detect and tackle ecological changes in agricultural, forestry and natural ecosystems and landscapes. Thematic Strand 1 integrates natural and social sciences concepts to develop and integrate novel analytical frameworks and tools that contribute to progress in fundamental and applied fields of environmental research (Task 1.1) and ecological sustainability in agri-food and forestry ecosystems (Task 1.2).

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

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 future scenarios of climate and environmental change to develop, test and implement suitable mitigation and adaptation measures, such as intercrop agriculture, riparian restoration (e.g. to assess ecosystem service provisioning of green infrastructures) or bioclimatic cultivar adaptation (e.g. crop zonation).

In brief, Task 1.1 aims to:

- To forecast and monitor the growth and development of crops under variable climates;
- To evaluate the effect of micro and mesoclimatic conditions on water dynamics and survival strategies of grapevines using plant-based measurement techniques;
- Assess the grape potential of several *Vitis vinifera* varieties in the same edaphoclimatic conditions and definition of physiological biomarkers to identify varieties more resistant to summer stress;
- Implement an operational toolbox of sustainable agroecological practices oriented to local vineyards specificities, increase Mediterranean vineyards' resilience to climate change and diseases, reduce the use of the agrochemical, and boost local circular agriculture;
- Evaluate the toxicity induced by heavy metals intensively used in viticulture;
- Create a network of weather stations in the SCG to collect local weather information, and support the development of a weather warning network;
- Develop mapping and modelling tools to simulate and estimate future chestnut production;

- Develop a manual of good chestnut cultivation practices to be adopted by producers;
- Develop smart system irrigation for chestnut based on tree water potential, soil humidity sensors and remote sensing;
- Study the impact of silicon nutrition on chestnut resilience against the conjugated stresses of drought and heat;
- Evaluate the influence of meteorological conditions (fire weather) on the wildfire regime (spatial and temporal patterns of wildfire characteristics, e.g. fire incidence, seasonality, etc.);
- Assess the relationship between land use/land cover changes and wildfires;
- Assess the influence of climate on the effect of tree species-mixing, namely on tree growth-climate relationship and drought resistance;
- Assess the groundwater resources and evaluate their sustainable use;
- Evaluate the toxicological effects of microplastics and waterborne copper, alone or combined, will be d in different fish species providing novel insights regarding the environmental impacts of microplastics in freshwater and marine biota;
- Assess the effects of glyphosate-based herbicides to determine if relevant environmental levels impact aquatic communities, namely fish;
- Study the effect of exogenous compound sprays as a short-term strategy to mitigate cherry cracking;
- Study the effect of kaolin and seaweed-based extracts as a middle and long-term strategy to mitigate the negative effects of climate change on the physiological performance of hazelnut tree and nut quality;
- Study the effect of deficit irrigation on the physiological and biochemical performance of almond trees;
- Study leaf morphological traits as plant protection against extreme weather events.

Task 1.2 – Sustainability in agri-food and forestry ecosystems

Task 1.2 research encompasses multivariate analysis and modelling of habitat and land-use change impacts on terrestrial and aquatic environments, and ecosystem services as well as characterization of agri-food and forestry systems. Multidisciplinary research, relevant to stakeholders, will develop and apply techniques for species and biodiversity conservation, and pest control. Following this line, the compatibilization of agriculture intensification with biodiversity conservation will be tested. Modern methods (i.e. innovative hyperspectral imaging, computational intelligence techniques, and decision spatial support systems) will be developed and implemented as part of the CITAB's strategy to test innovative technologies to increase efficiency and system resilience, as well as facilitate the interaction between service providers and consumers to protect and enhance ecosystem services (water and soil quality, soil biodiversity and

temperature regulation). Therefore, research to develop, test, and apply spatiotemporal dynamic predictive analytical tools will be directed towards understanding how natural (e.g. seasonality, precipitation, energy flow) and anthropogenic (e.g. fertilizer application in agricultural systems, discharge of effluents, variations in crop type) changes affect ecosystem integrity.

In specific, Task 1.2 aims to:

- Contribute to the predictive research on the key interactions between relevant landscape characteristics and management strategies taking into consideration the perspectives and expectations of different stakeholders and policy decision-makers. A special focus will be given to the economic valuation of the ecosystem services, not only for the methodological challenges involved (e.g. addressing the value of biodiversity or cultural heritage) but also because the final outputs can be of major interest to managers and policy-makers, with high impact on stakeholders;

- Develop a new integrative participatory approach that will allow a better characterization and harmonization of biodiversity and ES assessment methods across terrestrial and aquatic Atlantic landscapes;

- Follow up the 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, thus contributing to the recovery of river continuity avoiding fragmentation of the aquatic environment;

- Within the scope of water security problems, the topics related to flood control and the payment for water services to landowners, willing to produce clean water in their headwater catchment parcels, will be investigated;

- Evaluate cultural practices (in crops such as grapevines) that promote sustainable water use strategies under abiotic stresses;

- Develop several root growth methodologies and imaging acquisition using legumes as crop models. The main goal is the establishment of a cost-effective methodology, able to identify water deficit resilient genotypes, prompt plant breeding programs and so suitable for more sustainable agriculture;

- Continuing the studies of the hyperspectral image combined with deep learning models to be used in the assessment and monitoring of wine grape quality, namely by developing new enhanced oenological parameters' prediction models and by improving the feature selection methodology involved;

- Develop an ecophysiological model of the grapevine, capable of supporting researchers and producers to diagnose the effects of different environmental and agro-technological factors on phenology, zoning and diseases of the vine, as well as

estimating the potential of adaptation strategies in mitigating the expected inconveniences for this crop in the future Mediterranean climate;

- Precision monitoring of agro-systems and assessment of the impacts of global changes (climate and anthropic): agrobiodiversity evaluation and characterization of agricultural genetic resources;
- Follow with the toxicological studies, carried out in animal models and in animals of zootechnical interest, to reduce management costs;
- Assessment of fire severity as driven by land use and land cover, topography and weather.

ACTIVITIES

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

Aligned with RIS3 policy, this Thematic Strand explores innovative approaches to develop and update processes and technologies to crop and food products, biological materials and agri-food residues. The Thematic Strand 2 will bring added value to agri-forestry ecosystems, agri-food and forestry products and co-products, boosting regional and national economic growth. This Strand directly involves sector stakeholders throughout the 2 vertically structured tasks applying multidisciplinary research.

Task 2.1 – Innovative technologies and processes

Task 2.1 focuses on a major unit objective – optimization and development of innovative technology for more competitive agri-food and forestry production chains. This task optimizes solutions for current and future stakeholders, boosting competitiveness and income by improving food and forestry crop productivity, reducing management costs and increasing profit. To meet these objectives this task research will focus on (i) the development of physiological and best management tools; (ii) the production of novel technological applications, including predictive management software and spectral imaging applied to crop and forestry parameters (e.g. maturation stages, growth rates, harvest periods, water and cycle nutrients, fertilizer management, disease); (iii) identification of key intervention points to optimize production and identify suitable species, varieties and rootstocks; (iv) characterization of vegetation and quality to optimize physiological responses to climate conditions. This will contribute to sustainable economic income for regional stakeholders, but findings extend to the national level.

Therefore, Task 2.1 aims to:

- Hyperspectral images combined with Deep Learning models will be used to assess and monitor wine grape quality, namely by developing new enhanced oenological parameters' prediction models and by improving the feature selection methodology involved.

- Development of a root phenotyping methodology through the implementation of an approach to image acquisition and image analysis of cowpea root to quantify several root traits and ultimately understand the legume's responses to drought stress.

- Understanding vine response through the development of rationale adaptation strategies, particularly by using kaolin and silicon as foliar protector/biofertilizer agents of grapevines growing under water stress, strong light and high temperature.

Task 2.2. Biological validation of by-products and natural compounds

High-added value of sustainable bio-based products in the food supply chains to fulfil European policies targeting zero waste policies, circular economy and the green deal, a strategic approach to integrate sustainable food production systems with the consumption of safe food products and the existing links to healthy people and healthy societies is a priority to CITAB. The consumers should envisage the selection of food towards healthier and sustainable choices, taking into account sustainable local and regional food systems and the development of environmentally friendly agriculture practices. This Task aims to address these challenges throughout the isolation, identification and characterization of natural compounds and their by-products, followed by their validation in biological systems (in vitro and in vivo approaches). Reduction of wastes in animal and agricultural production systems and in the food supply chains, as well as approaches to enhance the re-utilization of such products are addressed to promote sustainable food consumption and facilitate the shift to healthy and sustainable diets.

In brief, Task 2.2 aims to:

- Isolation, identification and characterization of potentially valuable bio-based compounds and their by-products in an integrated food and health system.
- Promote sustainable re-utilization of agrifood by-products.
- Produce new bio-based valued compounds and evaluate their possible applications in the development of healthier products.
- Assess nutraceutical, therapeutical and toxicological properties of bio-based products throughout cell cultures and animal models.

COOPERATION

National

Strengthening the link between CITAB research and stakeholder needs, CITAB will initiate the participation in two national mobiliser projects, “cLABEL+: Innovative natural, nutritious and consumer-oriented 'clean label' foods” and “rePLANT: Implementation of collaborative strategies for integrated forest and fire management”, which joined together a total of 40 national entities (22 industrial partners, two technological interface centres and 16 research units).

In 2023 the Centre will strengthen its position as a research provider for private and public stakeholders, with the establishment of several contracts with CITAB’s Laboratories of Applied Ecology (LEA) and Fluvial Ecology (LEF). Moreover, the mobiliser projects with the industry and the Operational Group projects, funded by the Rural Development Programme, will be a source of funding for the Centre.

International

The Centre expect the approval of one or two international projects.

DISSEMINATION

We will try to consolidate the communication processes implemented in previous years so that CITAB's notoriety can increase according to the excellence of the science produced. The objective is to transfer to public opinion the true scientific capacity of CITAB researchers using communication strategies already implemented. In 2023, CITAB will continue to promote conferences, seminars and workshops with themes that capture the range of CITAB's areas of expertise. Like in past years, target audiences will include the academic community, as well as key stakeholders from the public and private sectors. Contributions and keynote talks will be given by CITAB and consortium members and invited experts. CITAB researchers will give communications at several national and international conferences.

Organization of conferences

All funded projects will apply Open Science principles, covering the organisation of stakeholder-relevant themed workshops, seminars and conferences (e.g. to present project findings and deliverables to different target audiences), researcher participation in conferences, open access publishing, creation of dedicated websites and use of social media to rapidly disseminate news to a broader audience.

Outreach activities

As in the past, CITAB will increase the number of outreach activities for junior and high schools. In this context, several initiatives are planned to be taken in 2023, despite the restrictions affecting outreach and outdoor activities. CITAB will promote dissemination events oriented mainly toward high school and university students, either in person or by remote communication tools. The most relevant and impact initiatives will be the summer courses "Verão com Ciência", the "OCJ-Scientific Occupation of Young People on Vacation", and the "Science, and Technology Week".