UNIVERSITÀ DI TRENTO

C3A CENTRO AGRICOLTURA ALIMENTI AMBIENTE

PhD in AGRIFOOD AND ENVIRONMENTAL SCIENCES

CALL 2024 – CYCLE 40

Reserved scholarship
A - Innovative insurance contracts to boost environmental performances of agricultural businesses (Project UE HE RIA PRUDENT GA n°101134051 E43C23000580006)

Funding Body: **UniTrento (C3A) - Project: UE HE RIA PRUDENT**

Supervisor 1: **Prof. Simone Cerroni**
Supervisor 2: **Prof. Roberta Raffaelli**

Context / Synthetic description of the project and research outcome

The relationship between the use of agricultural insurances and farms' environmental performances is not well understood (e.g., Horowitz and Lichtenberg, 1993; Möhring et al., 2020). However, there is a stream of research arguing that agricultural insurance could be used as an instrument to improve the environmental sustainability of agricultural businesses (Coble et al., 2003; Jørgensen et al, 2020). This project aims at the development of an agricultural insurance product that is designed to improve the environmental performances of agricultural businesses (in addition to protecting against production risks) and explore whether such products have a market for specific primary production sectors (vines or olives) in Italy. This insurance contract can be designed using different framings to nudge farmers towards its purchasing. The project aims at exploring the types of nudges that are more effective in increasing demand for this product, and identify which markets segments respond better to different types of nudges. These research questions are explored using economic experiments and randomized control trials.

References:

Coble, K. H., Hanson, T., Miller, J. C., & Shaik, S. (2003). Agricultural insurance as an environmental policy tool. Journal of Agricultural and Applied Economics, 35(2), 391-405.
Horowitz, J. K., & Lichtenberg, E. (1993). Insurance, moral hazard, and chemical use in agriculture. American journal of agricultural economics, 75(4), 926-935.
Jørgensen, S. L., Termansen, M., & Pascual, U. (2020). Natural insurance as condition for market insurance: Climate change adaptation in agriculture. Ecological Economics, 169, 106489.
Möhring, N., Dalhaus, T., Enjolras, G., & Finger, R. (2020). Crop insurance and pesticide use in European agriculture. Agricultural Systems, 184, 102902.

PhD in AGRIFOOD AND ENVIRONMENTAL SCIENCES

CALL 2024 – CYCLE 40

Reserved scholarship: **B- CROSSGRAPE: Exploiting primed acclimation strategies via cross-tolerance in Vitis vinifera for inducing adaptation under climate change scenario** **PRIN 2022 - PNRR (DD 1409 del 14/09/22) – PNRR - M4C2 INV 1.1; Project code P2022PCAYW CUP E53D23020970001**
Funding Body: **UNITN - PRIN 2022 PNRR**
Supervisor 1: **Michele Faralli** Supervisor 2: **Massimo Bertamini, Maria Stella Grando**
Context / Synthetic description of the project and research outcome Climate change projections indicate that many areas will experience more frequent and severe drought and heat events in the future. Grapevine (Gv), one of the most economically important crops in the Mediterranean basin, is already facing climate change-related issues associated both with reduced yield and diminished berry quality. Therefore, optimising Gv physiological function by defining cutting-edge strategies incorporating physiological knowledge and management approaches is key for the future viticulture. The most common strategies for addressing drought tolerance in Gv focused on water-efficient technologies aimed at managing water application or at improving crop water-use through breeding. Few management strategies explicitly consider the management or manipulation of physiological processes (e.g. PRD, DI). An unexploited, yet effective approach for fine-tuning the response of Gv to environmental stresses is termed primed acclimation (PA). PA is a regulated stress application to induce a primed state that can stimulate manipulation in root:shoot partitioning, root architecture, stomatal dynamics and osmotic adjustment (OA). To date, no efforts have been placed on defining the best PA scheme for grapevine (e.g. chemical, cross-tolerance) and in assessing the underlying physiological mechanisms of PA state in Vitis vinifera. The aims of the project will be 1) to assess the best cross-tolerance combination for inducing PA state in Gv, 2) to determine the metabolites associated with the increase in OA (i.e. sugars, aminoacids), 3) to define the physiological advances of an increased OA (i.e. growth, photosynthesis, gs, ROS scavenging by sugar signals), 4) to exploit this new knowledge on PA cycles (priming via chemicals, water stress, heat stress) in controlled environment conditions and 5) optimise PA cycle in ad hoc field trials in which berry and wine quality will be also assessed. CROSSGRAPE will be the first work providing a comprehensive analysis of OA, physiology, and PA strategies for enhancing stress tolerance in grapevine while maintaining must and wine quality.

PhD in AGRIFOOD AND ENVIRONMENTAL SCIENCES

CALL 2023 – CYCLE 40

Reserved scholarship:

C- Research and development of new alternatives based on microorganisms, plant extracts, and Soft chemistry to Control grapevine downy mildew (Plasmopara viticola) and plant diseases caused by bacteria (e.g., Erwinia amylovora on pome fruits) for new IPM strategies in crop production. (Acronym: SoftControl)

Funding Body: **University of Trento; Diachem SpA**

Supervisor 1: **Gerardo Puopolo, UNITN**

Supervisor 2: **Dario Sterzi, Diachem SpA**

Context / Synthetic description of the project and research outcome

Overview:

Downy mildew caused by Plasmopara viticola and fire blight caused by Erwinia amylovora are two significant threats to grapevine and apple production worldwide.

Although they belong to two different domains, E. amylovora and P. viticola are both sensitive to copper ions, and copper-based plant protection products are the main products that can be used in organic production.

In the past years, the input of copper in agriculture has been constantly decreased and organic producers are lacking alternative products effective in controlling apple fire blight and grapevine downy mildew. However, there is hope. UNITN and Diachem SpA, an Italian company investing in the development of eco-friendly plant protection products, have designed SoftControl, a research project that holds the promise of providing new solutions for these problems.

Project goals:

- ✔ Evaluation of new eco-friendly alternatives based on plant extracts and soft chemistry for controlling P. viticola on grapevine and E. amylovora on apple.
- ✔ Characterisation of the mode of action of the most effective active ingredients using omics technologies
- ✔ Determination of the optimal dose and application interval, rain fastness, and dependency on environmental conditions.

Reserved scholarship:
D - The multifaceted role of microbiomes in the agroecosystems: regulators of cognition in honey bees and effectors of biodiversity in spontaneous fermentations (Progetto Caritro MicroBee, CUP E63C23001870007)

Funding Body: **University of Trento - CIMEC**

Supervisor 1: **Omar Rota Stabelli, C3A, UniTN**
Supervisor 2: **Gianfranco Anfora, C3A, UniTN**

Context / Synthetic description of the project and research outcome

The study of microbiomes can expand our understanding of complex agro-environmental systems by enlarging the classical single-organism viewpoint to a more comprehensive multi-species perspective. Microorganisms can be efficiently studied using a metagenomic approach on both amplicon and shot-gun data to reconstruct both the bacterial and the fungal component of the microbiome. Metagenomics provides unparalleled opportunities to understand how the microbiome affects the biology and ecology of insects, soil, plants, and food production.

This project aims to investigate the peculiar ways in which the microbiota influences different aspects of the agroecosystems. We are planning at least two main research projects on two complementary models. In the first model we will study how the microbiota influences honeybees' behaviour and cognition, by studying how stress factors such as pesticides, nutrients, and bacteria mono-colonisation affect the gut microbiome and how the latter in turn affects the behaviour and cognition of honeybees. This will be done crossing amplicon and shot-gun metagenomics profiles with behavioural experiments. In a second model we will study the importance of the microbiota (in particular the mycobiome) in the spontaneous fermentation of wine. This will be done by comparing the genomes of yeast isolated from wine must of different Italian localities: analyses will provide strong insights in the biodiversity of fungi and other fermenting microbes in the natural agroecosystem. Possible bees-yeast relationships will be explored by crossing the results from the two projects. In general, the proposed research will contribute to understanding biological and ecological mechanisms that will be useful for protecting the environment and its biodiversity, as well as the quality of agri-food productions.

This scholarship aims at training a student capable of applying computational and evolutionary metagenomics to practical issues of the agroecosystem.

Reserved scholarship: **E - Numerical modelling of atmospheric transport processes of particulate matter along mountain slopes**
Funding Body: **DICAM (University of Trento) and Environmental Agency of the Autonomous Province of Trento (APPA)**
Supervisor 1**: Dino Zardi** Supervisor 2: **Gabriele Tonidandel**
Context / Synthetic description of the project and research outcome Particulate matter, composed either of biogenic or abiogenic substances, play a crucial role in the environment, affecting air quality, atmospheric radiation budgets propagation of species, ecosystems' dynamics, human health, and nucleation processes in clouds, and hence precipitation. Transport of such substances over mountainous terrain is made more complicated than over flat areas by the complexity and variety of the wind structures found over mountain slopes. In particular, thermally driven slope winds, often occurring after daytime heating and nighttime cooling of slopes, offer preferred flow patterns, which may variously combine with convection in the upper atmosphere. Also, turbulence associated with these flows plays a crucial role in the uptake, diffusion and deposition of these substances. The candidate will develop and apply new concepts, derived from recent advances in our understanding of the above winds, to existing mathematical and numerical models, in order to improve their capability of reproducing the above transport processes in a variety of situations. Both Eulerian and Lagrangian approaches will be tested. The latter will include both forward- and back-trajectories. Comparison with data from field measurements will allow suitable validation of the models. Cooperation will be pursued with the Environmental Agency of the Autonomous Province of Trento, with the Botany Unit of the Civic Museum in Rovereto, and with the Environmental Botany Unit of the Edmund Mach Foundation.

Reserved scholarship:
F - VINE-CHANGE: Unlocking the underlying mechanism defining intra-varietal (cv. Chardonnay) and inter-specific (Vitis spp) variability in key traits of adaptation to climate change

Funding Body: **Fondazione Edmund Mach**

Supervisors : **Bontempo Luana (FEM), Franceschi Pietro (FEM), Faralli Michele (UNITN), Bianchedi Pierluigi (FEM), Bertamini Massimo (UNITN)**

Context / Synthetic description of the project and research outcome

It is now established that high temperature and low water availability affect the phenology of grapevine, as well as grape berry development and ripening, hastening the latter while affecting both primary and secondary metabolism. Although several agronomic techniques have been proposed to limit the negative feedback of climate change on leaf and berry physiology, genetic variability can provide novel genotypes with superior traits. Intra-variety variability (clonal variation) is known to exist in several Vitis vinifera varieties and for several physiological and quality traits. To date, however, no significant and extensive work has been carried out on Chardonnay, one of the most oenologically important varieties for sparkling wine worldwide. At the same time novel rootstocks are critical for defining novel avenues in viticulture; yet, our understanding of species-specific adaptation to specific environmental conditions is sparse and needs further investigation.
In this project a series of SMA clones, French clones along with newly putative material (40 individuals in total) selected in the last four years in several pre-clonal vineyard around Trentino will be studied in controlled environment conditions (year 1 and 2) over 3-to-4 experiments and vineyard (from year 2, one vineyard that will be established in 2024). A comprehensive set of analysis including phenology, productivity and berry quality will be performed, while underlying mechanisms of tolerance to multifactorial stress conditions will be monitored via stable isotopic measurements, untargeted NMR metabolomics and proximal physiology. In the field, quantitative phenotyping will be also performed by using remote/proximal sensing techniques. For Vitis spp, a series of controlled environmental conditions experiments will be carried out to understand the mechanisms associated with stress tolerance.
The project aims at assessing Chardonnay intra-variability with further insight on specific mechanisms of tolerance. Similarly, inter-specific variation in Vitis spp, a critical step for designing breeding programs, will be evaluated. The possibility to exploit novel clonal and Vitis material will be also evaluated and may provide viticulturists with preferable combination of genotypes.

Reserved scholarship: **G - Impact of climate change on carbon and nitrogen cycles in forest ecosystems**
Funding Body: **Fondazione E. Mach**
Supervisor 1: Damiano Gianelle **(Fondazione E. Mach)** Supervisor 2: Mirco Rodeghiero **(Università degli Studi di Trento, C3A)**
Context / Synthetic description of the project and research outcome Climate change is going to profoundly disrupt forest ecosystems biogeochemical cycles particularly affecting carbon and nitrogen cycles. Climate extremes like warmer temperatures, altered precipitation patterns and disturbance events (wildfires, wind storms and drought) are causing the release of large amounts of stored carbon. Moreover, elevated temperatures increase respiration rates, potentially offsetting forests carbon uptake. Changes in growth dynamics and species composition further impact carbon sequestration. Carbon and Nitrogen cycles are strongly linked and rising temperatures are going to accelerate soil organic matter decomposition therefore promoting nitrogen availability for plant uptake. However, excessive nitrogen deposition which is also partly released from human activities, disrupts nutrient balances and biodiversity. These alterations can lead to shifts in species composition, affecting ecosystem stability. As a consequence, feedback loops in these cycles exacerbate climate change through increased carbon emissions and nitrogen pollution. Project goals: The project will analyse, through leaf, tree and ecosystem level measurements the impact of climate change on carbon and nitrogen cycles in a beech forest of Trentino, as part of ANAEE infrastructure.

Reserved scholarship:

H - Effects of ozone-enriched storage atmosphere on fruit postharvest quality

Funding Body: Laimburg (Centro di Sperimentazione)

Supervisor 1: **Annachiara Berardinelli (Unitn)**

Supervisor 2: **Fabrizio Costa (Unitn)**

Context / Synthetic description of the project and research outcome

Ozone, a highly unstable triatomic oxygen molecule, is one of the most powerful oxidants with several advantages, such as the absence of detectable residues on treated products. The application of ozone in the food industry has significantly increased both at experimental and commercial levels, as a sanitizer in the food industry aiming at inactivation of microorganisms, or as a removal agent of toxic substances such as mycotoxins and pesticide residues. In recent years, ozone has been also applied in the postharvest of fruit for the improvement of potential storability through the ozone-mediated oxidation of ethylene.

The use of ozone in management of post-harvest quality of horticultural products has been recently extensively studied. However, currently available data on fruit changes are limited and fragmented in addition to a scarce knowledge about optimal concentrations of the gas and times of treatments according to the fruit characteristics. It is known that, when applied incorrectly, ozone can also have a negative impact on fruit qualitative attributes.

For a reliable optimization of fruit post-harvest ozonation management and a prolongation of shelf life, the PhD project aims at:

- Optimising the production and the distribution of the gas in a pilot lab setup.
- Studying the effect of the gas on the metabolic processes of a selection of both climacteric (apples and pears) and non-climacteric fruits (strawberries, cherries, and raspberries).
- Studying the influence of ozone on mechanical and chemical attributes and on micro-structural properties.
- Studying the effective role of the ozone in activating the antioxidant defence mechanism in plant cells and metabolising reactive oxygen species (ROS).
- Scaling the technology in a semi-industrial plant.
- Transctiptome analysis to dissect the physiological impact of ozone treated fruit.

Reserved scholarship:
I - Investigating Nutritionally Viable and Environmentally Sustainable alternatives to Traditional animal-based foods: (INVEST): A multidisciplinary approach with the consumer at the center.

UE H2020 SISTERS [GA N° 101037796 - CUP E45F21001020006] and UE H2020 PROMEDLIFE [GA N° 2132 - CUP E43C22000480006)

Funding Body: **University of Trento C3A**

Supervisor 1: **Flavia Gasperi (UniTN)**

Supervisor 2: **Eugenio Aprea (UniTN)**

Context / Synthetic description of the project and research outcome

In response to the pressing environmental concerns and the increasing demand for sustainable food options, this project proposes to explore and develop environmentally sustainable and nutritious alternatives to conventional animal-based foods taking into account consumer preferences. By focusing on innovative plant-based and/or lab-grown alternatives, we aim to mitigate the environmental impacts associated with traditional animal agriculture while promoting healthier dietary choices focusing on the sensory characteristics of the alternative products.

The main objectives of the project are: i) to review the existing and more promising alternatives to animal-based foods, including, but not limited to, plant-based proteins, cultured meats, and insect-based products; ii) to propose new formulations for sustainable food products that are nutritionally balanced and appealing to consumers. iii) to analyze the chemical and physical properties that impact sensory perception of the studied products; iv) to conduct a sensory and hedonic characterization of the more promising alternatives and evaluate their impact on consumption intentions.

The expected outcome of the research are: i) the development of innovative and sustainable food products that offer consumers nutritious alternatives to conventional animal-based foods; ii) the increase of consumer awareness and acceptance of plant-based and lab-grown food options, leading to shifts in a more sustainable dietary behaviour and consumption patterns; iii) the dissemination of research findings through academic publications, scientific and industry conferences, and public outreach initiatives to foster knowledge sharing and collaboration in the field of sustainable food innovation.