



Development of innovative priming technologies safeguarding yield security in soft fruit crops through a cutting-edge interdisciplinary approach



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PRIMESOFT at a glance

The development of non-toxic synthetic and natural priming agents (PAs) towards sustainably-sourced and environmentally sound products for the development of a resource-efficient circular economy is an R&D activity that recently has received considerable attention. However, the effort of the Lead Market Initiative (LMI) Advisory Group to trigger a market prospective for innovative products, remains still, to a large extent, unimplemented. PRIMESOFT's overarching objective is to explore innovations in the application of PAs in value-added soft fruit crops from a range of perspectives and strengthen educational, research and innovation activities among

innovation activities among the Widening Institution (Cyprus University of Technology) and 4 internationally-renowned Advanced Partners (APs). Through this multi-actor approach, we aim to bridge the gap between chemical and nanomaterial priming research and agricultural practice in order to bring the inventions closer to application and commercialization towards resource-efficient smart farming practices. Besides the novelty of its technological approach that will be validated by sophisticated Life cycle cost analysis, PRIMESOFT's ambition is to use computational analysis and mechanistic modelling to identify key components



that regulate the mode of action of PAs through the employment of transcriptomic and metabolomic approaches. The WI is expected to receive pioneering education, research and technological capacity by a polymorphic Consortium that share highly complementary skills and the nature of their activities creates added value. Outreach activities are expected to create significant scientific, societal and economic impacts and are particularly dedicated to the researchers of the WI in order to acquire the necessary competencies to seek a position of professional maturity. Specifically, PRIMESOFT has planned 2 thematic

workshops, 4 training schools with hands-on practice in state-of-the-art methodologies, and an international scientific conference. PRIMESOFT aspires to enhance strategic networking activities of WI with both APs and stakeholders of the agro/food sector during and beyond the end of the project. To this aim, a business plan towards the development of a Regional Center of Excellence in Plant Sciences will be developed.

Scientific and technological objectives

- ~ To establish a community of practice and spread excellence in the domain of applying PAs on soft fruit crops.
- ~ To create knowledge hubs with a core in the application of PAs as a cutting-edge technological approach for direct use in modern agricultural practices.
- ~ To evaluate the commercial potential and conduct technology marketing to encourage industry engagement of the inventions and execute the exploitation activities.
- ~ Transfer of knowledge activities, access of infrastructure and technological know-how and to enhance creativity by new approaches in R&I collaboration.
- ~ To provide ground-breaking work in the correlation of multi omics approaches with field data modelling and Life cycle analysis.
To enhance production and explore possibilities to adapt cultivation of soft fruits under adverse conditions due to climate change.



Widening objectives

- ~ To develop a critical mass of high -profile researchers of the Widening Institution and raise reputation, research profile and attractiveness of the Cyprus University of Technology.
- ~ Knowledge transfer to the small-holder Cypriot farmers for greater resilience in agricultural practice.
- ~ To strengthen research management capacities and administrative skills of the WI staff and raise the profile of the WI within the European Research Area.
- ~ To establish long-term collaborations with the APs towards increment of the S&T capacity and innovation potential.



PRIMESOFT

scientific strategy:

overview
of experimental
approaches

Agronomic, Physiological Features

- ~ Yield, net photosynthesis, time of flowering
- ~ Qualitative attributes
- ~ Cellular damage indicators
- ~ Assays of enzymatic & non-enzymatic antioxidants

Omic tools

- ~ Gene expression analyses
- ~ Global transcriptomic analysis (RNAseq)
- ~ Metabolomic analysis (Volatile organic compounds and phytochemical compounds)

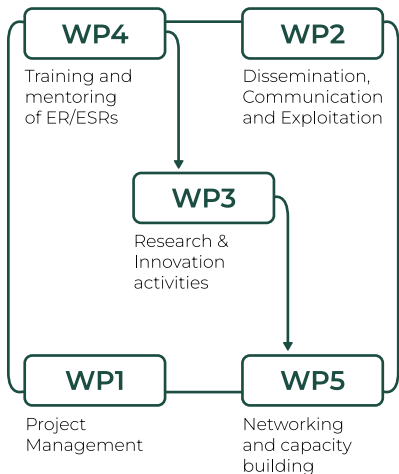
Eco-efficiency approaches

- ~ Life Cycle Analysis & Life Cycle Cost Analysis
- ~ Assessment of proposed cultivation protocols
- ~ Product development (i.e. encapsulation of PA)

Data analysis & modelling

- ~ Integration of -omics data
- ~ Multivariate statistics
- ~ Annotation and network analysis

Work packages



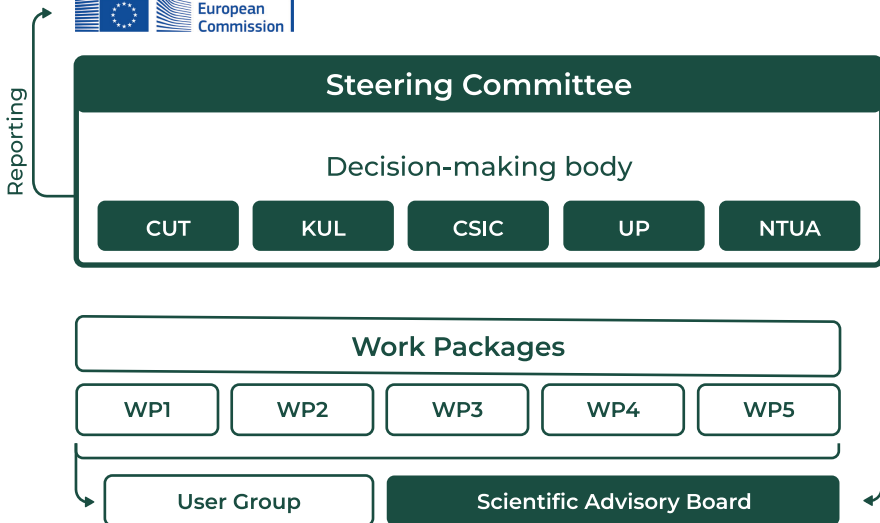
Training schools – Exploratory workshops

- ~ Grant proposal writing & implementation (University of Potsdam)
- ~ Priming in plants – agents, processes, molecular settings (University of Potsdam)
- ~ LCCA as a decision support tool on agro/food value chain (National Technical University of Athens)
- ~ Volatile Organic Compounds analysis: techniques, data processing and statistical tools (Katholieke University of Leuven)
- ~ Phytochemicals, food quality and health-promoting effects (CSIC)





Project management scheme for PRIMESOFT



Coordinator

CUT is a dynamic University with six leading Schools/Faculties and 13 Academic Departments, able to offer education and high-level research, in primary branches of science and applied technology. CUT has set as its strategic target the design and development of research activities both within the University and in cooperation with Advanced research Institutes in Cyprus and abroad. CUT Fruit Sciences/Postharvest Group [www.fruitsciences.eu] and CUT Plant Stress Physiology Group [<http://plant-stress.weebly.com/>] belong at the Department of Agricultural Sciences, Biotechnology and Food Science. These groups have highly complementary expertise on fruit crops, priming effect in plant systems, plant adaptation to

abiotic stress conditions and postharvest physiology and technology. A PRIMESOFT key impact is to develop a business plan towards establishment of a Regional Center of Excellence in Plant Sciences for the whole Eastern Mediterranean region through the merging of CUT Fruit Sciences and Plant Stress Physiology groups in a single entity. This Center will tackle research, educational and communication/outreach activities related to the agricultural and food sector and will gradually establish close and productive relationships with key national academic and research centers as well as international agencies and specialized academics/personnel.

Partner

National Technical University of Athens (NTUA) is the top Technical University in Greece. The Laboratory of Process Analysis and Design (LPAD) is the oldest laboratory of the School of Chemical Engineering at NTUA, which has systematically contributed in the development of the School, since 1908. The area of expertise of LPAD can be summarized in (a) the development of novel, functional food products, including product design, quality and sensory control of the final product, as well as shelf-life determination, (b) toolbox development for functional foods and novel processes - development of user-friendly database systems including literature data on food properties, (c) analysis

of data, (d) development of mathematical models describing the physical processes and thermo-physical properties of materials, (e) experimental and applied study of the physical industrial processes, such as drying methods, extraction methods, novel encapsulation methods, etc. applied in the food industry, (f) process scale-up, (g) recovery of functional compounds from various natural sources, (i) *in vitro* digestion studies, and (k) life cycle assessment and environmental management for the determination of the economic and environmental impact of several products and processes.

Partner

University of Potsdam (UP) is the largest university in the federal state of Brandenburg, Germany. In 2016, UP was awarded the certificate 'HR Excellence in Research' by the European Commission that identifies the organisation as provider and supporter of a stimulating and favourable working environment for researchers. Plant Science and Genomics in particular, are at the forefront of academic teaching and research at Faculty of Science. The Department of Molecular Biology is part of the Institute of Biology and Biochemistry, which belongs to this Faculty. The Department has a wide-ranging expertise in plant genomics, in particular with respect to analysis of transcriptional factors and gene regulation, abiotic stress response, and

senescence, including priming. UP will coordinate analyses on how priming agents exert their function at the genome or biochemical/physiological levels and will provide its expertise in unravelling the cellular control points underlying the priming process. This will in particular cover priming-dependent transcriptome studies and the identification of transcription factors that control priming-affected genes, e.g. using yeast one-hybrid screens. The UP will lead the organization of two exploratory workshops in grant proposal writing and implementation and one hands-on training school entitled 'Priming in plants – agents, processes, molecular settings'.

Partner

KU Leuven participates through its research division MeBioS which investigates the interaction between biological systems and physical processes. MeBioS is one of the leading postharvest research groups worldwide. Half of its research is in collaboration with the agro-food industry. These activities are founded in a deep knowledge on physiological behavior of fruits and vegetables after harvest combining omics techniques with advanced biostatistics and biophysics models to interpret the results. MeBioS has a longstanding experience on non-destructive fruit quality evaluation and has been at the front of developments like NIR spectroscopy, hyperspectral imaging and acoustic firmness detection.

In addition, MeBioS has put much effort in optimizing fast profiling techniques for fruit aroma and taste. Aroma is a key quality indicator for soft fruits and KU Leuven has a long-standing experience on such analysis. KU Leuven will support a training school entitled “VOCs analysis: techniques, data processing and statistical tools” and WI staff will have access to the relevant infrastructure (HS-SPME-GCMS, TDU-CIS-GCMS, SIFT-MS). Knowledge and expertise on the analytical technology, data processing and multivariate data analysis will be shared with the WI staff.

Partner

The Spanish National Research Council (CSIC) is the largest public institution dedicated to research in Spain and the third largest in Europe. CEBAS-CSIC has expertise on phytochemical analysis with advanced analytical chromatographic methods, bioavailability and metabolism of food bioactives, pharmacokinetics; biological mechanisms of action of phytochemicals and their metabolites; interaction of phytochemicals with gut microbiota and metabolomic approaches. CSIC will assess the potential beneficial effect of priming agents in phytochemicals and nutraceutical properties of horticultural commodities, a research area of prime importance with significant technological

implications. To this aim state-of-the-art infrastructure (UPLC-Q-TOF-MS; UPLC-QQQ-MS; HPLC.IT-ESI-MS-MS; HPLC-TOF MS- NMR; GC-MS) will be used. In addition, CSIC will organize a training school in the fields of phytochemicals, food quality and health-promoting effects. Training sessions in metabolomics studies for identification of biomarkers related to food quality, safety and bioactivity will be also performed. In addition, based on the available infrastructure, CSCIC will accomplish a cost/benefit analysis and propose infrastructure that will render CUT autonomous in a series of analysis.

