PRIMESOFT

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

Topic: **Workshop ´Priming in plants – agents, processes, molecular settings´**

Date: **March 29th – 30th, 2023**

Time: **09:00 a.m. – 05:00 p.m. (CET)**

Hosted by: **University of Potsdam**

Venue: **Potsdam Science Park, GO:IN**

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Science of Priming

Prof. Dr. Bernd Mueller-Roeber

University of Potsdam, Germany

Faculty of Sciences

Department Molecular Biology

https://www.uni-potsdam.de/de/ibb-molecularbiology/research-overview

Title: Definition of priming and concept

An overview of the priming concept in plants in response to environmental challenges is provided in this talk. First, a categorization of necessary ´input´ in the form of priming events, priming agents or biostimulants is given. Moreover, several types of responses induced during the priming will be discussed with respect to their effect on improved stress management of the plant. Second, the similarities and differences in how priming agents and plant biostimulants (such as seaweed extracts and microorganisms) increase abiotic stress tolerance will be discussed. Finally, a description of current, broadly utilized plant priming techniques is given.

Title: Current directions in plant priming research

This talk presents an overview of current directions in plant priming research, focusing on scientific topics and open research questions. It will highlight recent experimental approaches in plant priming research, and interesting results obtained, at phenotypic and mechanistic levels. Advanced and specialized phenotyping techniques are required to monitor plant growth. Hence, techniques addressing various phenotyping aims will also be discussed.

Prof. Dr. Vassilis Fotopoulos

Cyprus University of Technology (CUT), Cyprus

Department of agricultural sciences, biotechnology and food science

Plant Stress Physiology Group

http://plant-stress.weebly.com/

Title: Classes of priming agents

Increased frequency of extreme environmental events resulting from global climatic changes remarkably influences plant growth and development. Close examination of plant-to-plant communication in nature has revealed the development of unique strategies from plants for responding to abiotic stress, with one of the most interesting being through priming for improved defense responses. The process of priming involves prior exposure to a biotic or abiotic stress factor making a plant more tolerant to future exposure. Priming can also be achieved by applying natural or synthetic chemical compounds as well as functionalized nanomaterials which act as signaling transducers, 'activating' the plant's defense system. Furthermore, microorganisms can also be employed under such approaches. Priming offers an attractive alternative to established approaches such as conventional breeding and genetic modification with key advantages, representing a characteristic example of integrative plant physiology where multiple disciplines such as materials science, agriculture and analytical chemistry join forces to develop exciting new tools in modern

agriculture. The current presentation gives an up-to-date description of the main biological, chemical and nanomaterial priming agents used in agricultural research, known modes of action, while special focus will be given on benefits/downsides of their application, along with potential future directions of this exciting technology.

Prof. Dr. Salma Balazadeh

Leiden University, The Netherlands

Faculty of Science, Institute of Biology Leiden

Molecular Plant Stress Biology

https://www.universiteitleiden.nl/en/staffmembers/salma-balazadeh#tab-1

Title: Mechanisms of thermomemory in plants

Global warming due to climate change adversely affects crop yield, jeopardizing the food supply for a growing world population. Breeding stress-resilient cultivars is, therefore, an urgent need. An exciting but poorly understood phenomenon is ´thermomemory´ whereby plants ´remember´ a high temperature from the past to robustly withstand a later – and even more extreme – heatwave. During the memory period, several but not all molecular and biochemical heat stress (HS)-induced changes are maintained, which prepares, or 'primes', the plant to respond more effectively to future HS events. However, the molecular machinery that underlies the memory and forgetfulness of stress in plants is largely unknown. During my talk, I will summarize our current understanding of the mechanisms underlying thermomemory. Furthermore, I will highlight our recent findings on the importance of protein stability control for regulating thermomemory.

Dr. Thomas Griebel

Free University Berlin

Institute of Biology

Plant Physiology

https://www.bcp.fu-berlin.de/en/biologie/arbeitsgruppen/physiologie_biochemie/ag_baier/research/index.html

Title: Cold priming and plant resistance against bacterial pathogens

Plant resistance against pathogens relies on a repertoire of plant immune receptors and pathogen virulence activities. Environmental conditions further shape the outcome of a pathogen infection. We study whether and how plants benefit from a prior abiotic stress exposure during a subsequent infection with bacterial pathogens.Our data show that a short 24-hour cold priming phase (4 °C) was sufficient to reduce plant susceptibility against virulent *Pseudomonas syringaepv. tomato DC3000* (*Pst*) not only when the bacterial inoculation was done immediately after the cold treatment but also after a recovery phase of 5 days. Cold priming-reduced susceptibility required functional plastid ascorbate peroxidases but also a membrane-located respiratory burst oxidase. We suggest that cellular redox communication and well-balanced control of reactive oxygen species is central for abiotic priming against bacterial pathogens in plants.

Prof. Dr. Bruno Mezetti

Università Politecnica delle Marche, Ancona, Italy

Department of Agricultural, Food and Environmental Sciences

https://www.urp.cnr.it/copertine/formazione/form_concorsi/CV_Commissari/CV%20Mezzetti%20Bruno.pdf

Title: RNAi Technology for controlling plant Stress

Interfering RNA can be used to improve plant composition while enhancing levels of beneficial nutrients, and to improve plant productivity by suppressing undesirable traits and switching resources to more beneficial quality and yield traits. RNAi-based biocontrol can be applied using two main approaches: by in planta stable expression (HIGS) or by exogenous application of formulated RNAi-based control products (SIGS). RNAi-based control products can be directly applied using current agricultural practices such as spray application, trunk injection for tree species, seed soaking, root drenching through hydroponic systems in greenhouses etc. Due to the novelty in the development of RNAi-based control products, only a few products are currently available at a high technology level for open field validation. Many promising RNAi-based molecules are still under development and validation at the laboratory, greenhouse, and confined field level. The interest in RNAi-based technology is also reflected in the rapid increase in the number of publications and patents on RNAi, from both the public and private sector, over the past ten years.

Application and Statistics

Dr. Kieran Guinan

BioAtlantis Ltd., Ireland
Research Manager
https://www.bioatlantis.com/

Title: Approaches to experimental design and statistics in biostimulant research. (online)

Robust experimental design is the foundation for good experimentation and applied research, particularly when comparing the effects of biostimulants on different biological parameters in plants and crops. In the field of animal science, it is common practice to incorporate the coefficient of variation (the ratio of the standard deviation to the mean) into experimental design, to ensure there are sufficient replicate numbers and sufficient statistical power. However, this standard is not always implemented in crop field trials, primarily due to the high level of variability typically observed at field level. Consequently, some field trials may not have the necessary statistical power to identify significant effects. This presentation will provide an overview of best approaches to experimental design and statistical analysis, and will provide guidelines for early stage plant researchers who plan on undertaking experiments and crop trials at field level.

Dr. Michael Schirrmann

Leibniz-Institut für Agrartechnik und Bioökonomie (ATB), Potsdam, Germany

Precise Crop Monitoring

https://www.atb-potsdam.de/en/about-us/team/staff-members/person/michael-schirrmann

Title: Crop monitoring with Unmanned Aerial Vehicles (UAV)

Unmanned aerial vehicles (UAVs) have the potential to revolutionize remote sensing and have a significant impact on crop monitoring and precision agriculture in the future. As a flexible monitoring platform, UAVs allow to acquire remote sensing information from the plant to the field-level. For UAV remote sensing, flight planning and sensor gear can be extremely well adapted to the needs of the application, enabling the collection of data from various parts of the electromagnetic spectrum as well as 3D canopy information from overlapping images using structure-from-motion. From ultra-high-resolution imagery acquired from low altitude flight missions, even individual plants, species, or pests can be recognized. This talk will give an overview about the current possibilities and limitations of the UAV use for crop monitoring.

Dr. Shravani Basu and Dr. Sebastien Foucaud

SBSF Agritech, Berlin, Germany

Managing Director

https://www.sbsf-agritech.com/

Title: Uses of AI in Agriculture

AI is becoming an essential part of precision farming for crop monitoring, yield estimation, and pest and weed identification. AI recognizes changes in the environment and identify crops. This helps farmers decide what to plant, when to plant and harvest by giving them information about crop yields and weather forecasts. Computer vision can use satellite images to detect large-scale crop disease and nutrient deficiencies, or it can automatically classify seed attributes like size and color in real time to optimize seed selection and germination. SBSF Agritech uses large climate, weather, soil, landscape, crop, and tree databases to develop AI-based products that predict which geographical locations and crops and trees will deliver the maximum sustainable yield. Using physiological traits, we forecast a site's GHG sink capacity and suggest the best crops and trees for sequestration through reforestation or agroforestry. In this session, we will discuss some uses of AI in agriculture.

Priming in Agriculture

Dr. Sujeeth Neerakkal

BioAtlantis Ltd, Ireland
Head of Plant Research
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Title: The role of seaweed based biostimulants in enhancing crop tolerance to abiotic stresses: scientific insights, markets, and regulatory frameworks.

Biostimulants are products that stimulate plant nutrition processes independently of the product's nutrient content (EU-regulation 2019/1009). The European biostimulant market is estimated to be USD 1.5 to 2 billion in 2022 and is anticipated to expand at a compound annual growth rate of 10-12% (European Biostimulants Industry Council, EBIC 2022). Non-microbial biostimulants such as seaweed extracts are aimed to improve tolerance to abiotic stress and quality traits in crops. Recent research has demonstrated that certain seaweed extract treatments can induced gene modulations and metabolic changes in model plants and crop species, thus preventing abiotic and oxidative stress damages. It has been proposed that unique biomolecules found in seaweeds are responsible for plant priming and abiotic stress mitigation effects observed. Collectively, the physiological and molecular data reveals that seaweed based priming technologies can be employed in climate-smart strategies to alleviate oxidative stress-induced damages in crops.