University of Zurich[UZH] | ETH zürich | University of Basel

Zurich-Basel Plant Science Center

PSC & Syngenta Symposium 2020

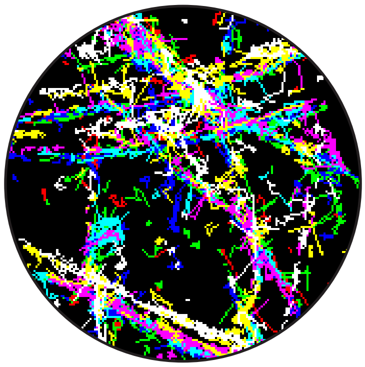

Image: Single molecule tracking, Julien Gronnier, University of Zurich

PROGRAM

13:00– 13:10
WELCOME by Prof. Bruno Studer (PSC chair)

KEYNOTES

Chair: Prof. Bruno Studer

13:10–13:30
How different ‹source to sink› constellations in crop plants affect the performance of a modern aphicide
Anke Buchholz, Syngenta

13:30–13:50
Plant responsiveness to microbiota feedbacks
Prof. Klaus Schläppi
Department of Environmental Sciences
University of Basel

13:50–14:10
Soil resources and global change
Prof. Sebastian Dötterl
Department of Environmental Systems Science, ETH Zurich

14:10–14:30
Plants in space
Prof. Meredith Schuman, Remote Sensing Laboratories in the Departments of Geography and Chemistry, University of Zurich

FELLOW PRESENTATIONS

Chair: Prof. Klaus Schläppi

14:30–14:45
Plant life history influences the criteria used to reward mutualistic AMF
Sören Weber, University of Zurich

14:45–15:00
Improved measurements of plant transpiration for sustainable agricultural water use
Dr. Eugénie Paul-Limoges, University of Zurich

15:00–15:15
Influence of plant genes on microbial abundance in Arabidopsis phyllosphere
Jana Mittelstrass, University of Zurich

15:15–15:30
Mycorrhiza-facilitated interactions in intercropping systems in dryland agriculture
Santiago Perez-Bernal, University of Basel

15:30–15:45
Action of essential bacterial effectors on conserved plant receptor kinases: Towards strategies for durable and broad-spectrum disease resistance
Laura Herold, University of Zurich

15:45–16:00
Effects of microbial endosymbionts on the transmission of plant pathogens by aphid vectors
Patricia Sanches, ETH Zurich

FINAL REMARKS
Willy Rueegg (Syngenta)

WEDNESDAY, November 4th, 2020 ONLINE VIA ZOOM

Registration: www.plantsciences.uzh.ch/en/research/fellowships/syngenta/symposia.html

Partner choice and biodiversity-ecosystem functioning in the arbuscular mycorrhizal symbiosis

PD Dr. Pascal Niklaus, Prof. Jordi Bascompte, Marcel van der Heijden, University of Zurich; Ansgar Kahmen, University of Basel

Sören Weber, PhD student

Arbuscular mycorrhizal fungi (AMF) are mutualists of plants, and their diversity has a large effect on plant community assembly and ecosystem functioning. A predominant role of AMF is the transfer of phosphorous to plants in exchange for sugars and fatty-acids. Previous research has demonstrated that both AMF and plants can trade resources reciprocally. However, it is unclear how this preferential trade within complex assemblages of AMF and plant taxa mediates the observed positive effects of AMF diversity on plant community diversity and productivity. To address this, I use a diverse set of AMF and plant taxa, manipulate AMF and plant access to each other with specialized microcosms, evaluate changes in AMF species composition with quantitative PCR, and monitor resource exchange with radioactive isotopes of phosphorous and carbon.

Improved measurements of plant transpiration for sustainable agricultural water use

Alexander Damm, University of Zurich; Nina Buchmann and Johan Six, ETH Zurich

Eugénie Paul-Limoges, Postdoc

As agriculture uses the largest amount of water worldwide (~70%), shortages and changes in water availability will be a predominant stress to food security in upcoming years. The current efficiency of crop irrigation is however very low, with less than 65% of the irrigation water being used by the crops, and therefore, resulting in large water losses from agricultural fields mostly through evaporation from surfaces (E). Plant transpiration (T) is the main process by which water moves through the plants to the atmosphere and represents the water needed to sustain the plants. Nevertheless, accurate measurements of plant T at ecosystem level are currently lacking. We thus suggest to improve measurements of plant T using an innovative combination of ecophysiological, biometeorological and remote sensing measurements to enhance the sustainable use of water. First, we improve the partitioning of evapotranspiration (ET) measured with eddy covariance towers into the biological T and physical E by combining field-level techniques from ecophysiology and biometeorology at a cropland test site. Second, we investigate the use of remotely sensed sun-induced fluorescence (SIF) as a new informative prior for plant and ecosystem T using tower-based spectrometer measurements and process models. Third, we use a modelling framework to scale up the developed method for plant T using SIF to other crop species. Finally, we propose two applications to help farmers reduce agricultural water losses, one based on field measurements and the other based on downscaling remote sensing products to individual agricultural fields.

Identifying the plant genes that shape the leaf metabolome and microbiome

Matt Horton, University of Zurich and Julia Vorholt, ETH Zurich

Jana Mittelstrass, PhD student

Identifying the drivers of plant-microbe interactions is key to minimizing agricultural losses and may improve efforts to protect biodiversity. Studies of the plant microbiome have revealed that these communities are shaped by a combination of environmental factors, interactions among microbes, and genetic differences among hosts. In the case of host-genetic factors, researchers have begun to identify plant genes that guide the assembly of the leaf and root microbiome, but a detailed understanding of how plant genes and chemistry shape the microbiome is lacking. In my project, we characterize the pattern of leaf-metabolomic diversity in *Arabidopsis thaliana* using accessions collected from around the world. We use a combination of metabolomics, microbiome sequencing, and genetics to investigate the function of plant genes associated with variation in leaf chemistry and the leaf microbiome. In addition, we will use a recent advance in gene mapping to identify candidate genes simultaneously associated with variation in leaf chemistry and the leaf microbiome. Combined, these data will enable us to ask whether genes that underlie variation in leaf chemistry also contribute to variation in the leaf microbiome.

Mycorrhiza-facilitated bioirrigation in intercropping systems in dryland agriculture as a new tool to stabilize and increase yields of small holder farmers

Ansgar Kahmen and Mathimaran Natarajan, University of Basel; Astrid Oberson, ETH Zurich

Santiago Perez-Bernal, PhD student

Climate change induced water limitation and drought threatens the yield of dryland agriculture in developing countries. In particular for small holder farms cost effective low input solutions are needed to stabilize and increase yields in dryland farming. The main goal of my project is to develop the ecological know-how that will allow to establish “bioirrigation” in millet - legume intercropping systems, where deep rooted legumes can redistribute water from deep and moist soil layers to shallow and dry soil layers and make it available to shallow rooted millets. As a consequence, millets will benefit from the presence of deep rooted legumes and improve their water relations, nutrient uptake and yields when water in the top soil becomes limiting. In contrast to previous attempts that were unable to trigger an effective water transfer between intercropped deep and shallow roots plants, we propose here to make bioirrigation effective by connecting the rhizosphere of the intercropped legume and millets by a common mycorrhizal network (CMN) that will facilitate the water transfer between the intercropped plants. We perform experiments under controlled conditions in the greenhouse at the University of Basel and establish field trials at the Agricultural University of Bangalore, India. If successful, this project will introduce bioirrigation as a cost effective tool for dryland agriculture, that will help to stabilize and increase the yields of small holder farmers.

Action of essential bacterial effectors on conserved plant receptor kinases: towards strategies for durable and broad-spectrum disease resistance

Cyril Zipfel, University of Zurich; Giovanni Broggini, ETH Zurich; Euiwhan Chung, Syngenta

Laura Herold, PhD student

Crop losses are caused by pathogens and pests, which threaten food security and also impose significant monetary and/or environmental costs to control the ensuing diseases using chemicals. A more sustainable approach is to use genetics to increase disease resistance against important pathogens in crops. This however requires a more detailed understanding of the molecular mechanisms controlling the interaction between pathogens and their host plants. My project is based on the characterization of conserved, essential proteins that are injected within plant cells by pathogenic bacteria. These proteins, called effectors, are key determinant of virulence and thus of disease establishment and/or progression. I identify the plant proteins that are targeted by these effectors, characterize the impact that the effectors have on the targeted proteins, as well as reveal the role of these plant proteins in plant immunity (or other processes). Using this information, I will then use precise modern genome-editing techniques to debilitate the targeting of these proteins by bacterial effectors so that plants are more resistant to phytopathogenic bacteria. This research – guided by phylogenetic insights – will rely on a detailed comparative study between the model plant *Arabidopsis thaliana* and the fruit crop apple, which will ultimately allow the direct translation of the results in apple. As such, this project will provide both significant scientific insights and potential practical applications for crop protection.

Effects of microbial endosymbionts on the transmission of plant pathogens by aphid vectors

Mark Mescher, Clara Sanchez-Rodriguez and Consuelo de Moraes, ETH Zurich; Anke Buchholz, Syngenta

Patricia Sanches, PhD student

Interactions between aphids and endosymbiotic bacteria have been studied extensively as models of evolutionary mutualism. Recent research indicates that symbionts can also have important effects on interactions between aphids and other organisms. For example, it has been suggested that some endosymbiotic bacteria enhance the ability of their host aphids to colonize novel host plants. Mutualistic symbionts may also have effects on interactions involving other aphid-associated microbes, including aphid-vectored plant pathogens. However, little is currently known about the potential effects of aphid endosymbionts on disease transmission. In my project, I explore how endosymbionts influence aphid-plant-virus interactions. Specifically, I explore how aphid association with different microbial endosymbionts influences: (i) aphid preferences for and performance on infected plants; (ii) defence responses of virus-infected and healthy plants; (iii) aphid susceptibility to natural enemies; and (iv) the acquisition, retention, and transmission of plant viruses by aphid vectors. The knowledge will provide new insights into disease ecology and into the ecology and evolution of aphid interactions with endosymbionts. Furthermore, this project will lay the foundation for future work on the implications of endosymbionts for the spread of viral plant diseases, with potential relevance for efforts to control the spread of economically important diseases in agricultural systems.