miCROPe 2019 – International symposium on 'Microbe-Assisted Crop Production – Opportunities, Challenges & Needs'

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Global crop production is challenged by climatic changes, decreased availability of fertile land and the global demographic development. The increasing world's population requires new solutions to warrant food security and safety. In addition, global warming, extreme weather events and emerging pathogens pose a major threat on yield stability. Consumers are increasingly aware of food and environmental safety and consider sustainability of food production as a key issue. Therefore, in many countries legislation requests lower inputs of chemicals such as inorganic fertilizers or pesticides. Overall, there is a need to intensify agricultural production in a sustainable manner and to identify solutions to combat abiotic stress, pathogens and pests.

We are well aware that humans are associated with complex microbiota, usually termed as the human microbiome, which are essential for our health and well-being. Similarly, plants are associated with complex microbiota, which play a key role for plant performance. The rhizosphere is an important hot spot of microbial diversity and activity as roots exude a number of different substances like sugars or amino acids, which serve as important nutrients for microorganisms. In addition, various plant organs such as roots, stems, leaves and also reproductive organs such as seeds are internally colonized by various microorganisms, termed as endophytes. Also the plant surface, e.g. the phyllosphere (i.e. the surface of leaves) is colonized by microorganisms. These microbiota have been also termed as the accessory plant genome and encompass microorganisms, which have highly beneficial functions in regard to plant production. To a great extent these microorganisms are important to improve plant nutrition by providing nutrients such as rhizobia and other nitrogen-fixing bacteria. Rhizobia establish a symbiosis with legumes, in which they colonize plant nodules and reduce atmospheric N_2 to ammonium, which is available to plant nutrition. Other microorganisms mobilize nutrients present in soils including mycorrhizal fungi or phosphate-solubilizing bacteria. Some microorganisms have the capacity to improve stress tolerance of plants to abiotic stress such as drought by employing different mechanisms such as the production of hormones or by interference with plant hormone production. Equally important are microorganisms, which are able to combat plant pathogens and protect the plant against diseases.

Highly promising results can be seen in the lab and greenhouse studies when applying microbial inoculants with greatly increased biomass production and tolerance towards plant pathogens. Thus expectations for field application are high. Few inoculants such as those using nitrogen-fixing rhizobia or arbuscular mycorrhizal fungi have been applied for more than a century, whereas applications for other microorganisms require further understanding and improvement. On the one hand, understanding is needed on mechanisms employed, the ecology of the introduced microorganism and its interactions with the native microbiome. On the other hand application and delivery technologies have to be developed warranting optimal establishment and activity of any applied microorganism.

The symposium "Microbe-assisted crop production – opportunities, challenges and needs" (miCROPe 2019 – www.microPe.org), which took place from 2-5 December 2019 in the Orangerie/Apothekertrakt of the

Schönbrunn castle in Vienna, Austria, addressed basic and applied aspects of applying beneficial microorganisms in crop production. This symposium, which was organized by the AIT Austrian Institute of Technology and by the Austrian Association of Molecular Life Sciences and Biotechnology (ÖGMBT), covered mechanistic understanding of beneficial plant-microbe interactions, microbiome research and application know-how. Specific sessions included 'Successful microbial applications' (session chairs: Kellye Eversole, Angela Sessitsch), 'Mechanisms mediating holobiont and multipartite interactions' (session chairs: Alga Zuccaro, Paolina Garbeva), 'Plant understanding of interactions with beneficial microbes' (session chairs: Heribert Hirt, Adam Schikora), 'Microbiome understanding beyond profiling' (session chairs: Klaus Schlaeppi, Jenny Kao-Kniffin), 'Microbial biocontrol of pests, pathogens and weeds' (session chairs: Gabriele Berg, Karen Bailey), 'Microbial applications for improving nutrition and abiotic stress tolerance' (session chairs: Guenter Brader, Philipp Franken) and 'Disruptive approaches for engineering the phytobiome & microbial delivery' (session chairs: Trevor Charles, Michael Ionesco). The opening lecture was given by Steven Lindow (Univ. of California, US), whereas the closing lecture was given by Jos Raaijmakers (Netherlands Institute for Ecology). The symposium was accompanied by four satellite workshops, taking place before or after the symposium, on 1) 'Advanced microscopy techniques for plant-microbe interaction analysis', 2) '4th International workshop on interactions between crop plants and human pathogens, 3) '2nd EUCARPIA Workshop on Implementing Plant-Microbe Interactions in Plant Breeding' and 4) 'Workshop on key regulatory concepts and requirements in Europe, Asia-Pacific and the Americas'.

Overall, 302 delegates from 33 countries participated at the miCROPe 2019 symposium with 28% of all delegates being students, who had numerous possibilities to present their work in talks, poster pitches and poster presentations. Tanja Galindo (Pennsylvania State University, US) received the ISME Best Talk Award (250€) and Shubhangi Sharma (Leibniz-Institut für Gemüse-und Zierpflanzenbau, Germany) received the ISME Best Poster Award (250€). The remaining amount (500€) was spent for renting poster walls enabling students and post-docs to present their posters. Early stage researchers also had plenty of networking activities with their peers and the international scientific community as well as the industry.