Scientific Report
"10th International Symposium on Phyllosphere Microbiology"

19.-23. July, 2015, Monte Verità, Ascona, Switzerland
Chair: Julia A. Vorholt (ETH Zurich)

Topic and goal of the conference:

The phyllosphere, or the above-ground parts of plants is responsible for terrestrial photosynthesis and carbon dioxide fixation. It represents a vast habitat of about one billion km^2 that is colonized by a variety of different microorganisms, mostly bacteria but also yeasts, fungi, oomycetes and viruses. Bacterial inhabitants in the phyllosphere alone are estimated to number up to 10^{26} cells globally and impact the global carbon and nitrogen cycle. Besides, bacteria and other microorganisms affect plant growth and health.
Cultivation-independent studies have revealed that a few bacterial phyla predominate in the phyllosphere of different plants and that plant factors are involved in shaping these phyllosphere communities. The plant microbiota thus does not represent the result of random assemblies of microorganisms. It features specific adaptations and exhibit multipartite relationships both with host plants and among community members, including bacteria and fungi. Insights into the underlying structural principals of indigenous microbial populations will help to develop a deeper understanding of the phyllosphere microbiota and will have applications in plant growth promotion and protection.

In no small part, the periodic international symposia on phyllosphere microbiology (the first one held in 1970 at the University of Newcastle, UK) have served as an important forum for dissemination of developments in this field and as a forum for critical discussion of the issues that are to be defined or resolved.

The **main objectives of the conference** were to:

1) Provide a forum in which research in phyllosphere microbiology is discussed in relation to developments in other areas, and an arena in which new and current ideas and concepts can be discussed and critically reflected.
2) Present latest cutting edge research that covers to large extent unpublished work.
3) Stimulate discussion and speculation as to where future phyllosphere research efforts may encounter the greatest potential gain.
4) Bring in industry perspectives how phyllosphere microbiology can help developing new products for sustainable agriculture.
5) Provide a forum where young and established scientists can meet in a familiar atmosphere.
6) Stimulate an open atmosphere of unhampered exchange and welcome new members of the community.
7) Attract many international participants to Monte Verità and make it the best conference of the year for them.

Most important results of the conference:

The International Symposium on Phyllosphere Microbiology has been *the* most important international meeting in the field for 45 years, focussing on the microbiology ecology and molecular biology of microorganisms in the aerial parts of plants. The 10th International conference successfully continued this series, demonstrating how interdisciplinary approaches that combine ecology, molecular biology and biochemistry, omics approaches and mathematical modelling can advance our knowledge of bacteria, fungi, oomycetes and viruses to formulate new concepts in phyllosphere microbiology. It further included speakers from the private sector (for the first time) and showed how current research in academia are paralleled by efforts in the private sector to make use of "microbials" and helped establishing contacts between researchers at Universities and industry.

The conference had a total of 70 participants (similar to previous meetings). It featured one keynote lecture, 19 invited talks and 17 short scientific talks selected from abstracts in a 7 scientific oral sessions. Amost half (47%) of the participants were females. The participants were from Switzerland, Germany, France, Austria, UK, USA, Canada and Japan. Posters (23)

were presented in two very well attended late afternoon poster sessions. The best early stage prize sponsored by CSF was awarded to Aurelien Carlier (University of Zurich, Switzerland). Best poster prizes (sponsored by ISME) were awarded to Cristelle Laforest-Lapointe (U Quebec in Montreal, Canada) and Christine Vogel (ETH Zurich).

Due to the advances of novel experimental techniques in cultivation-independent analyses by next-generation sequencing and intense cultivation-dependent approaches the field is experiencing a true revival. The Phyllosphere Microbiology conference 2015 focused on a wide coverage of topics, from bacterial adaptation, leaves as source and sink of microorganisms, interaction between plants, microorganisms and insects, food safety and plant protection and growth promotion. A number of highlights have emerged from individual sessions at the conference of which a few are listed below:

The keynote lecture by Steven E. Lindow (UC Berkeley) gave an excellent start to the conference, demonstrating impressively how research in phylloshere microbiology was initiated and how novel technologies help to address outstanding questions, in particular regarding the dispersal of bacteria. Morris highlighted the importance of the phyllosphere as a source for atmospheric bacteria with ice nucleating activity which impact cloud and rain formation through a "positive rainfall feedback". A number of participants presented their efforts on culturing isolates (Lindow, Vorholt, Tomso (AgBiome), Simmons (Monsanto)) and presented novel resources to investigate the function of individual bacteria as well as synthetic communities in the future. Another highlight presented at the meeting was the yet unpublished insight that commensal phyllosphere bacteria trigger immune responses in plants (Vorholt, He) and it was speculated that the endogenous microbiome is necessary for the development of immunocompetence in plants. Reymond presented the responsiveness of plants against insect eggs at the molecular level and its importance in the context of pathogen attack. Leveau introduced artificial leaf surfaces as a model to study bacterial dispersal. Carlier gave novel insights into leaf nodule symbiosis which is based on obligate bacteria for growth and development. Koskella proposed the importance of phages that could be co-evolving with microbiota and possibly participate in microbiome community selection. Lundberg gave valuable advice on community independent analyses using next-generation sequencing. Shepherd presented plants as a source of proteins with antimicrobial activity; since protein can be captured in a non-destructive manner the platform (tobacco plants) is now also explored to produce antibodies. An open plenary discussion identified key questions in phyllosphere microbiology and links to society. Overall the importance of the field was highlighted for agriculture and for studying basic concepts in evolution and ecology.

In numerous personal feedback during and after the conference, participants expressed their highest enthusiasm about the meeting. The social atmosphere during the conference was friendly, inclusive for everybody with intensive communication also between established and young researchers and not 'cliquish' at all. Informal networking among the participants was greatly facilitated by the familiar atmosphere in the dining places as well as by the presence of a large and pleasant open bar area at the terrace.

Sponsors: The conference organizer, program committee and participants are very grateful for support to conduct the meeting. First of all, the support from the center **Congressi Stefano Franscini** is acknowledged via funds from the **Swiss National Science Foundation (SNSF)** and **ETH Zurich**. The support from CSF allowed the conference to be organized in the stimulating atmosphere of Monte Verità and to invite outstanding speakers from various countries to support their stay on site. The **Fondazione Monte Verità** is greatly acknowledged for hosting the meeting and providing excellent infrastructure. Additional funding is acknowledged from the **Swiss Academy of Sciences (scnat)** via the **Swiss Society for Microbiology (SGM)** (travel awards for younger participants), the **International Society for Microbiology Ecology (ISME)** (support for keynote lecture, poster award, travel awards younger participants), and from private companies: **AgBiome** (Raleigh, NC, USA), as well as **Roche**, **Novartis**, **Syngenta** and **BASF** via the "Kontaktgruppe KGF".

Group picture, Monte Verità, Ascona Switzerland
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CSF Awardee Aurelien Carlier, U. Zurich