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Editorial

Ecology and application of *Azospirillum* and other plant growth-promoting bacteria (PGPB) – Special Issue

Plant growth-promoting bacteria of non-leguminous plants have been the focus of research since several decades because non-leguminous plants like rice, wheat, maize – to name just the most prominent ones – are the most important crops feeding the ever growing human population on our planet. Leguminous plants harbour specific symbiotic systems with root or stem-nodulating rhizobia for plant growth promotion and nitrogen fixation, which are characterized by high host specificity of plant-bacteria interaction, such that it was not possible until now to widen the application range of rhizobia beyond this evolutionary boundary.

The major motif to contribute to sustainable support of non-leguminous crop plant growth with less fertilizer and agrochemical input led Dr. Johanna Döbereiner and her research group at the EMBRAPA-Institute of Agrobiologia in Seropédica, Rio de Janeiro, Brasil, to investigate root-associated nitrogen fixing bacteria of non-leguminous crop plants in the 1960 and 1970s. This resulted in the rediscovery of the rhizosphere diazotrophic bacterial species *Azospirillum brasilense* and *Azospirillum lipoferum*, published in 1978. In the following years and decades, many more very interesting root surface colonizing and endophytic diazotrophic PGPB were discovered and characterized from this and other laboratories. The search for prominent and potent diazotrophic PGPB and their diversity in nature is still a fascinating ongoing research field.

Physiological and biochemical research of basic metabolic features of *A. brasilense* and its plant growth promotion potential was pioneered also in the late 1970s by Dr. Yaacov Okon when he was pursuing post-doc in Prof. R.H. Burris laboratory at the University of Madison, Wisconsin, USA and continued at the Hebrew University of Jerusalem, Faculty of Agriculture in Rehovot, Israel. Important biochemical and molecular genetic research on *Azospirillum* and its interaction with plants were contributed in the 1980s also by several other labs working on *A. brasilense* and other diazotrophic PGPB. Currently, much expectation is on the almost completed genomic sequencing projects of *A. brasilense* Sp245 in U.S.A. and *A. lipoferum* 4B in France. The genomes of other diazotrophic

PGPB, like *Azoarcus* sp. BH52, *Herbaspirillum seropedicae* and *Gluconacetobacter diazotrophicus* were recently completed enabling new insights and starting points of even more advanced studies.

On the other hand, *Azospirillum* has been the focus of applied research also from the 1970s of last century. It became soon apparent, that plant growth promotion has also much to do with phytohormonal and phytosanitary mechanisms of microbial interactions in the rhizosphere and microbe-plant interactions with the potential for substantial stimulation of plant development and health. The practical application as inoculant (biofertilizer) was a quite controversial one from the beginning, because the growth response of crops is not completely predictable in its extent and depends – not surprisingly – on many ecological and agrobiotechnological factors. Nevertheless, much progress has been made also in this field, leading to an ever growing and successful application of *Azospirillum* and PGPB in several regions of the world, especially in South and Central America. The leading countries in practical field applications of *Azospirillum* are Mexico with estimated 300,000 ha inoculated fields in 2007, and Argentina where over 220,000 ha of wheat and corn were commercially inoculated with *Azospirillum* in 2008. This development most recently coincided with the dramatic raise in the oil price and costs of chemical nitrogen fertilizer as well as the fast growing importance of plant based “biofuels” in the context of the sought for solutions of the global climate change crisis.

A new emerging field for these bacteria is their potential use in solving environment problems such as assisting reforestation efforts of severely eroded lands, restoration of marine mangrove ecosystems, phytostabilization of mine tailings, assisting in metal and pesticide decontamination of soils and biological treatment of wastewater where they enhance the capacity of microalgae in recycling of wastewater.

Already in the early 1980s, a series of scientific workshops on “*Azospirillum*: genetics, physiology, ecology” have been initiated and organized in Germany at the Institute of Genetics, University of Bayreuth by Prof. Dr. Walter Klingmüller and coworkers, continued by workshops in Hannover,

Germany and Sárvár, Hungary, by Dr. Istvan Fendrik, University of Hannover (Germany). This series was lately continued in September 2007 by the "VIth Azospirillum and related PGPR"-workshop organized by Prof. Yvan Moenne-Locoz (University of Lyon, France) and Prof. Bruno Touraine (University of Montpellier, France) and their teams as satellite meeting of the "Rhizosphere II" symposium in Montpellier, France. In October 2007, there was another prominent workshop on *Azospirillum* in Argentina "First International workshop on *Azospirillum*" that was organized by Dr. Fabricio Cassan, Dr. Claudio Penna and the network for quality control of inoculants of the Argentinean Association of Microbiology in Cordoba, Argentina.

This special issue contains contributions to these two workshops combined with other contributions in this research field. We thank the editor in chief, Prof. Dr. Christoph Tebbe and the editorial staff, especially Michelle Paczy, for their great support and dedication in preparing this very timely special issue on "Ecology and application of *Azospirillum* and other PGPB".

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