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Editorial

Grain-Resided Endophytic Bacteria as Plant-Growth Promoting and Biocontrol Agents: Food for Thought

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Plant-resided endophytic community attracts growing attention during past decades due to several reasons: i. endophytic microbiota provides host plant with basic nutriments required for its growth; ii. endophytic microbiota promotes plant tolerance to abiotic stresses such as drought, salinity etc.; iii. endophytes are involved in the plant resistance to phytopathogenic microorganisms. All these features are important for the agriculture in the aspect of crop yields [1-3]. Grain-resided endophytes deserve special attention.

Growing number of literature data convincingly indicates, that symbiotic microbiota of plants and animals (humans) has a lot in common. Judge for yourself. Human symbiotic microbiota starts to colonize some ecological niches (e.g. a gut - largest compartment inhabited by the commensal microorganisms) during the embryogenesis (*in utero*) [4]. These early colonizers substantially determine the following formation of symbiotic community in the gut, as well as the development of Mucosa-Associated Lymphoid Tissues - a largest compartment of the immune system, which is endowed with the function of body patrolling for invading pathogens. Dysbiotic events in gut microbial community result in abnormalities in both local mucosal immunity and systemic immune reactivity. This leads to the development of numerous diseases in adulthood including increased susceptibility to infectious diseases [5].

Approximately the same situation is observed in the plant. Endophytic community of the adult plant partially originate from the seeds/grains (vertical transmission). Grain-resided endophytes in turn are inherited from the parent plant [6]. This initial grain-resided community is supposed to influence the formation of endophytic communities of different adult plant compartments. Grain-resided endophytes significantly stipulate successful crop seed germination using different mechanisms. These microorganism are able to fix nitrogen, solubilize minerals such as phosphorus, potassium, and zinc, that is particularly important for the crop growing in soils with deficiency of essential plant nutrients. In addition, grain-resided inhabitants produce plant growth hormones (gibberellic acid, indole-3-acetic acid, cytokinins and ethylene), as well as siderophores. Literature data and our own experience evidence, that endophytes possessing multiple (vs single) plant growth promoting properties are of great value [7,8]. Another important plant-beneficial trait of endophytic community is the protection against plant pathogens. This issue has not been extensively explored yet. One can suggest three components of the protective effect of endophytic microorganisms: i. aforementioned plant growth-promoting activities, which allow the growing plant to get stronger and to form mechanical protective barriers; ii. immune potentiating activities, which allow to develop and maintain immune defense mechanisms against pathogens; iii. direct antagonistic effects of some endophytic representatives against plant pathogens [9-11]. Participation of endophytic microorganisms in plant immunity is currently one of the most interesting matters in question. Our knowledge concerning plant immunity *per se* is quite limited, and the role of grain-resident endophytic community in the development of the plant resistance to host and non-host pathogens, as well as mechanisms of these phenomena are still waiting for their discoverers. Here are just a few examples of gaps in existing knowledge concerning the role of grain-resided endophytic microorganisms in the formation

and maintenance of plant immunity: i. is high alpha diversity good or bad for the grain-resided endophytic community from the point of view of its immune potentiating activity? ii. is colonization of grain by endophytic microorganisms a programmed or stochastic process? iii. whether there is a succession of the endophytic community of the grain during its germination? iv. are there "normal" and "dysbiotic" endophytes, the latter of which contributes to the development of inappropriate plant immunity mechanisms?

Answers to these and another questions, a deep insight into grain-resided endophytic community could comprise a great help for the development of new highly stress-resistant cereal cultivars with a stable yield.

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