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Evolutionary genetics of microbe-plant symbioses: A conduit for constructing the sustainable crop production systems

Symbioses of plants with beneficial microbes implementing numerous nutritional (N_2 fixation, mobilization of soil phosphates), defensive (biocontrol of pathogens and phytophagans) and anti-stress functions, are widely distributed in natural ecosystems. These symbioses are broadly used in sustainable agriculture based on substitution of the hazardous chemical fertilizers and pesticides by the environmentally friendly microbial preparations. Using the model of rhizobia (N_2 -fixing symbionts of legumes) we dissect the microbe-plant co-evolution into three major stages: Pleiotropic symbioses (equilibrium between mutualistic and antagonistic partners' interactions); mutual partners' exploitation (evolutionary stable mutualism based on the partners' metabolic exchange) and altruistic interaction (genetic or epigenetic reduction of microsymbionts' viability resulted in a marked increase of their beneficial impacts on the host). Based on this strategy, an algorithm for genetic construction of microbe-plant symbiosis for the sustainable crop production is suggested: Improvement of Principle Beneficial Function (PBF) responsible for the plant fitness (e.g., activation of nitrogenase synthesis or its energy supply); optimization of host ability to utilize the products of PBF (optimization of plant habitus for maximizing the allocation of N_2 fixation products from nodules to shoots); improvement of partners' altruistic interactions based on PBF (in rhizobia-inactivation of the negative N_2 fixation regulators which result in an increased host benefit but a decreased ex *planta* survival). The perspectives of constructing the plants with permanent PBF-implementing organelles (e.g., N_2 -fixing plastids) will be considered.

Biography

Provorov Nikolai has completed his PhD from All-Russia Research Institute for Agricultural Microbiology. He is the Deputy Director in Research of All-Russia Research Institute for Agricultural Microbiology. He has published over 20 papers in reputed international journals and has been serving as an Editorial Board Member of international journal *Annals of Applied Biology*. The scope of his expertise includes evolutionary genetics of symbiosis, mathematical simulation of population dynamics and genetic construction of symbiotically active microbes.

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