Plant–microbe interaction: prospects for crop improvement and management

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SHORT COMMUNICATIONS

Plant–microbe interaction: prospects for crop improvement and management

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Abstract In nature, plants and microorganisms interact constantly to modulate their growth and development. The interaction could be beneficial or hostile. Plants are constantly exposed to a range of pathogens, and have evolved mechanisms to fight the pathogen infections with the help of complex networking pathways. In addition to the pathogens, many beneficial organisms such as endophytes, of both, bacterial and fungal origin, are ubiquitously present in all plants. Unlike from their pathogenic counterparts, the endophytes do not cause any disease symptoms in their host plants. Some of the recent scientific discoveries and views concerning plant–microbe interactions are presented here.

Keywords Endophyte · Plant-microbe signaling · Abiotic stress · Crop improvement

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Plant–microbe interaction

It is now firmly established that plants are invariably associated with microbes (bacteria, archaea and fungi) in their rhizosphere, phyllosphere and endosphere. These plant microbiota govern the health and performance of their host plant. The microbiota of the plant consists of a few dominant species called the core microbiome whose association with a given plant is constant irrespective of the environmental conditions. Apart from the major microbiome which influences the fitness of the host plant, there are also those microbes that occur in lower numbers in the endosphere of a plant whose roles are not clearly understood.

Certain microbes called the endophytes, occupy the endophere of plants; they are short or long-term residents of living tissues of plants and could be symbiotic, mutualistic, or latent pathogens (Hyde et al. 2019). The fungal components of this plant endosphere are termed fungal endophytes. They belong mostly to the phylum *Ascomycota* and have been reported from all plants screened so far for their presence. Among these, the *Neotyphodium* type endophytes which are associated with cool season grasses grow systemically within their plant hosts and are transmitted horizontally through seeds. They produce different types of alkaloids which ward off insect pests and are toxic to grazing animals. Incorporation of select strains of these endophytes into the grass endobiome has resulted in successful biological control of insect pest of these grasses.

Apart from this, there are many species of *Ascomycete* endophytic fungi which invariably exhibit highly localized infection and are transmitted horizontally. Although their eocological roles and their interaction with their plant hosts and other co-occurring endomicrobes are not clear, they have attracted attention as producers of novel secondary

metabolites vested with desirable bioactivities including anti-microbial and anti-cancer activities. Furthermore, a few also elaborate industrially exploitable secondary metabolites of their host plants. Many studies have proved that these fungal endophytes augment the fitness of their host plants by increasing their tolerance to abiotic and biotic stressors.

Like the fungal endophytes, the bacterial endophytes are also ubiquitous and establish a symbiotic, mutualistic, or commensalistic association with plants. Their presence is known to increase the resistance of their plant hosts to infection by disease causing bacteria, fungi and nematodes. Some bacterial endophytes degrade xenobiotics thus increasing the tolerance of their host plants to such chemicals.

Owing to possession of such desirable traits and their non-pathogenic nature, the use of endophytes in crop improvement is an emerging trend. The reviews and research papers in this special section on *Plant–microbe Interaction* addresses certain issues related to use of the microbes in agriculture. Although only a few aspects of endophyte-based crop improvement are stressed in this issue, it highlights the importance a holistic approach to understand better the composition of plant endomicrobiota, their interactions (with biotic and abiotic factors), and functioning as influenced by method of inoculation and agricultural practices for more successful use.

Reference

Hyde, K. D., Xu, J., Rapior, S., et al. (2019). The amazing potential of fungi: 50 ways we can exploit fungi industrially. *Fungal Diversity, 97,* 1–136.