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BIORATIONAL MANAGEMENT OF SOILBORNE PLANT DISEASES: NOVEL APPROACHES FOR UNDERSTANDING PROKARYOTIC-EUKARYOTIC INTERACTIONS IN THE RHIZOSPHERE

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ABSTRACT: Prokaryotic-eukaryotic interactions in the rhizosphere among plant, pathogenic and beneficial microorganisms have great ecological and agricultural importance, yet few have been well characterized at molecular and cellular levels. We initiated some bioassay, molecular and microscopic approaches to elucidate and characterize the interface of plant-microbe and microbe-microbe interactions in the rhizosphere. One of the foci of our studies is to elucidate mechanisms of ecochemical interactions between plants and soilborne Peronosporomycete phytopathogens in the rhizosphere using a damping-off pathogen *Aphanomyces cochlioides*. Our bioassay-guided chemical and microscopic studies revealed that the zoospores of *A. cochlioides* locate their host plants (sugar beet, spinach *etc.*) *via* chemotaxis and then precisely change morphologically to initiate infection directly regulated by a host-specific chemical signal, cochliophilin A (5-hydroxy-6,7-methylenedioxyflavone) released from the roots. In contrast, nonhost plant roots exude diverse chemical weapons to ward-off zoospores and protect themselves from the attack of the pathogen. These findings offer useful clues for designing biorational management of the notorious soilborne Peronosporomycetes. As some rhizoplane bacteria are known to function as antagonists of soilborne phytopathogens, another focus of our investigation is to elucidate the modes of damping-off disease suppression by two host rhizoplane bacteria, *Lysobacter* sp. SB-K88 and *Pseudomonas* sp. EC-S101. Our bioassay followed by various microscopic studies on plant-bacteria and bacteria-*A. cochlioides* interactions revealed that rhizoplane bacteria colonize on the surfaces of both plants and Peronosporomycete hyphae in a diverse fashion and suppress damping-off diseases in sugar beet and other host plants by affecting cytoskeleton, ultrastructure and other cellular activities of the pathogen through antibiosis and/or competition for space and nutrition. The perspectives of our novel approaches to shed light on plant-microbe and microbe-microbe cross talks in the rhizosphere will be discussed in relation to the biorational management of the soilborne plant diseases.