Microbial Metabolomics Interaction and Ecological Challenges of Trichoderma Species as Biocontrol Inoculant in Crop Rhizosphere

ABSTRACT

The fungal species belonging to the genus Trichoderma has been globally recognized as a potential candidate of biofertilizer and biocontrol agent to prevent devastating soil-borne fungal pathogens and enhance growth and productivity of agricultural crops. The antagonistic activity of Trichoderma to pathogenic fungi is attributed to several mechanisms including antibiosis and enzymatic hydrolysis, which are largely associated with a wide range of metabolites secreted by the Trichoderma species. Besides suppressing target pathogens, several metabolites produced by Trichoderma species may act against non-pathogenic beneficial soil microbial communities and perform unintended alterations within the structures and functions of microbial communities in the crop rhizosphere. Multiple microbial interactions have been shown to enhance biocontrol efficacy in many cases as compared to bioinoculant employed alone. The key advances in understanding the ecological functions of the Trichoderma species with special emphasis on their associations with plant roots and other microbes exist in the crop rhizosphere, which are briefly described here. This review focuses on the interactions of metabolites secreted by Trichoderma species and plant roots in the rhizosphere and their impacts on pathogenic and non-pathogenic soil microbial communities. The complex interactions among Trichoderma–plants–microbes that may occur in the crop rhizosphere are underlined and several prospective avenues for future research in this area are briefly explored. The data presented here will stipulate future research on sustainably maximizing the efficiency of Trichoderma inoculation and their secondary metabolites in the crop soil ecosystem.