



Fungi vs. Fungi in Biocontrol: An Overview of Fungal Antagonists Applied Against Fungal Plant Pathogens

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Plant pathogens cause severe losses or damage to crops worldwide and thereby significantly reduce the quality and quantity of agricultural commodities. World tendencies are shifting towards reducing the usage of chemically synthesized pesticides, while various biocontrol methods, strategies and approaches are being used in plant disease management. Fungal antagonists play a significant role in controlling plant pathogens and diseases and they are used as Biocontrol Agents (BCAs) throughout the world. This review provides a comprehensive list of fungal BCAs used against fungal plant pathogens according to modern taxonomic concepts, and clarifies their phylogenetic relationships because the wrong names are frequently used in the literature of biocontrol. Details of approximately 300 fungal antagonists belonging to 13 classes and 113 genera are listed together with the target pathogens and corresponding plant diseases. *Trichoderma* is identified as the genus with greatest potential comprising 25 biocontrol agents that have been used against a number of plant fungal diseases. In addition to *Trichoderma*, nine genera are recognized as significant comprising five or more known antagonistic species, namely, *Alternaria*, *Aspergillus*, *Candida*, *Fusarium*, *Penicillium*, *Pichia*, *Pythium*, *Talaromyces*, and *Verticillium*. A phylogenetic analysis based on partial sequences of the 28S nrRNA gene (LSU) of fungal antagonists was performed to establish their phylogenetic relationships.

Keywords: biocontrol agents, disease control, fungicides, plant diseases, plant pathogens, phylogeny, *Trichoderma*

INTRODUCTION

Plant pathogens including fungi, bacteria, viruses and nematodes cause serious losses or damage to crops worldwide and significantly reduce the quality and quantity of agricultural commodities. These losses pose a major threat to global food production annually (El Ghaouth et al., 2002; Dean et al., 2012; Singh, 2014; O'Brien, 2017). Moreover, pathogenic infection in the field or in post-harvest