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Combinations of Fungal and Bacterial Antagonists for Biological Control of the Rice Root-Knot Nematode *Meloidogyne graminicola*

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Abstract

The rice root-knot nematode *Meloidogyne graminicola* is a serious pest across rice-wheat rotation areas of South Asia's IndoGangetic Plain and in rice producing areas of Southeast Asia. This nematode can cause yield losses of between 20 and 80 %. Two of the most effective control measures, soil flooding and nematicide application, are of increasingly limited utility due to water shortage and high cost of nematicides. Given the limited scope of management options, the development of an integrated strategy that combines resistance breeding with biological and cultural control is needed. Biological control using endophytic microorganisms has been demonstrated to be highly effective against sedentary and migratory endoparasites including plant parasitic nematodes. Therefore, a biological control system, as an alternative control measure for management of the rice root-knot nematode, is being developed. Three different antagonists; a pathogenic fungus (*Trichoderma* sp.), mutualistic endophyte (*Fusarium verticillioides*) and an endophytic bacterium (*Bacillus megaterium*) isolated from soils of different rice growing regions in Vietnam and Taiwan, were used in different combinations to enhance biological control of the root-knot nematode. The effect of single or multiple applications of these biocontrol agents against *M. graminicola* infestation was investigated under greenhouse conditions. The biocontrol agents were applied to the rice seedlings at different growth stages either individually, simultaneously or sequentially. Root galling severity was then compared between different treatments. Compatibility of these microorganisms in vitro was also studied. This paper discusses methods of fungal and bacterial application, compatibility of biological control agents in vitro and the possibilities of combining different antagonists to enhance biocontrol efficacy.

Keywords: *Bacillus megaterium*, biological control, endophytic bacteria, endophytic fungi, *Fusarium verticillioides*, *Trichoderma*

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