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BIOLOGICAL CONTROL OF SOILBORNE ROOT INFECTING FUNGI IN TOMATO AND OKRA

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Abstract

In a green house experiment soil artificially infested with a pathogenic strain of *Fusarium oxysporum* f. sp. *lycopersici* suppressed the infection of *Macrophomina phaseolina, F. solani* and *Rhizoctonia solani* on tomato and okra roots. The suppressive effect of *F. oxysporum* increased in the presence of *Trichoderma harzianum, T. koningii, Gliocladium virens, Paecilomyces lilacinus, Bradyrhizobium japonicum* and *Rhizobium meliloti* against *F. solani* and *M. phaseolina*. *F. oxysporum* induced mortality in tomato plants. Root colonization by *F. oxysporum* increased in *F. oxysporum* infested soil with reduced plant growth and less infection of *M. phaseolina* and *R. solani*. *T. harzianum, T. koningii, G. virens, P. lilacinus, B. japonicum* and *R. meliloti* showed significant control of *M. phaseolina, F. oxysporum* and *F. solani* infection on tomato and okra both in *F. oxysporum* infested and uninfested natural soil, whereas *T. koningii, G. virens* and *B. japonicum* increased *R. solani* infection in *F. oxysporum* infested soil in tomato.

Introduction

The members of the genus *Fusarium* are among the most important pathogens of crop plants in the world (Nelson *et al.,* 1983). The fungi occur chiefly as soil saprophytes both as mycelium and as chlamydospores in the soil particles or plant debris (Booth, 1971). Of the various species of *Fusarium, F. oxysporum* Sclecht, emend, Snyd & Hans and *F. solani* (Mart.) Appel & Wollenw, emend. Snyd & Hans are very common in agricultural fields of Pakistan producing root rot and wilt diseases on a wide range of plants (Ghaffar, 1992). There are reports that infection by one pathogen may alter the host response to subsequent infection by another (Taylor, 1979). The infection by *Fusarium* was found usually associated with *Rhizoctonia solani* Kühn and *Macrophomina phaseolina* (Tassi) Goid., in field crops (Ghaffar, 1988). Considering the hazardous effect of pesticides, microbial antagonists have been used for the control of soilborne root infecting fungi viz., *M. phaseolina, R. solani* and *Fusarium* spp., (Tu, 1980; Elad *et al.,* 1983; Ehteshamul-Haque *et al.,* 1990; Perveen & Ghaffar, 1991). This study reports the effect of artificial infestation of natural soil with *F. oxysporum* inoculum on the efficacy of microbial antagonists in the control of root rot infection caused by *M. phaseolina, R. solani, F. oxysporum* and *F. solani* using tomato and okra as test plants.

Materials and Methods

F. oxysporum was isolated from tomato seeds and its pathogenicity on tomato was confirmed (Perveen & Ghaffar, 1992). Fifteen days old inoculum of *F. oxysporum* multiplied on 5% corn meal-soil medium at 15% moisture at 28°C was mixed into unsterilized soil pH 8.05 @ 1 gm/100 g (cfu 10^7). The soil had a natural infestation of 2-7 sclerotia g^{-1} of soil of *M. phaseolina* as assessed by using wet seiving and dilution

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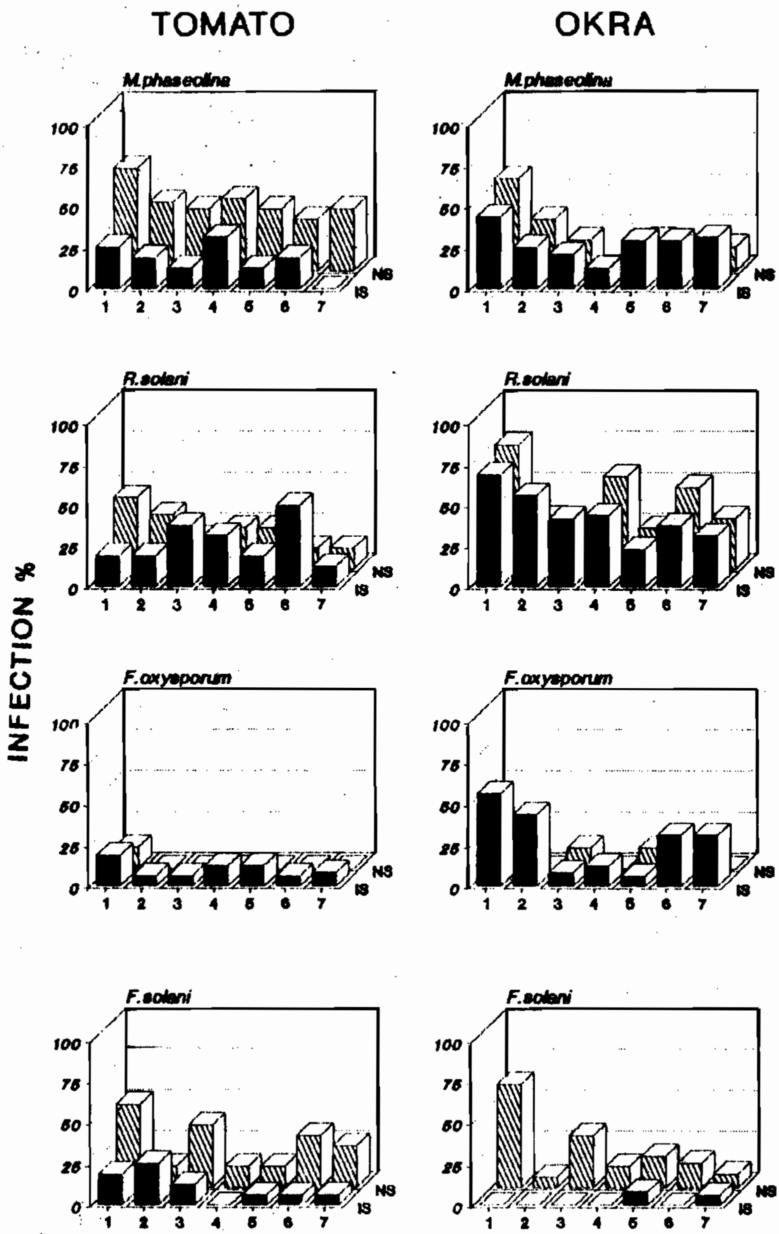

Fig.1. Effect of microbial antagonists in the control of soilborne root infecting fungi on tomato and okra in *F. oxysporum* infested soil (IS) and natural soil (NS): 1 = Control, 2 = *T. harzianum*, 3 = *T. koningii*, 4 = *G. virens*, 5 = *P. lilacinus*, 6 = *B. japonicum*, 7 = *R. meliloti*.

technique (Sheikh & Ghaffar, 1975); 5-15% colonization of *R. solani* using sorghum seeds as baits (Wilhelm, 1955); *F. oxysporum* 10^2-10^3 and *F. solani* 10^{-3}-10^4 cfu g^{-1} of soil, as assessed by soil dilution technique (Nash & Snyder, 1962). In another set soil was not infested with *F. oxysporum* inoculum. Seeds of tomato and okra were sown in 8 cm diam., plastic pots, each containing 250 gm of soil @ 8 seeds per pot. A 25 ml conidial or cell suspension of biological antagonists viz., *T. harzianum*, *T. koningii*, *G. virens*, *P. lilacinus* @ 10^7 cfu ml^{-1} and *B. japonicum* and *R. meliloti* @ 10^8 cfu ml^{-1} were drenched in pots. Pots without microbial antagonists served as control. Each treatment was replicated four times and pots were randomized on green house bench and adjusted at 50% water holding capacity (W.H.C).

Plants were uprooted after 6 weeks growth. After washing the roots in tap water, 5 cm long root pieces from each plant were cut, surface sterilized with 1% $Ca(OCl)_2$ for 3 minutes and transferred on to PDA plates containing Penicillin (100000 units/litre) and Streptomycin (0.2 gm/litre). Plates were incubated for 5 days at 28°C and incidence of root infecting fungi viz., *M. phaseolina*, *R. solani*, *F. oxysporum* and *F. solani* was recorded. Data on plant mortality, plant height and fresh weight of shoots were also recorded. Data were subjected to analysis of variance, using factorial ANOVA (FANOVA) on MSTAT, version[4].

Results

Artificial infestation of soil with *F. oxysporum* significantly reduced infection of *M. phaseolina* and *F. solani* both on tomato and okra in presence and or absence of biocontrol agents viz., *T. harzianum*, *T. koningii*, *P. lilacinus*, *G. virens*, *B. japonicum* and *R. meliloti*. Infection of *R. solani* was suppresed in treatments where *F. oxysporum* was mixed in soil without microbial antagonists as compared to natural soil. *F. oxysporum* was found to reduce the efficacy of *T. harzianum* on okra; *T. koningii* on tomato and okra; *G. virens* and *B. japonicum* on tomato in the control of *R. solani*. All the microbial antagonists significantly reduced infection of *R. solani* in natural soil. Except *R. meliloti* all the microbial antagonists were found ineffective or showed an increase in *R. solani* infection on tomato where *F. oxysporum* was used for infestation of soil (Fig.1).

Infection of *M. phaseolina* on tomato and okra was significantly reduced by *T. harzianum*, *T. koningii*, *G. virens*, *P. lilacinus*, *B. japonicum* and *R. meliloti* both in natural soil and in soil artificially infested with *F. oxysporum* as compared to untreated control. *F. oxysporum* reduced the efficacy of microbial antagonists against *R. solani* infection but microbial antagonists showed significant reduction in *F. oxysporum* and *F. solani* infection both in natural and *Fusarium* infested soil (Fig.1). Infestation of soil with *F. oxysporum* reduced *M. phaseolina* and *F. solani* infection accompanied with growth retardation of plants and mortality in tomato (Fig.2&3).

Discussion

In the present study soil infestation with *F. oxysporum* reduced the infection of *M. phaseolina*, *F. solani* and *R. solani* in the absence of microbial antagonists. Infection of *F. solani* and *M. phaseolina*, were greatly reduced in the presence of microbial antagonists viz., *T. harzianum*, *T. koningii*, *G. virens*, *P. lilacinus*, *B. japonicum* and *R.*

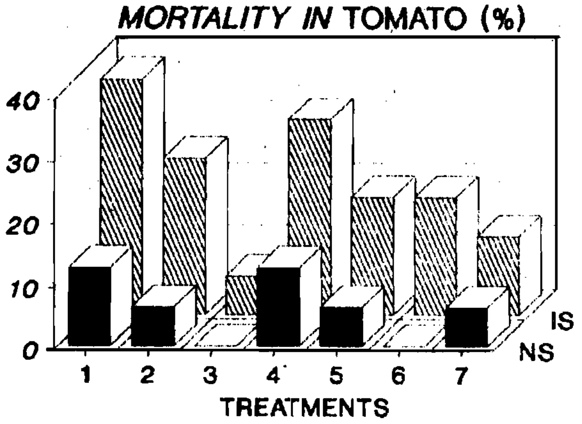

Fig.2. Effect of microbial antagonists on mortality of tomato plants in *F. oxysporum* infested soil (IS) and natural soil (NS): 1 = Control, 2 = *T. harzianum*, 3 = *T. koningii*, 4 = *G. virens*, 5 = *P. lilacinus*, 6 = *B. japonicum*, 7 = *R. meliloti*.

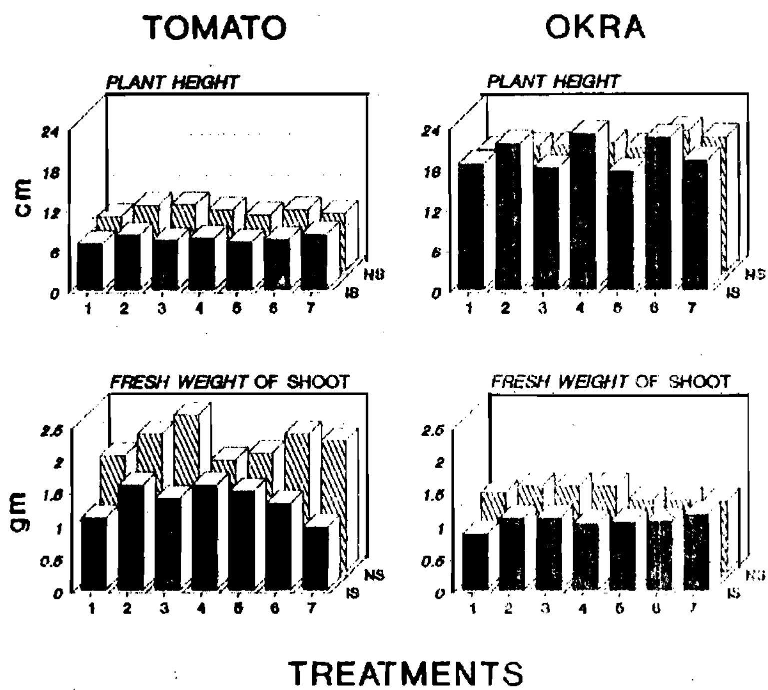

Fig.3. Effect of microbial antagonists on the plant height and fresh weight of shoots of tomato and okra in *F. oxysporum* infested soil (IS) and natural soil (NS): 1 = Control, 2 = *T. harzianum*, 3 = *T. koningii*, 4 = *G. virens*, 5 = *P. lilacinus*, 6 = *B. japonicum*, 7 = *R. meliloti*.

meliloti. *F. oxysporum* is a catostrophic wilt fungus, its non pathogenic strains are known to inhibit the growth of pathogenic strains of *F. oxysporum* on tomato (Alabouvette *et al.*, 1987; Louter & Edgington, 1990), cucumber (Mandeel & Baker, 1991), flax (Lemanceau & Alabouvette, 1991) and carnation (Postma & Rattink, 1991). *F. oxysporum* reduced the infection of *M. phaseolina* and *F. solani* but it retarded the plant growth and resulted in mortality in tomato. It would suggest that a non-pathogenic strain of *F. oxysporum* could be used as biocontrol agent. In the present study, root infection by *R. solani, F. solani* and *M. phaseolina* was greatly reduced in soil infested with *F. oxysporum*. Suppresion of root infection by *R. solani* in the presence of *F. oxysporum* (Datnoff & Sinclair, 1988) and *M. phaseolina* on soybean roots in the presence of *R. solani* or *F. solani* have been reported (Zambolim *et al.*, 1983). *T. harzianum, T. koningii, G. virens, P. lilacinus, B. japonicum* and *R. meliloti* showed significant control of *M. phaseolina, F. solani* and *F. oxysporum* both in natural and infested soil and *R. solani* infection in natural soil. Use of *Trichoderma* spp., *G. virens, P. lilacinus, B. japonicum* and *R. meliloti* have shown significant reduction of *M. phaseolina, R. solani* and *Fusarium* infections on mustard (Ehteshamul-Haque & Ghaffar, 1991), fenugreek (Ehteshamul-Haque & Ghaffar, 1992), mungbean, sunflower (Hussain *et al.*, 1990) and soybean plants (Tu, 1978).

The present study would suggest that while testing the efficacy of microbial antagonists, the effect of other rhizospheric microorganisms specially root infecting fungi should also be given due consideration. The non pathogenic strains of *F. oxysporum* could as well be used as biocontrol agent against *M. phaselina* and *F. solani* infection.

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