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BIOLOGICAL CONTROL OF *MACROPHOMINA PHASEOLINA* INFECTION ON MASHBEAN (*VIGNA MUNGO* (L.) HEPPER)

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Abstract

Experiments on the biological control of *Macrophomina phaseolina* of mashbean roots were carried out at two different field locations viz., Karachi and Islamabad. Infection and or colonization of mashbean roots by *M. phaseolina* reduced significantly (P = 0.01) at both field locations where seeds were treated with *Paecilomyces lilacinus*. *Trichoderma hamatum*, *Gliocladium virens* and *Aspergillus candidus*. *T. harzianum*, *T. viride* and *Streptomyces* sp., were effective in Karachi soil but not in Islamabad soil, whereas, *Rhizobium meliloti* failed to reduce *M. phaseolina* infection at any field location.

Introduction

Macrophomina phaseolina (Tassi) Goid, the charcoal rot fungus is known to produce severe losses in different crop plants including mashbean (*Vigna mungo* (L.) Hepper) in Pakistan (Ghaffar, 1988). The fungus is ubiquitous and infects roots of more than 500 plant species; of which atleast 66 different hosts have been recorded from Pakistan (Mirza & Qureshi, 1978, Shahzad & Ghaffar, 1986, Shahzad *et al.*, 1988; Sinclair, 1982).

In view of the increasing cost of chemical pesticides and the hazards involved in their use, biological control has been suggested as an alternate method of control (Mulder, 1979). Since seeds are more vulnerable to seedborne or soilborne infection, application of microorganisms to seeds rather than soil could provide better protection because of their direct proximity to the infection court (Kommedahl & Windels, 1981). Fungicides like Benomyl, Thiram, Ceresan and Vitavax have been used for the control of *M. phaseolina* infection on mashbean (Reddy & Subbayya, 1981). There does not appear to be any report on the biological control of charcoal rot of mashbean. Experiments were therefore carried out on the use of microbial antagonists as seed dressing for the control of *M. phaseolina* on mashbean.

Materials and Methods

An experiment was carried out in the field of the National Agricultural Research Centre (NARC), Islamabad, where the soil (clay loam, pH 8.35, total microbial counts 5.4×10^7 cfu/g) had a natural infestation of upto 8 sclerotia of *M. phaseolina* per g of soil as detected by wet sieving and dilution technique (Sheikh & Ghaffar,

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1975). Completely randomized block design with 3 replicates of 4 rows for each treatment was used. The same experiment was duplicated at the experimental plots of the Department of Botany, University of Karachi, where the soil (silt loam, pH 7.95, total microbial counts 7.4 X 10^7 cfu/g) showed a natural infestation of upto 16 sclerotia per g of soil.

Seeds of mashbean were treated with spore/cell suspension (@ 1.35 X 10^7 cfu/ml) of actively growing cultures of microbial antagonists viz., *Aspergillus candidus* (KUMH 224), *Gliocladium virens* (KUMH 464), *Paecilomyces lilacinus* (KUMH 244), *Trichoderma hamatum* (KUMH 29), *T. harzianum* (KUMH 115), *T. viride* (KUMH 656), *Streptomyces* sp., (KUMH 118) and *Rhizobium meliloti* (KUMH 139) using 1% sugar solution as the sticker. Seeds were sown in July, 1990, and the plants were uprooted after 30 days of growth. The roots were washed in running tap water and 1 cm root pieces surface disinfected with 1% $Ca(OCl)_2$, were transferred onto PDA plates containing penicillin @ 100,000 units/l and streptomycin @ 0.2 g/l. The Petri plates were incubated at 28°C for 5 days to confirm root infection and colonization by *M. phaseolina*. The data were analyzed by One-way Analysis of Variance method and Duncan's Multiple Range Test.

Results and Discussion

Infection of mashbean roots by *M. phaseolina* in the NARC, Islamabad plots was completely prevented where *P. lilacinus, T. hamatum, G. virens* and *A. candidus* were used for seed dressing. Seed treatment with *T. harzianum, T. viride, Streptomyces* sp., and *R. meliloti* failed to reduce root infection and frequency of root colonization by *M. phaseolina*. In the experiment carried out in Karachi soil, infection of roots by *M. phaseolina* reduced significantly ($p = 0.01$) in all the treatments except where *T. harzianum, A. candidus* and *R. meliloti* were used for seed treatment. However, the frequency of root colonization was significantly lower ($p = 0.01$) in *T. harzianum* and *A. candidus* treatments as compared to control (Fig. 1).

Antagonists applied to seeds not only have the potential of protecting the seed but being the initial colonizer of the roots, may also provide protection against root infecting pathogens (Kommedahl & Windels, 1981). Shahzad & Ghaffar (1989) found that *P. lilacinus*, which primarily is an egg-parasite of root-knot nematode (*Meloidogyne* spp.), significantly reduced *M. phaseolina* infection on mungbean, okra and gram. Similarly, Hussain *et al.*, (1990) reported that the use of *P. lilacinus, T. harzianum, G. virens, Streptomyces* sp., and *R. meliloti* as seed treatment provided significant protection to mungbean and sunflower roots against *M. phaseolina* infection. *R. japonicum* significantly reduced charcoal rot disease on soybean (Chakraborty & Purkayastha, 1984), whereas seed bacterization with *Rhizobium* spp., substantially reduced *M. phaseolina* infection on mungbean, okra and sunflower roots (Zaki & Ghaffar, 1987).

During the present studies, *P. lilacinus, G. virens, T. hamatum* and *A. candidus* effectively reduced infection and or colonization of mashbean roots by *M. phaseolina* at both the field locations, indicating their ability to adapt in different ecological conditions. *T. viride* and *Streptomyces* sp., provided protection against *M. phaseolina*

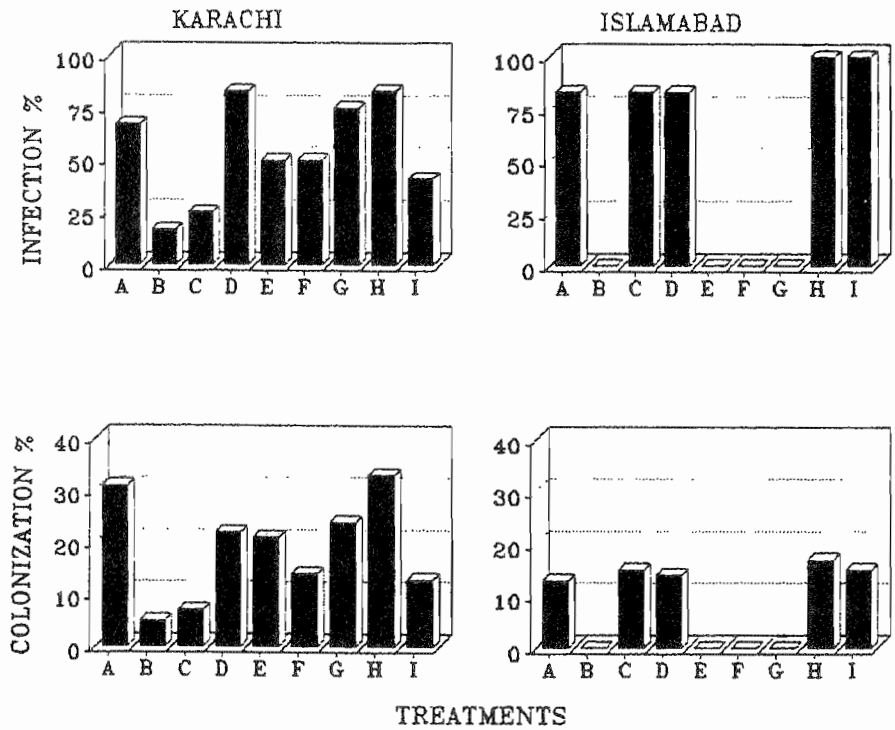

Fig. 1. Effect of seed treatment with microbial antagonists on infection and colonization of mashbean roots by *Macrophomina phaseolina*.

A= Control; B= *Paecilomyces lilacinus*; C= *Trichoderma viride*; D= *T harzianum*; E= *T hamatum*; F= *Gliocladium virens*; G= *Aspergillus candidus*; H= *Rhizobium meliloti*; I= *Streptomyces* sp.

in Karachi soil but not in Islamabad soil. Perhaps the soil physical charateristics and other ecological conditions in Islamabad soil suppressed the activity of these microbial antagonists. Although the use of *R. meliloti* has provided significant reduction in *M. phaseolina infection* on mungbean, okra and sunflower (Zaki & Ghaffar, 1987; Hussain *et al.*, 1990); seed treatment of mashbean with *R. meliloti* failed to provide any protection against *M. phaseolina* infection or colonization at any field location used during these studies. There may be differences in root exudates from different host plants which need elucidation. The possibility of a different strain of *R. meliloti* providing protection to mashbean roots against *M. phaseolina* infection should also be looked into.

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