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EFFECT OF SOIL MOISTURE ON THE COLONIZATION OF *MACROPHOMINA PHASEOLINA* (TASSI) GOID. ON ROOTS OF MASH BEAN

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Abstract

Plants showed vigorous growth of root and shoot system in unstressed natural soil and also soil artificially infested with sclerotia of *Macrophomina phaseolina* compared to stress conditions. In stress and soil artificially infested with *M. phaseolina* the plants showed black colouring and withering of aerial parts after 30 days' growth. Colonization of *M. phaseolina* was more on primary roots compared to the secondary roots in early stages, whereas, at later stages of plant growth the secondary roots were more infested. The colonization was more in artificially infested soil compared to natural soil.

Introduction

Mash bean (*Vigna mungo* L.) is an important crop of Pakistan, widely used as pulse and also in other foodstuffs and as dry straw for cattle. The crop is sown in May and harvested in July. Bacterial nodules developed on the roots of plants increase the fertility of soil. Of the soil borne root infecting fungi, *Macrophomina phaseolina* (Tassi.) Goid. is known to attack more than 500 species of plants in different parts of the world (Sinclair, 1982) and about 72 host species are reported from Pakistan (Mirza & Qureshi, 1978; Shahzad *et al.*, 1988) including mash bean, on which it produces root rot, stem rot, charcoal rot and pod rot. The fungus survives in soil in the form of sclerotia (60-100 x 56-80 μm), which are formed on host tissues and are subsequently released in soil during tissue decomposition (Smith, 1979). There are reports that stress conditions of soil increases the incidence of charcoal rot in pine (Hodges, 1962), sorghum (Edmunds, 1964), cotton (Ghaffar & Erwin, 1969), soybean (Meyer *et al.*, 1974), okra and guar (Sheikh & Ghaffar, 1979), chickpea (Husain & Ghaffar, 1995). In contrast, there are also reports that high soil moisture increases the colonization of *M. phaseolina* on peanut (Sundaraman, 1928; Abd-el-Ghani *et al.*, 1970; Husain & Ghaffar, 1992), bean (Ludwing, 1925) and coconut, (Menon *et al.*, 1952). Experiments were, therefore, carried out to study the effect of soil moisture on the colonization of *M. phaseolina* on the roots of mash bean.

Materials and Methods

Culture of *M. phaseolina* isolated from cotton roots were obtained from KUMH culture-54 (Karachi University Mycological Herbarium) for preparation of sclerotial propagules. The fungus was grown on corn meal sand medium (5 % w/w) for two weeks at 30 °C. The sclerotia were floated in sterilized distilled water, separated by decantation

method and dried at room temperature. Garden loan soil (pH 7.9) was collected from the experimental fields of Karachi University Campus and artificially infested with sclerotia of *M. phaseolina* @ 5 mg/100 g (w/w). The soil was transferred into 10 cm diameter plastic pots, each containing 450 g of soil. Five seeds were sown in each pot. Natural soil infested with sclerotia was kept as control.

A set of pots was kept at 10-20 % MHC, whereas, a comparable set was adjusted at 100 % MHC (Keen & Raczkowski, 1921). There were 15 replicates of each treatment and the pots were randomized on a screen house bench. To study the effect of MHC at various levels, other series of parallel experiments were carried out and MHC was adjusted and maintained at 10 % and 50 %.

At 10, 20, 30, 60 and 90 days interval, 10 plants from each treatment were uprooted gently and washed with tap water. One cm long primary and secondary root pieces from each plant were cut with a scissor and again washed 2-3 times with sterilized distilled water. Inside inoculation chamber, the root pieces were transferred in Petri dishes containing PDA amended with penicillin and streptomycin @ 80 mg/L. The primary and secondary root pieces were transferred in separate Petri dishes of each plant and incubated at 28 °C for 5 days to calculate the colonization and frequency of infection by *M. phaseolina* through the following formulae:

$$\text{Colonization \%} = \frac{\text{Number of root pieces colonized by } \textit{M. phaseolina}}{\text{Total number of plants observed}} \times 100$$

$$\text{Frequency \%} = \frac{\text{Number of root pieces colonized by } \textit{M. phaseolina}}{\text{Total number of root pieces observed}} \times 100$$

Results and Discussion

Plants growing in non-stress conditions with 50 % MHC showed vigorous growth of shoot and root systems. However, plants growing in stress condition with 10 %, 10-20 % and 50 % MHC showed poor growth in shoot and root systems in soil artificially infested with sclerotia of *M. phaseolina*. There was an indication that primary and secondary roots were colonized in both stress and non-stress conditions with no remarkable difference and also there was no significant correlation in relation to colonization of fungus with the age of plants. The effect of inoculum potential was also negligible both in soil infested with sclerotia of *M. phaseolina* and natural soil (Fig. 1).

Frequency of infection which is the real direct effect on roots of plants showed that the portion of root infected in stress conditions on primary and secondary roots increased with the age of plants also in non-stress soil, although the colonization was found to be more on secondary roots (Fig. 2). The root colonization also showed a relationship with the sclerotial population in soil, which was higher in artificially infested soil as compared to natural soil. The frequency of infection on cotton was also found to be directly proportional to the density of sclerotial population at different depths of soil and was higher in middle region of the roots (Husain & Ghaffar, 1975).

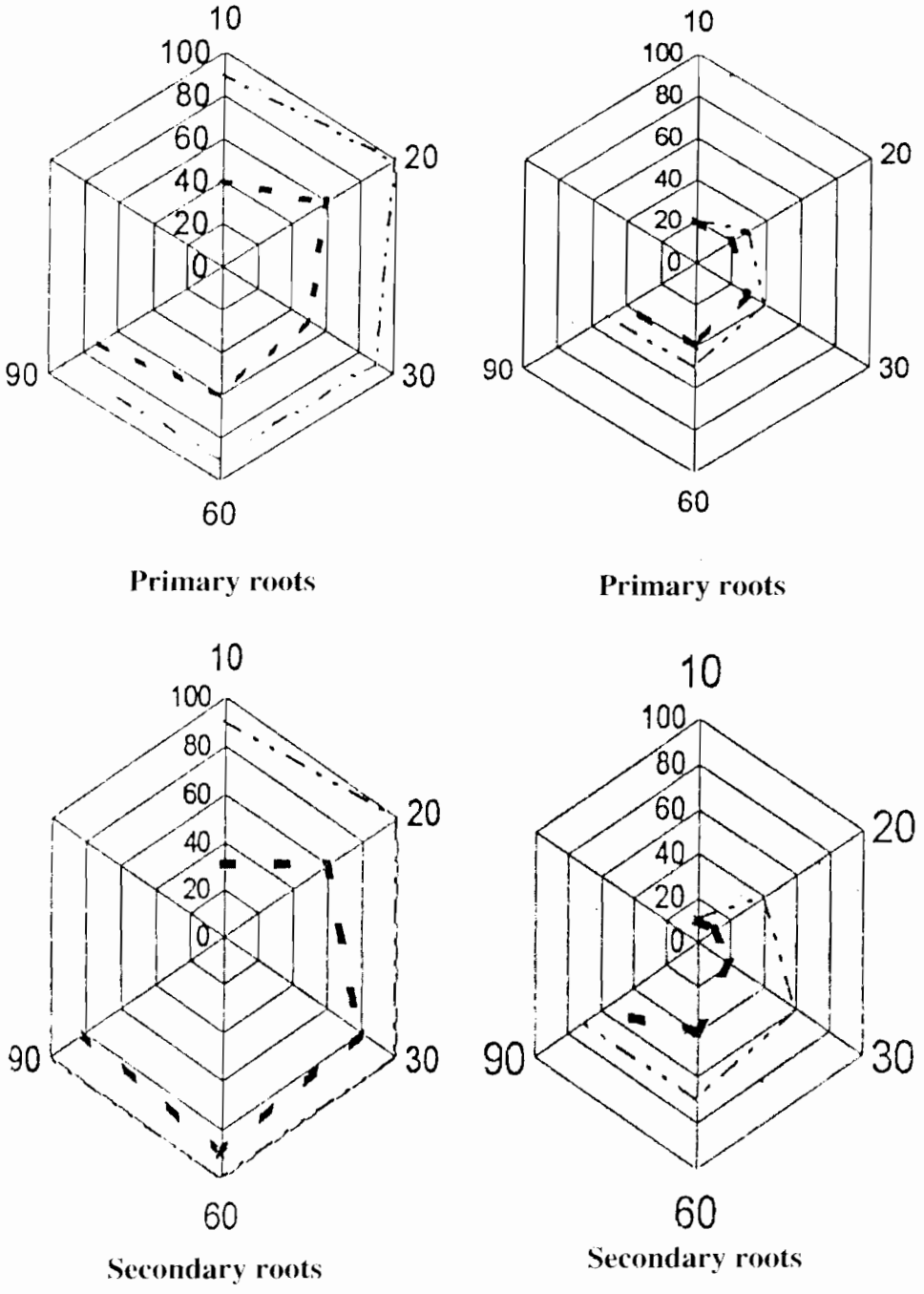

Fig. 1. Colonization of mash bean roots by *Macrophomina phaseolina* in natural and artificially infested soils adjusted and maintained at 10-20 % and 100 % MHC.

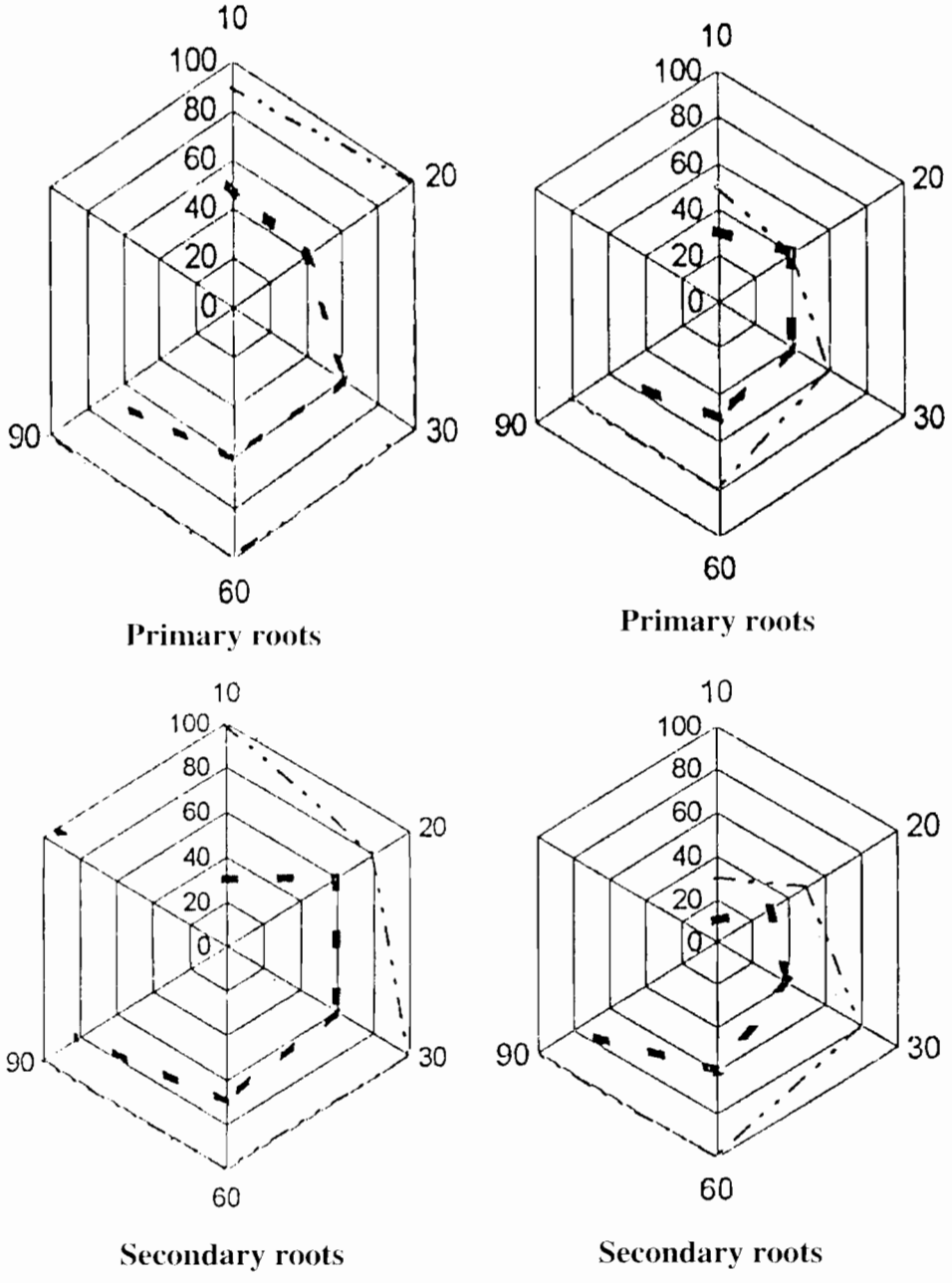

Fig. 2. Colonization of mash bean roots by *Macrophomina phaseolina* in natural and artificially infested soils adjusted and maintained at 10-20 % and 50 % MHC.

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