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EFFECT OF SOIL MOISTURE ON THE COLONIZATION OF *MACROPHOMINA PHASEOLINA* ON ROOTS OF CHICKPEA

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Abstract

Colonization of *Macrophomina phaseolina* on roots of chickpea was higher when plants were subjected to moisture stress as compared to unstressed plants. Colonization on primary roots was greater at early stages with secondary roots infected at later stages of plant growth.

Introduction

Macrophomina phaseolina (Tassi) Goid., produces charcoal rot or root rot of more than 500 species of plants in different parts of the world (Sinclair, 1982) where atleast 72 host plants have been recorded from Pakistan (Mirza & Qureshi, 1978; Shahzad & Ghaffar, 1986; Shahzad *et al.*, 1988). The fungus persists in the form of sclerotia (60-100 x 56-80 μm) which develop on host tissues and subsequently released in soil during tissue decomposition (Smith, 1969). Soil moisture stress conditions have been reported to increase the incidence of charcoal rot in pine (Hodges, 1962), sorghum (Edmunds, 1964), cotton (Ghaffar & Erwin, 1969), soybean (Meyer *et al.*, 1974; Ali & Ghaffar, 1991), black gram, guar and okra (Sheikh & Ghaffar, 1979). There are also teports where high soil moisture resulted in greater *M. phaseolina* colonization on peanut (Abd-el-Ghani *et al.*, 1970; Sundararaman, 1928; Husain & Ghaffar, 1992), bean (Ludwing, 1925) and coconut (Menon *et al.*, 1952). Experiments were, therefore, carried out to study the relationship between soil moisture and the colonization of *M. phaseolina* on roots of chickpea (*Cicer arietinum* L.).

Materials and Methods

Cultures of *M. phaseolina* (KUMH 54) isolated from cotton roots was used. The fungus was grown on corn meal-sand medium (5% w/w) for 2 weeks at 30°C. The sclerotia were floated in sterilized distilled water, then separated by decantation and dried at room temperature. Garden loam soil, pH 7.9, artificially infested with sclerotia of *M. phaseolina* @ 1 mg sclerotia g^{-1} soil was transferred into 10 cm diam., plastic pots, 350 g pot^{-1}. Four chickpea seeds were sown in each pot. Natural soil not infested with sclerotia was kept as control. A set of pots was kept at 10-20% MHC whereas in a comparable series soil was kept at 40-50% MHC (Keen & Raczkowski, 1921). There were 10 replicates of each treatment and the pots were randomized on a screen-

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house bench. At 20, 30 and 60 days interval, 10 plants from each treatment were uprooted and washed in running tap water. One cm pieces of primary and secondary roots of each plant were cut and after washing in sterilized distilled water, transferred in Petri dishes containing PDA amended with penicillin and streptomycin each @ 80 mg l^{-1}. The dishes were incubated at 28°C for 5 days to assess the frequency of infection and root colonization by *M. phaseolina* using the following formulae:

$$\text{Infection \%} = \frac{\text{Number of plants infected by } M.\ phaseolina}{\text{Total number of plants tested}} \times 100$$

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

In another similar experiment, soil moisture in pots was adjusted and maintained at 10% and 100% MHC. The frequency of infection and colonization of roots by *M. phaseolina* was recorded by the method described above.

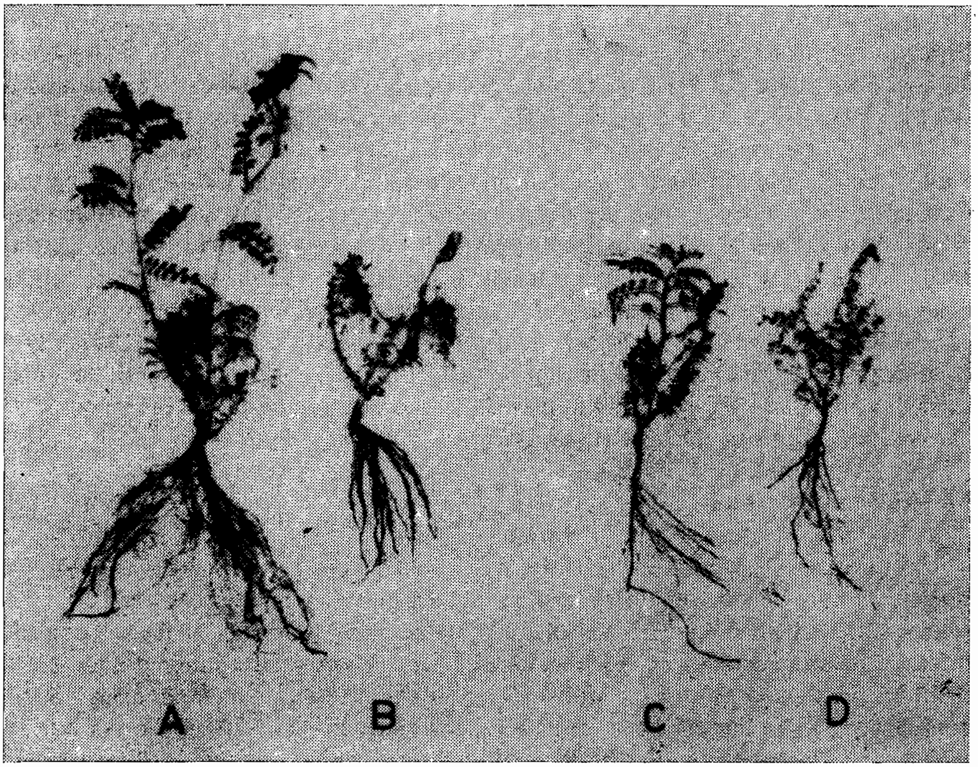

Fig.1. Effect of water stress on predisposition of chickpea plants to *Macrophomina phaseolina* infection.
A= Natural Soil adjusted and maintained at 40-50% MHC, B= Artificially infested soil adjusted and maintained at 40-50% MHC, C= Natural soil adjusted and maintained at 10-20% MHC, D= Artificially infested soil adjusted and maintained at 10-20% MHC.

Results and Discussion

Plants growing in soil with high moisture content (40-50%) showed vigorous growth as compared to those growing in soil with low moisture (10-20%). Soil artificially infested with *M. phaseolina* sclerotia showed poor growth of plants at both low and high moisture levels as compared to natural soil. Height of plants was significantly less ($p<0.05$) where plants were grown in soil with less moisture and greater population of *M. phaseolina* inoculum (Fig. 1).

There was an indication that primary roots were colonized more in the initial stages of growth of plants as compared to secondary roots which showed greater colonization when the plants become older. In both the natural and artificially infested soils, root colonization by *M. phaseolina* was greater at 40-50% MHC than at 10-20% MHC (Fig. 2). At 10-20% MHC, colonization of roots by *M. phaseolina* resulted in wilting of plants within 60 days. Although roots of plants growing in soil with 40-50% MHC were also colonized by *M. phaseolina*, however, wilting was delayed by 10-15 days. Such similar reports have been made by Husain & Ghaffar (1992) on peanut plants that availability of good moisture prevented the effect of greater root colonization by *M. phaseolina*. Dhingra & Sinclair (1978) also found that soybean plants growing under low moisture conditions showed typical symptoms of charcoal rot whereas plants growing in moist soil although infected with *M. phaseolina* grew vigorously without any symptoms of charcoal rot.

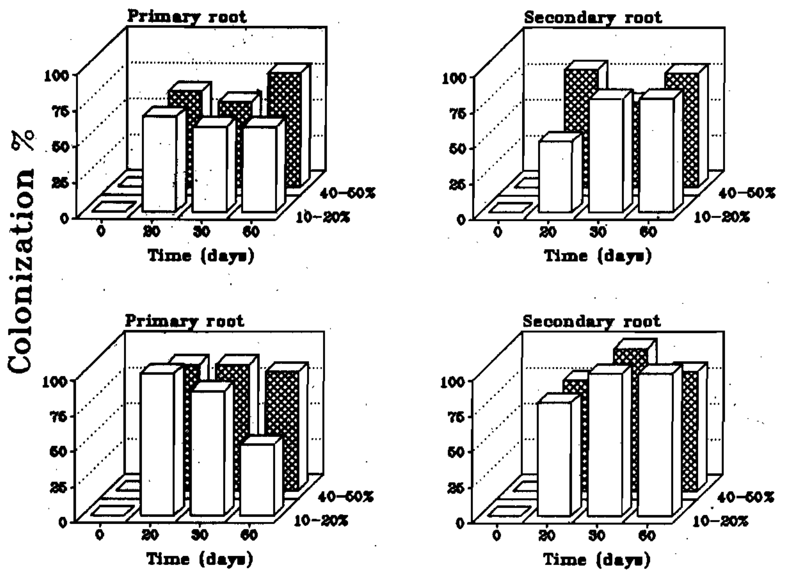

Fig.2. Colonization of chickpea roots by *Macrophomina phaseolina* in natural and artificially infested soils adjusted and maintained at 10-20% and 40-50% MHC.

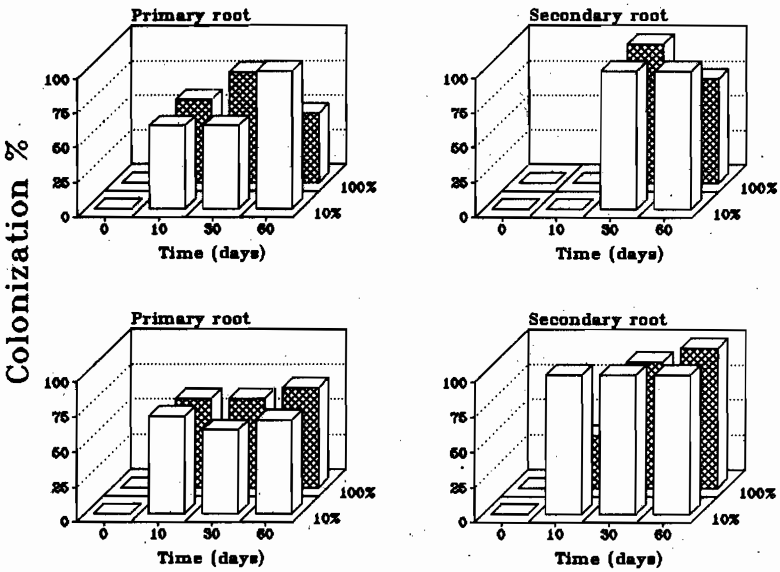

Fig.3. Colonization of chickpea roots by *Macrophomina phaseolina* in natural and artificially infested soils adjusted and maintained at 10% and 100% MHC.

Where the soil was adjusted at 10% and 100% MHC greater number of plants were infected at the initial stages of growth under water stress conditions as compared to saturated soil. At later stages of growth, although a similar number of plants were infected with *M. phaseolina*, the frequency of root colonization was more where the plants were subjected to moisture stress (Fig. 3). Presumably, under moisture stress conditions, infection spreads to greater portions of roots. Substances exuded by the roots of chickpea plants as a result of abnormal host metabolism in stressed soil induced greater colonization of roots by *M. phaseolina* needs investigations.

Sclerotial population in soil also showed some relationship with the frequency of root colonization by the fungus. At both the moisture levels, greater colonization of roots by *M. phaseolina* was observed in soil artificially infested with sclerotia of the fungus (Fig. 2 & 3). Shahzad & Ghaffar (1992) also found that the colonization of mung bean roots by *M. phaseolina* was positively correlated with the population of the fungus in soil. It would therefore suggest that the colonization of roots by *M. phaseolina* is related to both the population of the fungus in soil and soil moisture whereas a combination of high population of the pathogen in soil with low moisture could be deleterious to chickpea plants.

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