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FACTORS AFFECTING DEVELOPMENT OF COLLAR ROT DISEASE IN CHICKPEA

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Abstract

The study was conducted during the winter season of 2003 to assess the effect of factors like inoculum potential, age of the seedling and soil type on the incidence of collar rot disease in chickpea caused by *Sclerotium rolfsii* Sacc. An increase in the inoculum load of the pathogen enhanced the disease incidence. Among the techniques used for pathogenicity, use of inoculum in the form of wheat grains fully impregnated with mycelium of the pathogen was found to be simple, feasible and highly effective. In case of the soil textures, the mortality of seedling was higher in clayey soil. Younger seedlings were more susceptible and the susceptibility decreased with the increase in age of seedlings.

Introduction

Chickpea (*Cicer arietinum* L.) is an important grain legume crop predominantly sown under rainfed conditions in Pakistan. It is an important source of protein enriched human food and animal feed particularly for the population of Southeast Asia, besides its role in the management of soil fertility of dry lands (Suzuki & Konno, 1982). Average yield of chickpea in Pakistan is very low, almost half of the world and Asia (Malik, 1983). Among the biotic factors contributing towards low production of chickpea, the collar rot disease caused by *Sclerotium rolfsii* Sacc., is a major cause when weather conditions are conducive. The disease is favoured by good soil moisture, high soil temperature (25-30^{0}C) and low organic matter in the soil (Mathur & Sinha, 1968). Collar rot can cause 55-95% mortality of chickpea seedlings (Gurha & Dubey 1982). Some of the factors for severe outbreak of the disease include the presence of susceptible hosts, enough inoculum of virulent isolates of pathogen and climatic conditions favouring disease development over a period of time. *S. rolfsii* has wide host range with prolific growth and ability to produce persistent sclerotia to inflict the large economic losses associated with the pathogen (Mordue, 1974). The fungus can overwinter as mycelium in infected tissues or plant debris. Sclerotia serve as the principal over-wintering structure and primary inoculum for disease persistence near the soil surface. Sclerotia may exist free in soil or in association with plant debris. Those buried deep in the soil may survive for a year or less, whereas those at surface remain viable and may germinate in response to alcohols and other volatile compounds released from decomposing plant material (Punja, 1985). Sclerotia disseminate by cultural practices with infected soil and contaminated tools, infested transplanting seedlings, with water, wind and possibly seeds (Mahen *et al*., 1995). The present study was conducted to ascertain the effect of different levels of inoculum of the pathogen, seedling age and soil type on the development of collar rot in chickpea.

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Materials and Methods

The pathogen isolated from infected chickpea plants was multiplied on overnight soaked and autoclaved grains of wheat for use in different trials and sclerotia production was carried out on wheat straws**.** Pathogenicty was determined by the following techniques:

1. Effect of sclerotia by weight

The sclerotia of the fungus were thoroughly mixed with sterilized soil @ 0, 0.1, 0.2, 0.3, 0.4 and 0.5 g/ 560 g soil containing approximately 165 g sclerotia by number. Pots were watered and covered with polythene sheets for 24 hr for establishment of inoculum. Five chickpea seeds cv Bittal was sown in each pot 6 x 12 x 6 cm with three replications. Data were recorded after two-weeks of sowing to assess the efficacy of sclerotia on the seedling mortality.

2. Effect of inoculum by number

The seeds were surface sterilized with 0.1% Chlorox solution and sown in plastic pots filled with sterilized soil. In each pot, 5 chickpea seeds of cv Bittal were sown. Two-week old seedlings were inoculated by replacing surface soil 2 cm deep around the collar region of the seedling and the following five treatments were designated with three replications: (i) control (no inoculum), (ii) one wheat grain, (iii) two wheat grains, (iv) three wheat grains, (v) four wheat grains, (vi) and five wheat grains coated with the mycelium of *S. rolfsii* placed on each plant and covered with a thin layer of soil. The pots after inoculation were watered. Pathogenicity was determined on the basis of percent mortality of chickpea seedlings after two-weeks of sowing.

3. Effect of mycelium by weight

The fungus was grown on wheat grains and the inoculum @ 0, 3.0, 7.5, 10.0, 15.0 and 20.0 g was thoroughly mixed in sterilized soil in pots with 560 g of soil in each. The pots were watered and covered with polythene sheets for 24 hr for establishment of inoculum. Five surface-sterilized seeds of chickpea were sown in each pot replicated thrice. Data on the seedling mortality were recorded two-week after sowing to determine the pathogenicity.

Effect of soil type

In order to determine the efficacy of inoculum in different soils, the soils of different texture (clayey, clay loam, sandy loam and sandy) were obtained and inoculum @ 6g/kg soil was mixed in each soil type. Three pots were kept for each treatment. The pots were irrigated and covered with polythene sheet for 24 hrs for the inoculum to establish. Five-surface sterilized seeds of chickpea were sown in each pot and data on seedling mortality were recorded two weeks after sowing.

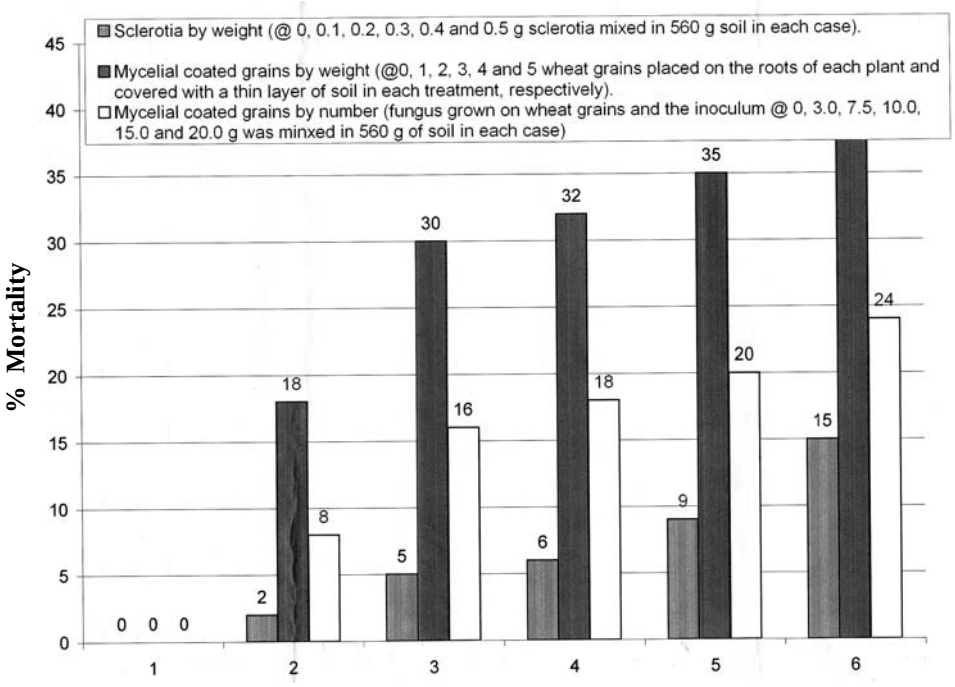

Fig. 1. Effect of different inoculum applying techniques on the pathogenicity of *Sclerotium rolfsii*.

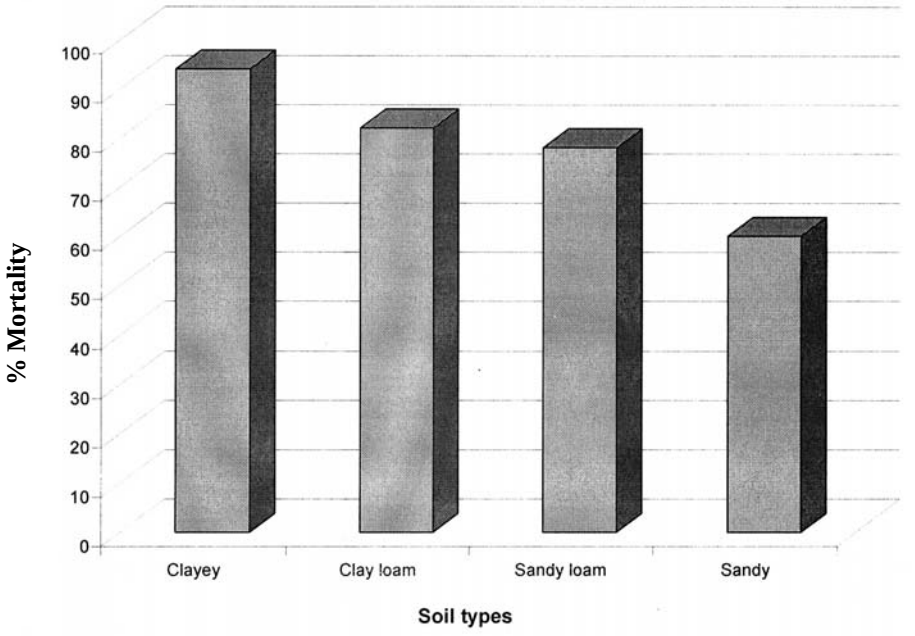

Fig. 2. Effect of soil types on the incidence of collar rot disease of chickpea

Effect of seedling age

To study the effect of seedling age as a factor towards the susceptibility of plants to disease, 6, 12, 18, 24 and 30 day old seedlings were raised in pots and inoculated by the method of Sugha *et al*., (1991). Data on seedling mortality were recorded ten days after inoculation in each case.

Results and Discussion

Results showed that there was a positive correlation between disease severity and inoculum concentrations where seedling mortality increased with an increase in inoculum load (Fig. 1). High inoculum concentration leads to increased disease severity (Sugha *et al.,* 1991) although this also depends on the susceptibility of chickpea cultivars and other environmental conditions. However the concentration of sclerotia by weight (0.1 and 0.5), by number (1 grain and 5 grains) and mycelium by weight (3 and 20 g) not statistically significant.

Different techniques have been used to assess the pathogenicity of *S. rolfsii* (Agarwal & Singh, 1969; Agarwal & Kotasthane, 1971; Guhra & Dubey, 1982). Using wheat grains fully covered with mycelium of the pathogen is simple, less time consuming, highly effective and much less inoculum requiring compared with other techniques. It gives consistent and reproducible results. The entire soil surface in the pots was covered with profuse growth of the pathogen, there is thus no likelihood of escape of the seedlings from the disease. Further, no soil around the plants was removed upto a particular depth to place the inoculum as is done in other techniques. Results of the entire experiment starting from planting to recording observations on seedling mortality were obtained within two weeks. The technique, therefore, is much faster than those used by other workers (Patil *et al.,* 1977, Gurha & Dubey, 1982). This procedure was also used by Sugha *et al.,* (1991) who tested a total of 210 lines/ varieties of chickpea for the resistance to collar rot and obtained consistent, quick and reproducible results. Other techniques employing sclerotia, wheat grain coated with mycelium by weight are time consuming, requiring much inoculum and less effective. These do not give consistent and reproducible results as compared to the wheat grains infested with pathogen and placed at collar region. There is more chance for the seedlings to escape from the disease. The infected soil of different textures supported equally good emergence of chickpea seeds. In clayey soil, seedling mortality was 94% whereas in clay loam, sandy loamy and sandy soils, it was 82, 78 and 60%, respectively (Fig. 2). Seedling mortality in sandy soil was significantly less than that noted in all other types of soil. Mishra & Shukla (1986) reported similar results while working with different textures of soil in chickpea. The seedlings of all ages were attacked by the pathogen. However, disease developed at a faster rate in younger than older seedlings. The results showed that disease was more severe on one week old seedlings (58.7 to 100%) than older plants (19.3 to 86.3%). Six days old seedlings of all the cultivars showed complete mortality whereas in case of C 727, complete mortality was noticed in the seedlings of 6, 12, 18 days (Fig. 3). Faster mortality of younger seedlings than older ones might be attributed to difference in their uncutinized surfaces. Seedling mortality was higher up to 18 days after inoculation while it was lower in adult plants. Mishra & Shukla (1986) also reported similar results while working with pigeon pea (*Cajanus cajan*) and *Phytophthora drechsleri* f sp. *cajani* for plant pathosystem.

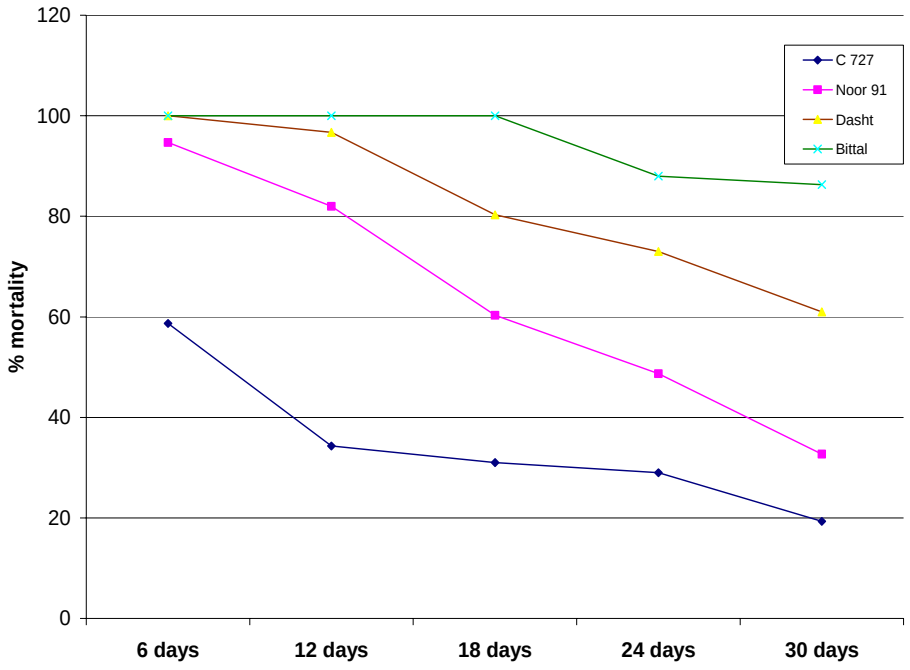

Fig. 3. Effect of seedling age on the incidence of collar rot disease of chickpea

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