Pathogenicity of root-knot nematode, *Meloidogyne incognita* and root-rot fungus, *Rhizoctonia solani* on okra [*Abelmoshcus esculentus L.*]

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Abstract
A pathogenicity test was conducted against root-knot nematode, *Meloidogyne incognita* and root rot fungus, *Rhizoctonia solani* on okra (*Abelmoschus esculentus*). The results showed that with the increase in the inoculum of *M. incognita* i.e. from 250-8000 J_2/plant and *R. solani* from 0.25 – 8.0 g mycelial mat/plant caused reduction in plant growth parameters viz., length, fresh weight and dry weight. The highest reduction in plant growth parameters was recorded in the plants inoculated with the 8000 J_2/kg of *M. incognita* and 8.0 g mycelial mat of *R. solani*/plant of fungus whereas the least reduction was recorded in 250 J_2/plant of nematode and 0.25g mycelial mat/plant. However the significant reduction in plant growth parameters was recorded in the plants inoculated with at and above 2000J_2/kg and 2g mycelial mat/plant of nematode (*M. incognita*) and fungus (*R. solani*) respectively. So these levels were pathogenic level.

Key words: Pathogenicity, *Meloidogyne incognita*, *Rhizoctonia solani, Abelmoschus esculentus.*
Introduction:

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] belongs to the family Malvaceae and native of South Africa. Used as vegetable, sugar cane juice cleaner, substitute for coffee, paper industry, sodium content is very high and is rich source of vitamin A, B. The root-knot nematode (*Meloidogyne* spp.) are most wide spread tiny organisms which limit worlds agricultural productivity (Sasser *et al*.,1982; Taylor *et al.,*1982).They attack almost all the cultivated plants but vegetables crops are their most preferred hosts (Sasser,1980). The yield of okra, tomato, and brinjal suffered 90.9, 46.2 and 2.3% losses, respectively, due to *Meloidogyne incognita* infestation at the rate of 3-4 larvae/g soil under field conditions (Bhati and Jain, 1977).

Plant parasitic nematodes are capable of producing recognizable disease symptoms on suitable susceptible hosts. Endoparasitic nematodes are more damaging and agriculturally important than other groups. Plant parasitic nematodes affect the production and economy of crop in diverse ways such as reduction in quality and quantity of crop, need of additional fertilizer and water, application of nematicides and impediment of production and trade by phytosanitary regulations (Weischer, 1968). Root-knot nematodes are among the most economically destructive group of plant parasitic nematodes causing damage and yield losses on most of the cultivated plants (Sasser and Freckman, 1987).

MATERIALS AND METHODS

Two weeks old seedlings of *Abelmoschus esculentus* were singly transplanted into 6" earthen pots containing 1 Kg sterilized soil + river sand + farm yard manure (3:1:1) mixture. After one week of transplantation each seedling was inoculated with 250, 500, 1000, 2000, 4000 and 8000 second stage juveniles (J_2) of *M. incognita*/kg soil. Similarly, to determine the threshold level of *R. solani* the seedlings were inoculated with 0.25, 0.50, 1.0, 2.0, 4.0 and 8.0 g mycelial mat/plant.

Feeder roots of okra seedlings, just before inoculations were exposed by carefully removing the top layer of soil and the required quantity of nematode suspension or fungus inoculum was poured uniformly all around the exposed roots using sterilized pipette. Exposed roots were immediately covered by levelling the soil properly. Untreated and uninoculated plants served as control. Each treatment was replicated three times and suitably randomized on a glass house bench. Watering was done as and when required.

The experiment was terminated after 60 days of inoculation and observations on plant growth parameters viz, plant length, fresh weight and dry weight, number of galls/root system, number of juveniles/ kg soil and number of females/ roots were recorded. Reproduction factor was determined by using formula, R=Pf/Pi, where Pf represents final and Pi initial population of nematode. Nematodes were extracted from the soil according to Cobb's sieving and decanting method followed by Baermann's funnel technique (Southey, 1970). The number of females in roots was determined by macerating 1g root in a waring blender. Data obtained were analysed statistically.

Results

Effect of different inoculum levels of *Meloidogyne incognita* on the growth parameters of okra

It is evident from the data presented in table 1 and Fig. 1 that the reduction in plant growth characters of okra were directly proportional to the inoculum levels of *M. Incognita* i.e. with increasing levels of the inoculum from 250 to 8000 second stage juveniles of *Meloidogyne incognita* there was a corresponding increase in the percentage reduction of plant growth characters of okra. However, inoculum level up to 1000 J_2/plant did not show any significant reduction in plant length. Significant reduction in plant length was recorded at and above 2000 J_2/plant. At this level, symptoms like thinly spread foliage with small leaves, yellowing and premature shedding of leaves, and stunting of plants, were also observed. Further it was observed that the reduction in plant growth i.e. length, fresh and dry weight was not significant between the inoculum levels of 4000 and 8000 J_2/plant.

A significant linear relationship was found between the initial population (Pi) and the final population (Pf) of *M. incognita.* The multiplication of root-knot nematode significantly reduced with the increase in the inoculum levels. The multiplication of root-knot nematode significantly reduced with the increase in the inoculum levels. The reproduction factor was highest (16.2%) at the minimum inoculums level (250 J_2/plant) and lowest 2.5%) at the maximum inoculum level (8000 J_2/plant). Thus, the rate of nematode multiplication showed a declining trend with the increase in the initial inoculum level suggesting it to be a density depending phenomenon (Table-2 and Fig-2)

It can be concluded from these results that the damaging threshold levels of *M. incognita* on okra was found to be as 2000 J_2 / plant (Table-1 and fig 1) .These results express minimum pathogenic level (2000 J_2/plant of *Meloidogyne incognita* on okra.

The present results on okra crop are in agreement with those of Mani and Sethi, 1984; Khan and Hussain 1991; Bhat, 2010 where also the pathogenic level of *M. Incognita* has also been reported as 2000 J_2/plant by various workers on different crops.

The differences observed in damaging threshold level of root-knot nematode (*Meloidogyne* spp.) may be attributed to the differences in experimental conditions, and the species/races of the root-knot nematodes involved.

It was also observed that with an increase in the level of inoculum there was a progressive increase in host infestation by root-knot nematode as indicated by the number of galls as well as the population of nematodes. Moreover, the rate of nematode multiplication was reduced with the increase in the inoculum density of *M. javanica*. This might be due to the destruction of root system by the parasitism of root-knot nematode which led the competition for food and nutrition among the developing nematodes within the root system and also due to inability of juveniles to find out new infection sites for subsequent generation (Ogunfowora, 1977). The high rate of multiplication at low levels of inocula, on the other hand, could possibly be due to the positive factors like abundance of food, lack of competition and the ability of host to support these levels of population. According to Oostenbrink (1966), the increase in the nematode populations and the subsequent reduction in the yield of crops are directly influenced by the initial density of the nematodes in the soil. His view holds true with the present findings where in plant growth was proportionately affected with increase in the number of galls and final nematode population. The progressive decrease in plant growth and nematode multiplication with the increasing inoculum of root-knot nematode on different crops has also been reported by (Raut and Sethi, 1980, Khan and Husain, 1989, Dalal and Bhatti, 1996; Khan, 2003; Khan *et al*., 2004; Khan and Ashraf, 2006; Khan *et al*., 2006).

Effect of different inoculum levels of *Rhizoctonia solani* on the growth parameters of okra

The data presented in Table 3 and Fig. 3 also clearly revealed that there was no significant reduction in plant growth parameters up to 1.0 g mycelia mat of *Rhizoctonia solani* as compared to control. Moreover, the reduction in plant growth parameters was increased with an increase in the inoculum levels from 0.25 to 8.00 g mycelial mat/plant. The significant reduction in plant growth parameters was observed at and above 2.00 g mycelial mat/plant. However, the reduction in plant growth was not significantly different between the inoculums levels of 2.0 and 4.0 and also at 4.0 and 8.0 g mycelial mat/plant.

Similarly, the percentage of root-rot/root system was also increased with increase in inoculum levels except at the lowest (0.25g mycelial mat /kg soil) inoculum level. The inoculation of *R. solani* at the rate of 0.25, 0.50 and 1.0g mycelial mat/plant did not show any significant variation in plant growth parameter as compared to control. Moreover, a significant progressive decrease in plant growth characters were recorded at and above 2.0g mycelial mat/plant. Similarly, the root-rot caused by *R. solani* was also increased with the increase in the inoculum levels except at the lowest inoculum.

It can the concluded from the above results that the damaging threshold level of *M. incognita* on okra was 2000 J_2/plant and that of *R. solani* was 2.0g mycelial mat/plant. The information gathered from the present study may provide the base line for further research to develop appropriate strategies for the management of root-knot nematode (*M. incognita*) and root-rot fungus (*R. solani*) on okra.

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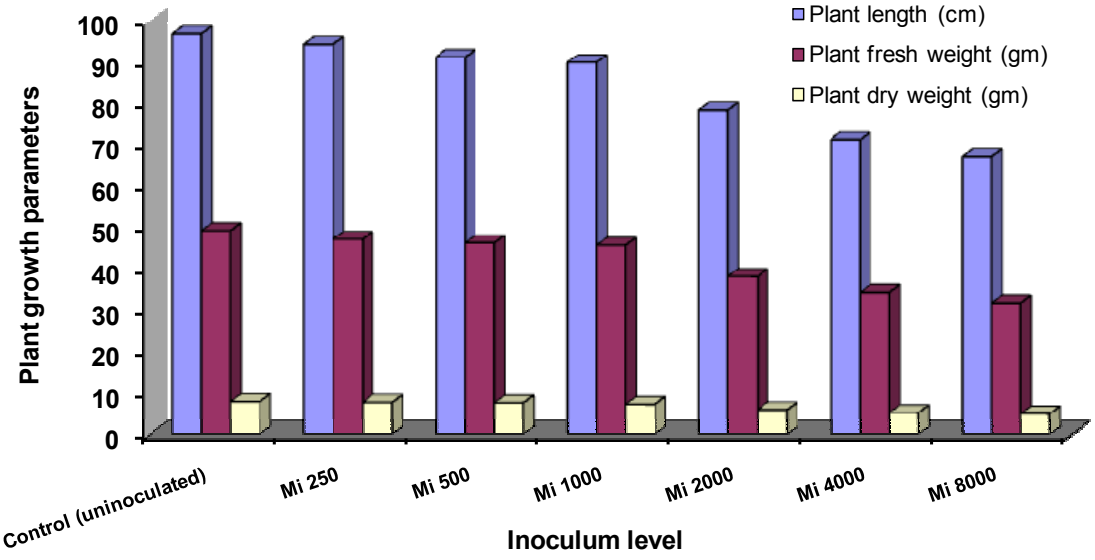

Fig. 1. Effect of inoculum levels of *Meloidogyne incognita* (Mi) on growth parameters of okra plant (*Abelmoschus esculentus* L.).

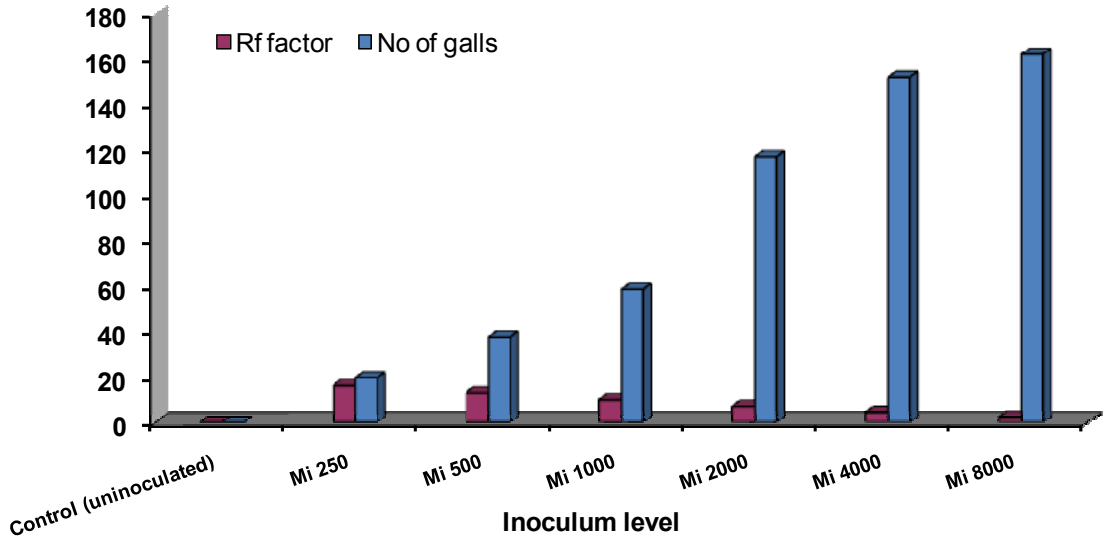

Fig. 2. Effect of inoculum levels of *Meloidogyne incognita* (Mi) on its reproduction factor (Rf) and gall formation on okra plant (*Abelmoschus esculentus* L.).

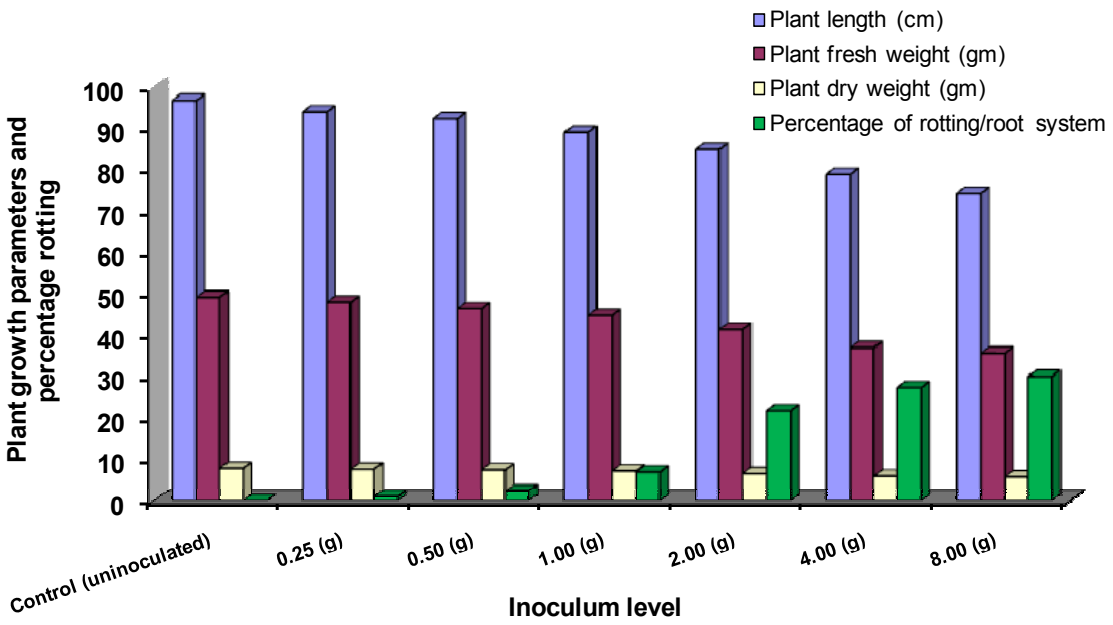

Fig. 3. Effect of different inoculum levels of *Rhizoctonia solani* (Rs) on growth parameters and percentage of rotting/root system of okra plant (*Abelmoschus esculentus* L.).