The Journal of Animal & Plant Sciences, 21(4): 2011, Page: 857-861
ISSN: 1018-7081

ASSESSMENT OF THE DAMAGE CAUSED BY *MELOIDOGYNE INCOGNITA* ON OKRA (*ABELMOSCHUS ESCULENTUS*)

M. A. Hussain, T. Mukhtar and M. Z. Kayani*

Plant Pathology Section, Regional Agricultural Research Institute, Bahawalpur, Pakistan.
Department of Plant Pathology, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan.
*Green Belt Project, Department of Agriculture, Rawalpindi, Pakistan.
Corresponding author email: arshad.sikhani@gmail.com

ABSTRACT

Among the most damaging root-knot nematode species, *Meloidogyne incognita* is one of the major constraints to okra (*Abelmoschus esculentus* L.) in vegetable-growing areas in Pakistan and other countries of the world. The relationship between a geometric series of six initial population densities (Pi) of *M. incognita* per Kg of soil and growth parameters and nematodes infestations was investigated on okra. Observations were recorded 45 days after inoculation with the nematode. It was found that all the inoculum levels reduced the shoot and root lengths, and fresh and dry weights. Increasing the nematode inoculum level increased the number of galls, egg masses and nematode population build up. The reductions in growth parameters and nematode infestations were found to be directly proportional to the inoculum level. On the other hand an inverse relationship was observed between the nematode build up and inoculum levels.

Key words: *Meloidogyne incognita*, inoculum densities, *Abelmoschus esculentus*

INTRODUCTION

Root-knot nematodes (*Meloidogyne* spp.) are serious and economically most important pests of all the cultivated crops around the world. According to Sikora and Fernandez (2005), root-knot nematodes are particularly damaging vegetables in tropical and subtropical countries of the world and cause losses up to 80% in heavily infested fields. Okra (*Abelmoschus esculentus*) ranked high amongst the economically important vegetables of the world. The immature fruits of okra are good sources of vitamin C, and are used for the preparation of certain soups and sauces. In the tropics, *M. incognita* very frequently attacks okra and causes leaf browning, suppression in plant growth, fruit yield and photosynthetic pigments of okra crop (Khan and Khan, 1994; Khan and Saxena 1992).

Short life cycle of six to eight weeks enables root-knot nematodes to survive well in the presence of a suitable host. In susceptible plants, the nematode population build up to a maximum usually as crop reaches maturity (Shurtleff and Averre, 2000) and in some cases the plants die even before reaching maturity (Singh and Khurma, 2007). Various methods are being employed for managing plant parasitic nematodes which cause reduction of nematode population densities to levels below damage thresholds (McSorley and Duncan, 1995; Hussain *et al*., 2011). Damage caused by the nematode is determined by relating pre-plant nematode densities to growth and yield of annual crops. The minimal density that causes a measurable reduction in plant growth or yield varies with nematode species, host plants, cultivar and environment (Barker and Olthof, 1976).

Infections of non efficient or efficient hosts by low densities of *Meloidogyne* spp. may enhance growth and yield of host (Madamba *et al.,* 1965; Olthof and Potter, 1972) or have no effect (Madama *et al.,* 1965), or cause severe damage to the crop (Barker and Olthof, 1976). In the present studies the effect of different inoculum densities of *M. incognita* was investigated on the growth and root galling of okra cv. Punjab Selection.

MATERIALS AND METHODS

The root-knot nematodes, *M. incognita* used in the experiments was already maintained on tomato cv. Money maker and mass produced from a single egg mass in the greenhouse of Regional Agricultural Research Institute, Bahawalpur. The highly susceptible cultivar of okra (Punjab Selection) was used to see the effect of different inoculum levels of *M. incognita*.

Three seeds of okra cv. 'Punjab Selection' were sown in plastic pots containing 5 Kg of formalin sterilized soil. After germination one healthy seedling was maintained. Ten days after germination the pots were inoculated with 500, 1000, 2000, 4000 and 8000 freshly hatched second stage juveniles of *M. incognita* by making four holes around the stem. The un-inoculated plants served as control. Each treatment was replicated five times.

The pots were arranged in a Completely Randomized Design on the bench of the green house at 25 ±2 ^{o}C. The pots were watered when required. Six weeks

after inoculation the plants were removed from the pots and data were recorded regarding growth parameters, number of galls, egg masses and reproduction factor (Rf). Percent reductions or increase in growth parameters was calculated over control by the formula given below

$$\text{Percent reduction or increase} \frac{A-B}{A} \times 100$$

Where A is the value of control and B is that of the treated one.

The experiment was repeated twice. Since there were no discrepancies in the mean values of all the corresponding treatments of the repeated experiments, the data of both the trials were averaged before statistical analysis. All the data were subjected to analysis of variance using statistical software Genstat 12th edition. Means were compared by Duncan's Multiple Range Test at $P \leq 0.05$. The regression analyses were done in Microsoft Excel, 2003 for windows.

RESULTS AND DISCUSSION

All the inoculum levels of *M. incognita* caused significant reductions over control. The analysis of variance regarding root length, shoot length, shoot weight and root weight showed highly significant effects of inoculum levels. A maximum reduction in root and shoot lengths and shoot weight were recorded at an inoculum level of 8000 J2s. The reductions in these parameters caused at a level of 4000 J2s were quite similar to those caused at 8000 J2s, showing that there is no statistical significant difference in these two levels. The reductions in these parameters were recorded 38.21, 36.95 and 43.78 % at 4000, and 42.1, 44.65 and 43.38% at 8000 J2s respectively. The minimum reductions were recorded at a level 500 J2s. The reduction in these parameters increased with an increase in inoculum level. These relationships are shown by trend lines and equations given in Figures 1, 2 and 4. Similar trend was found in dry shoot weight as shown in Figure 5. On the other hand, the inoculum levels resulted in the increase in root weight. A maximum increase of 33.54% was observed in fresh root weight at an inoculum level of 8000 J2s followed by 4000, while minimum increase was noticed in pots where 500 J2s were applied. The increase in root weight was found to be directly proportional to inoculum levels. The relationship has been shown by trend line and equation in Figure 3.

Significant increases in number of galls and egg masses were observed at all inoculum levels. Maximum galls and egg masses were produced at a level of 8000 J2s followed by 4000, while the galls and egg masses were the minimum in plants inoculated with 500 J2s. Direct relationships were observed between inoculum densities and number of galls and egg masses and are represented by regression equations in Figures 6 and 7.

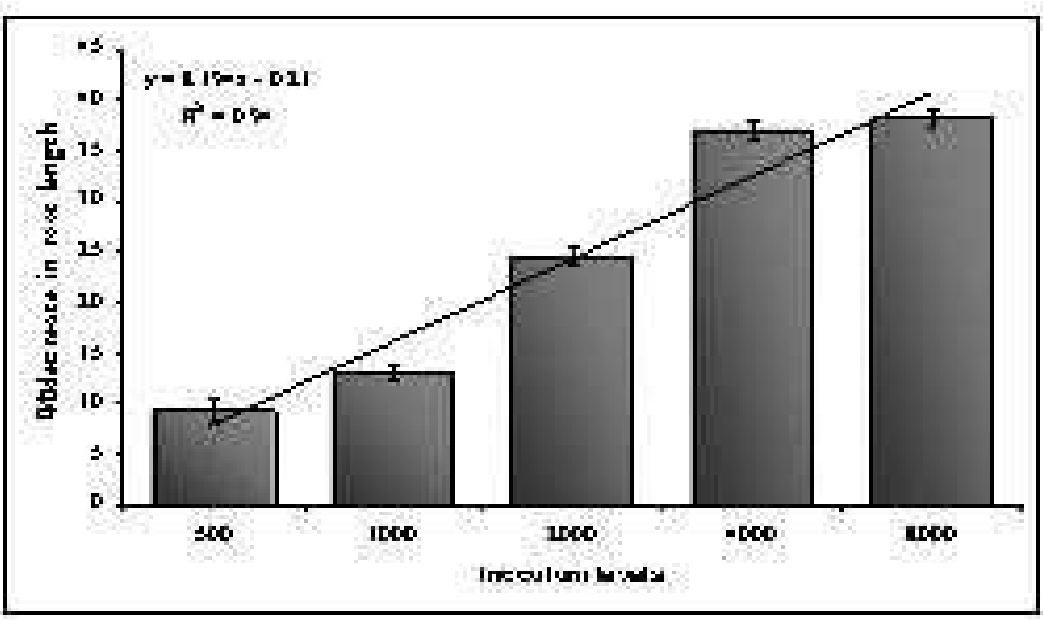

Figure.1: Effect of inoculum levels on the reduction (%) of root length of okra.

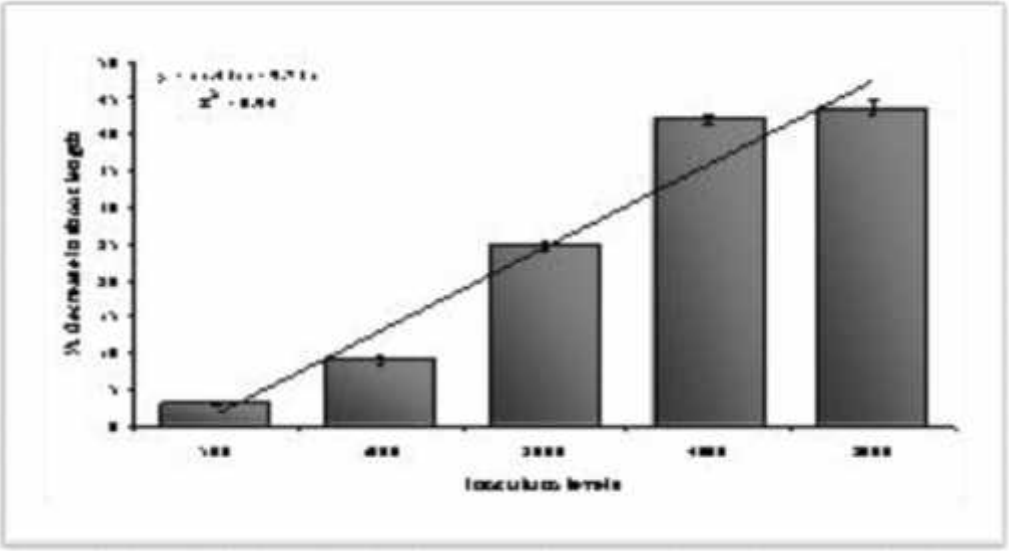

Figure.2: Effect of inoculum levels on the reduction (%) of shoot length of okra

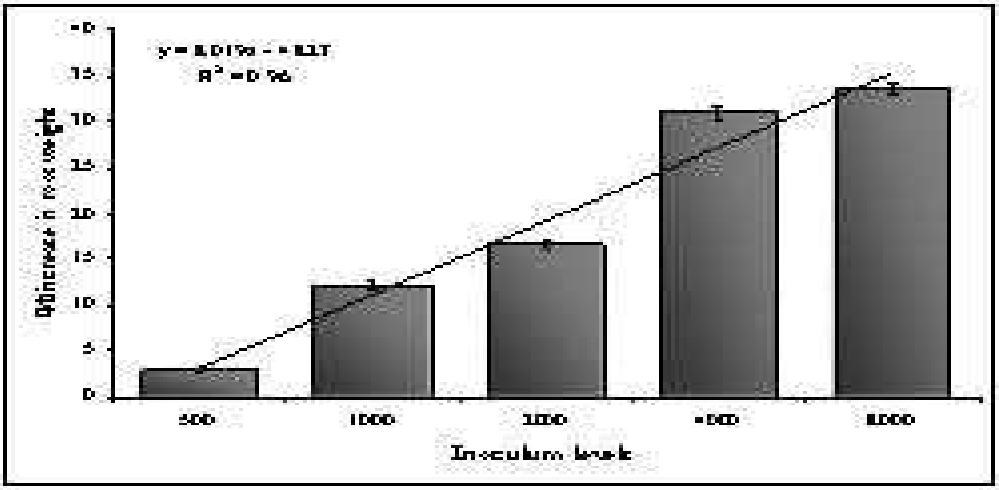

Figure.3: Effect of inoculum levels on the (%) increase in root weight of okra

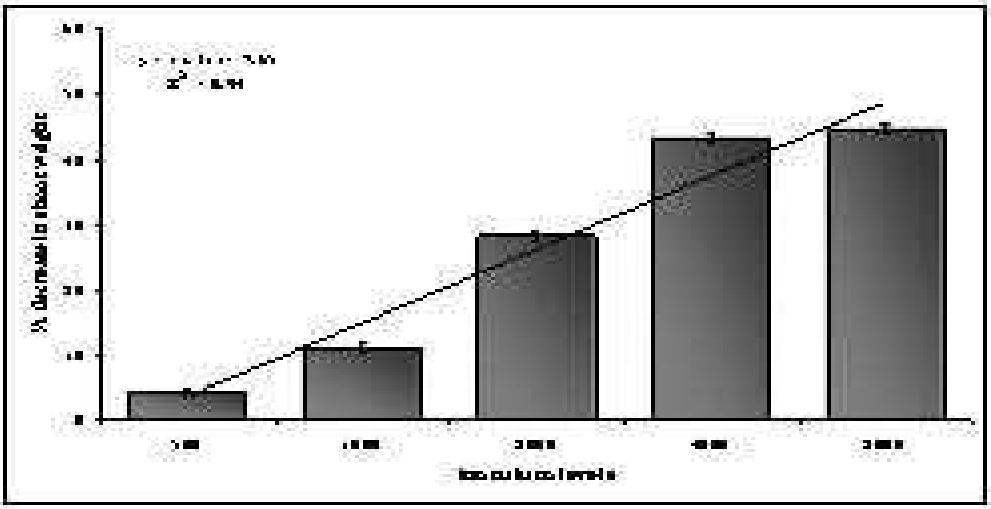

Figure.4: Effect of inoculum levels on the (%) decrease in shoot weight of okra

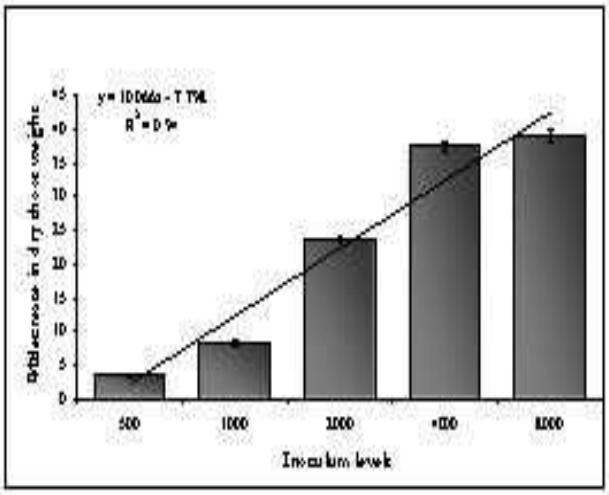

Figure. 5: Effect of inoculum levels on the (%) decrease in dry shoot weight of okra

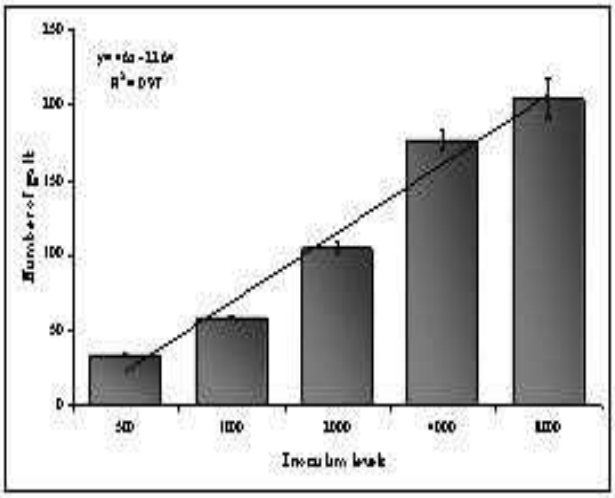

Figure. 6: Effect of inoculum levels on number of galls caused by *M. incognita*

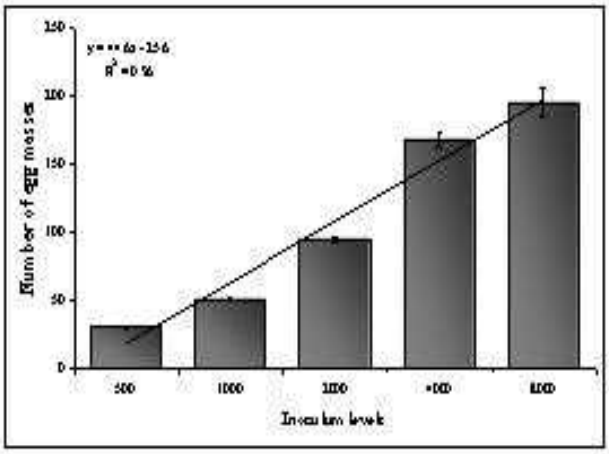

Figure. 7: Effect of inoculum levels on the egg masses of *M. incognita*

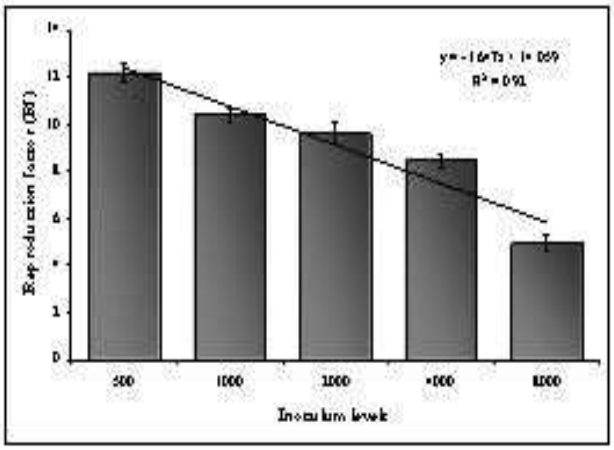

Figure. 8: Effect of inoculum levels on the Reproduction factor (Rf) of *M. incognita*

All the inoculum levels varied significantly regarding reproduction factor. Maximum Rf (12.2) was found at the lowest inoculum level and minimum (4.94) at the highest level. An inverse relationship was found between nematode levels and Rf as shown in Figure 8.

The progressive impairment in growth confirms the great damage potential of *M. incognita* on okra. The effects of different inoculum densities of different *Meloidogyne* species have also been studied by different workers on different hosts (Akhtar *et al.,* 2005; Sasanelli *et al.,* 2006; El-Sherif *et al.,* 2007 and 2009). The findings of these workers confirmed that the increase in nematode population and subsequent reduction in yield of crops or other manifestations of pathogenic effects, physiological responses (total leaf chlorophyll content, CO_2 exchange rate) and concentration of sodium, potassium, iron, manganese, copper and zinc are directly influenced by initial density of nematodes in soil. There are reports that the damaging effects of *M. incognita* population levels were higher on younger plants as compared to older ones. This was due to the tenderness and succulence of tissues of younger plants being more attractive and susceptible for large number of nematodes. The older plants being harder and stronger, suffered less. Choudhury (1985) reported that one week old seedlings of tomato cv. Money maker did not tolerate the attack of *M. incognita* larvae, while 3 and 5 week old seedlings did. Salares and Gapasin (1988) found that percent yield reduction of amplaya (*Momordica charania*) was lower on 8-week old plants compared with 2-, 4-and 6-week old plants when inoculated with different inoculum densities of *M. incognita.* Initial densities of *M. incognita* affected the rate of nematode multiplication; higher rates were observed where initial densities were lower. This might be due to destruction of root system and also due to the failure the larvae of the subsequent generations to locate the new infection sites of subsequent generations (Ogunfowora, 1977). Similar observations have also been

made by Khan (2003); Khan *et al.* (2004) and Pathak *et al,* (2000). It is therefore concluded that *M. incognita* is pathogenic to *A. esculentus* at all population levels and more damaging at higher densities.

REFERENCES

Akhtar, H., S. Anita and P. K. Shukla (2005). Effects of initial inoculum levels of *Meloidogyne incognita* on root-knot development and growth of *Vigna radiata* cv. ML-1108. Ind. J. Nematol. 35: 93-94.

Barker K. R. and T. H. A. Olthof (1976). Relationship between nematode population densities and crop responses. Annual Review of Phytopathology 14: 327-353.

Choudhury, B. C (1985). Effect of a standard inoculum level of *Meloidogyne incognita* on tomatoes of different ages. Int. Nematol. Network Newsl. 2: 4-5.

El-Sherif, A. G., A. R. Refaei, M. E. El-Nagar and M. M. S. Hagar (2007). The role of eggs inoculum level of *Meloidogyne incognita* on their reproduction and host reaction. Afr. J. Agric. Res. 2: 159-163.

El-Sherif, A. G., A. R. Refaei and S. B. Gad (2009). The role of different inoculum levels of *Meloidogyne javanica* juveniles on nematode reproduction and host response of peanut plant. Pak. J. Biol. Sci. 12:551-553.

Hussain, M. A., T. Mukhtar and M. Z. Kayani. 2011. Efficacy evaluation of *Azadirachta indica*, *Calotropis procera*, *Datura stramonium* and *Tagetes erecta* against root-knot nematodes *Meloidogyne incognita*. Pakistan Journal of Botany, 43 (Special Issue): 197-204.

Khan, M. R. and M. W. Khan (1994). Single and interactive effects of root–knot nematode and coal- smoke on okra. New Phytologist 126: 337 – 342.

Khan, M. R. (2003). Effect of different inoculum levels of root-knot nematode, *Meloidogyne incognita* race 2 on onion (*Allium cepa* L.). Ind. J. Nematol. 33: 75.

Khan, T. A. and S. K. Saxena (1992). Pathogenicity of *Meloidogyne incognita* Race-2 on okra (*Abelmoschus esculentus* cv. Red Wonder). Afro-Asian Journal of Nematology 1: 42-44.

Khan, T. A., S. Nasir and M. S. Ashraf (2004). Effect of population levels of *Meloidogyne javanica* on plant growth and nematode multiplication on cucurbits. Pakistan J. Nematol. 22: 83-89.

Madamba, C. P., J. N. Sasser and L. A. Nelson (1965). Some characteristics of the effects of *Meloidogyne* spp. on unsuitable host crops. N. C. Agricultural Experimental Station Technical Bulletin 169: 1-34.

McSorley, R. and L. W. Duncan (1995). Economic thresholds and nematode management. Advances in Plant Pathology 11:147-171.

Ogunfowora, A. O. (1977). The effects of different population levels of *Meloidogyne incognita* on the yield of tomato (*Lycopersicon esculentum*) in southwestern Nigeria. Plant Prot. 3: 61-67.

Olthof, T. H. A. and J. W. Potter (1972). Relationship between population densities of *Meloidogyne hapla* and crop losses in summer maturing vegetables in Ontario. Phytopathology 62: 981-986.

Pathak, K. N., K. Nishi and M. G. Haider (2000). Effect of population levels of *Meloidogyne incognita* on seed germination, seeding emergence and plant growth of cauliflower. Ind. J. Nematol. 30: 8-12.

Salares, F. G. and R. M. Gapasin (1988). Influence of inoculum density of root-knot nematode (*Meloidogyne incognita*) and plant age on yield of ampalaya (*Momordica charantia* L.). Philipp. J. Crop Sci. 13: 29.

Sasanelli, N., T. D'addabbo and M. Liskova (2006). Influence of the root-knot nematode *Meloidogyne incognita* r. 1 on growth of grapevine. Helminthologia 43: 168-170.

Shurtleff, M. C. and C.W. Averre (2000). Diagnosing plant disease caused by plant parasitic nematodes. The American Phytopathological Society, pp: 187.

Sikora, R. A. and E. Fernandez (2005). Nematode parasites of vegetables. In: Luc, M., Sikora, R. A. and Bridge, J. (Eds). *Plant parasitic nematodes in subtropical and tropical agriculture.* 2nd edition, CABI publishing, pp. 319-392.

Singh, S. K. and R. K. Khurma (2007). Susceptibility of six tomato cultivars to the root-knot nematode *Meloidogyne incognita*. The South Pacific Journal of Natural Sciences 13: 73-77.