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Full Length Research Paper

Effects of initial inoculums levels of *Meloidogyne incognita* J2 on development and growth of Tomato cv. PT-3 under control conditions

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Lycopersicon esculentum **is a widely grown vegetable crops throughout the world and it is highly affected by root-knot nematode (*Meloidogyne* spp.); globally more than 27% yield losses in tomato is due to their infections. As the inoculums level increases, the absorption, translocation and photosynthesis rate decreases in the host plants; it means damage caused by nematodes is directly proportional to the number of second-stage juveniles (J2) which are penetrating and establishing in the host roots. In this aspect, the present study focused on the effect of different inoculums on the tomato plants. The study reports that with increased intensity of root-knot nematode infection, the plant growth and biomass were highly reduced.**

Key words: Tomato, root-knot nematode, inoculum, growth, infection.

INTRODUCTION

Tomato (*Lycopersicon esculentum*) is a widely grown vegetable crops throughout the world and root-knot nematode (*Meloidogyne* spp.) is the major pest in this crop. More than 27% yield losses in tomato is caused by root-knot nematode (Kaur et al., 2011). Root-knot nematode affects the water and nutrients absorption and translocation in host plants; photosynthesis rate decrease in infected plants which is negatively correlated with inoculum levels; the photosynthetic products move toward the roots specifically into giant cells which were developed by the nematode infections and support nematode development and reproduction (Maleita et al., 2012). Symptoms caused by root-knot nematode infected plants are generally the plant yield suppression due to the poor development of root systems and leaf nutritional deficiencies such as chlorosis and wilting. The damage caused by nematodes is directly proportional to the number of second-stage juveniles (J2) which are penetrating and establishing in the host roots and reproduce rate inside the plant roots (Karssen and Moens, 2006). Increasing the initial population density of root-knot nematode negatively correlated with growth of

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tomato, pepper and sugarbeet (Griffin, 1981; Mekete et al., 2003). In this respect, the present study was focused on the effect of different inoculum levels of M. incognita on the plant growth and nematode infections in tomato plants.

MATERIALS AND METHODS

Biological materials

For the present study, tomato (*L. esculentum*) variety PT-3 was grown under glasshouse conditions at an ambient temperature (23–28°C), photo period (16/8 h day/night cycle) and relative humidity (60%). The sedentary root-knot nematode, *M. incognita* egg masses were collected from the infected tomato plant roots and cultured on tomato roots. For nematodes culture preparation, egg masses were isolated from the infected tomato roots and kept for hatching up to 48 h in single layered facial tissue paper supported by a wire mesh assembled in a Petri dish and freshly hatched second-stage juveniles (J2) were collected by using micropipette for the further inoculation.

Experimental design

A nursery was prepared in pure sterilized river bad sand under glass house conditions. The seeds were surface sterilized by immersion in 70% ethanol for 1-2 min and 0.2% (v/v) sodium hypochlorite for 5-10 min, respectively under aseptic conditions. After 4 leaves stage, plants were transplanted in ½ kg pots containing sterilized mixture of sand and soil in 1:1 ratio (pH and EC, 8.15 and 65.7 µS, respectively). 10 days after transplanting, at five different levels along with control (500J2, 750J2, 1000J2, 1250J2 and 1500J2 along with control) freshly hatched *M. incognita* second-stage juveniles (J2) were inoculated near the rhizosphere of tomato roots. Plant growth parameters and nematode development were observed after one month of J2 inoculation. Whole experiment was conducted in glass house conditions with six treatments having four replications for each treatment. All the pots placed in a completely randomized design and the experiment was repeated twice.

Effect on plant growth and root galls

Plants were harvested after one month of nematode J2 inoculation, and plant roots were washed thoroughly with tap water. After initial air drying, root/shoot length and fresh weight were recorded and immediately nematode induced root galls were counted in the clean Petri plates filled with tap water. Then plant samples were kept in paper bags, dried at 60°C in an electric oven for 48 h and the dry matter of plants was determined.

Root gall index (RGI)

RGI was calculated by the method of Soriano et al. (2000) with the scale of 0-5. 0 = 0% galling; 1 = <10% galling; 2 = 10-25% galling; 3 = 25-50% galling; 4 = 50-75% galling; 5 = >75% galling.

Statistical analysis

The data presented are mean values ± SE using completely randomize design (CRD). Measurements were performed on four replicates for each treatment (n=4). Plant growth parameters and root galls were subjected to one factorial analysis of variance (ANOVA) using STPR-3 statistical software. The differences between the means were compared using least significant differences at $p<0.05$. Different letters denote significant differences among treatments and control.

RESULTS

Effect on plant growth parameters

All the growth parameters were significantly ($P<0.05$) reduced in all nematode inoculated plants as compared with control plants. Significant reduction in root length was observed in 1000J2, 1250J2 and 1500J2 (Figures 1 and 2). Fresh matter of the plants was significantly different in all the treatments over the control plants. Shoot fresh weight is nearly same in all the nematodes treated plants, while, the root fresh weight was low in the plants which were inoculated with 1000J2, 1250J2 and 1500J2 treatments (Figure 3). This reduction in root length and fresh matter is because of poor development of lateral roots due to high infection rate. In dry matter observation, significant reduction was observed in all the nematode inoculated treatments when compared with control plants (Figure 4).

Effect on nematode originated root galls

Root galls formed by the nematodes were highly observed in 500J2 and 750J2 inoculated plants while in the plants which were inoculated with higher number of nematodes J2 had less root galls because no there was no development of lateral roots. For root gall index observation, the plants inoculated with 1000J2, 1250J2 and 1500J2 came under the scale of 5 when compared with the 500J2 and 750J2. In the plants with higher numbers of nematode J2, plant roots development was ceased due to high infection and more than 75% root gall formation (Table 1).

DISCUSSION

The results confirm the findings of Maleita et al. (2012); they reported that plants heavily infested with root knot nematodes exhibited stunted growth and poor yield, in some cases plants die even before reaching maturity (Singh and Khurma, 2007). However, Haider et al. (2003)

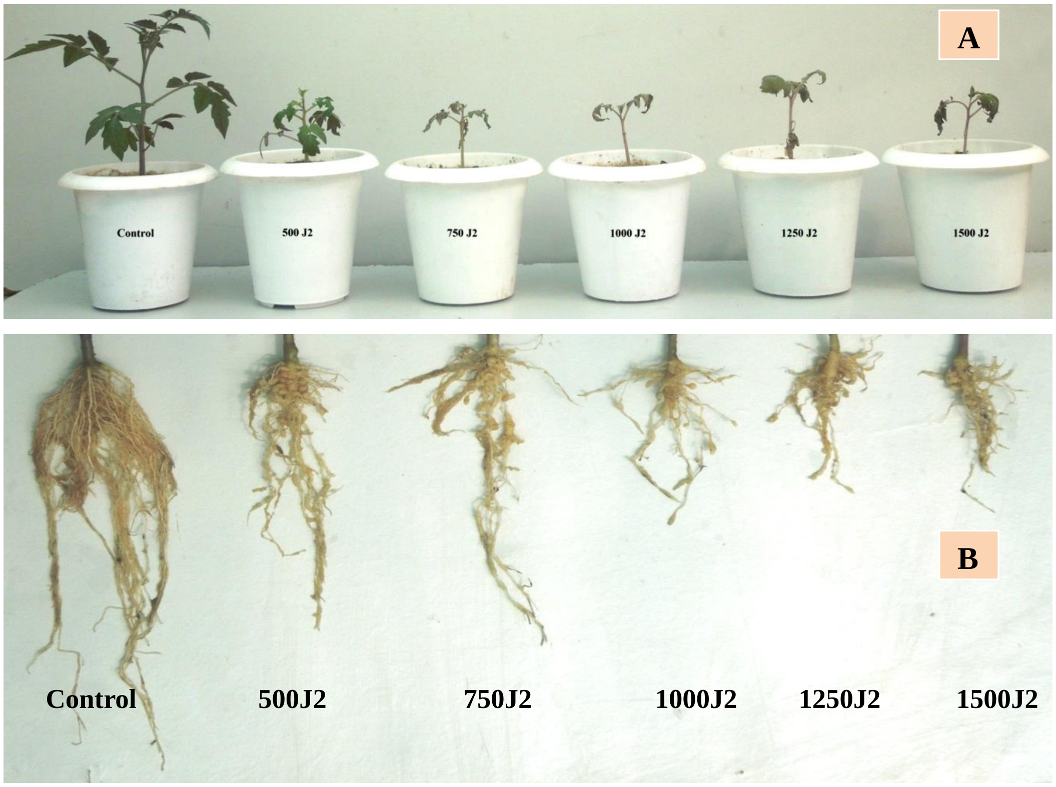

Figure 1. Effect of different levels of nematode inoculums on tomato plants. **A.** Effect on plants growth. **B.** Effect on plant roots.

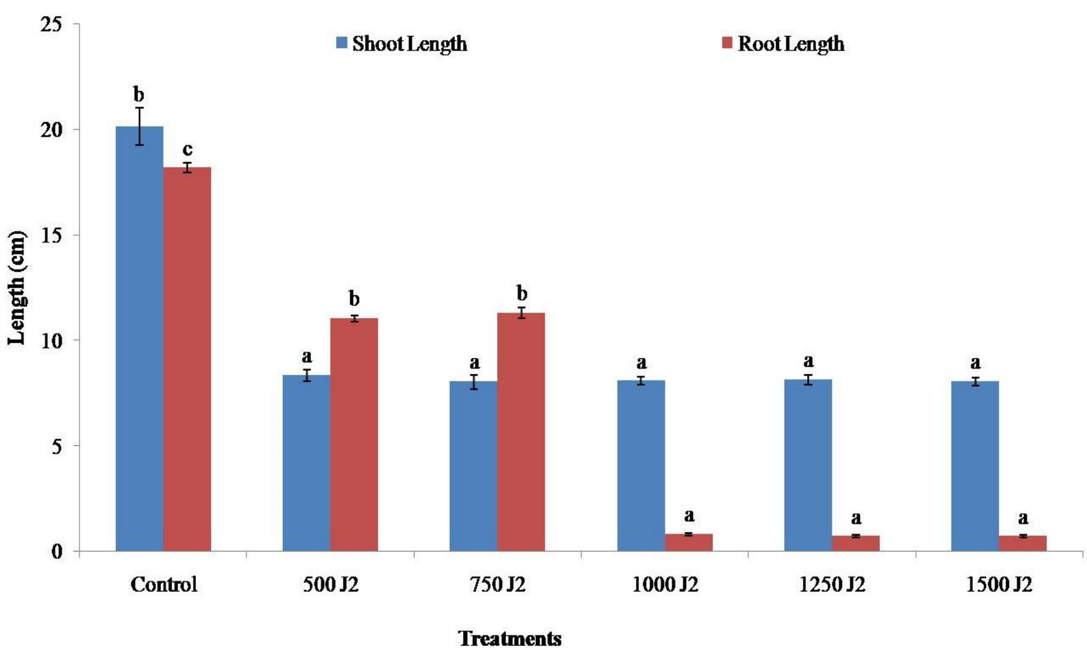

Figure 2. Effect of different levels of nematode inoculums on shoot and root length. Mean values (±S.E.) with different letters differed significantly at P< 0.05.

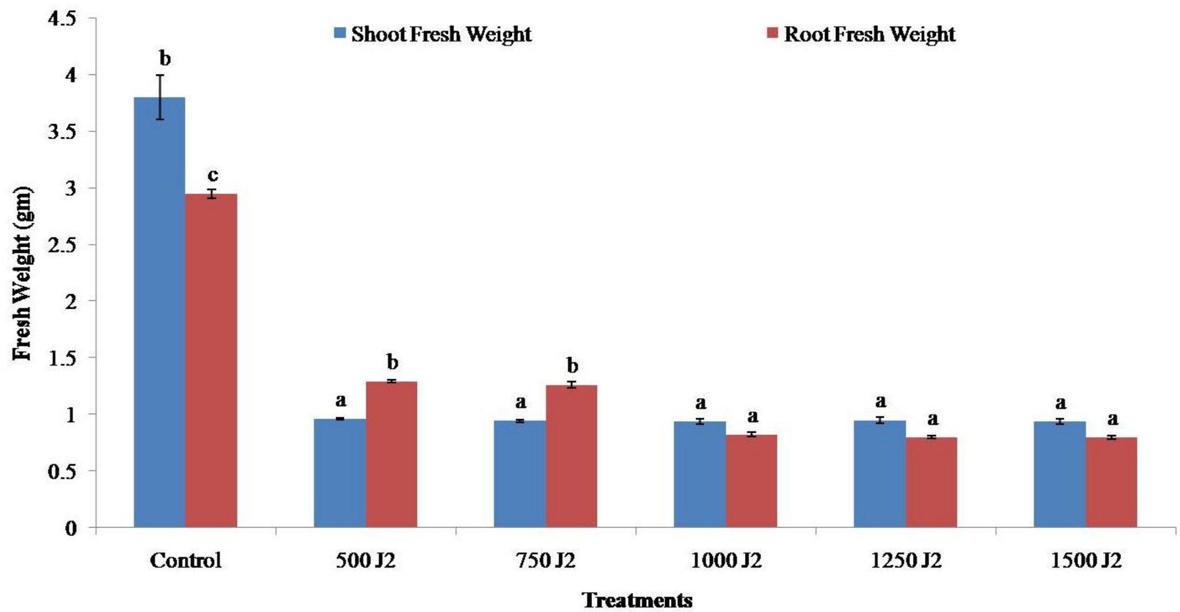

Figure 3. Effect of different levels of nematode inoculums on shoot and root fresh weight. Mean values (±S.E.) with different letters differed significantly at P< 0.05.

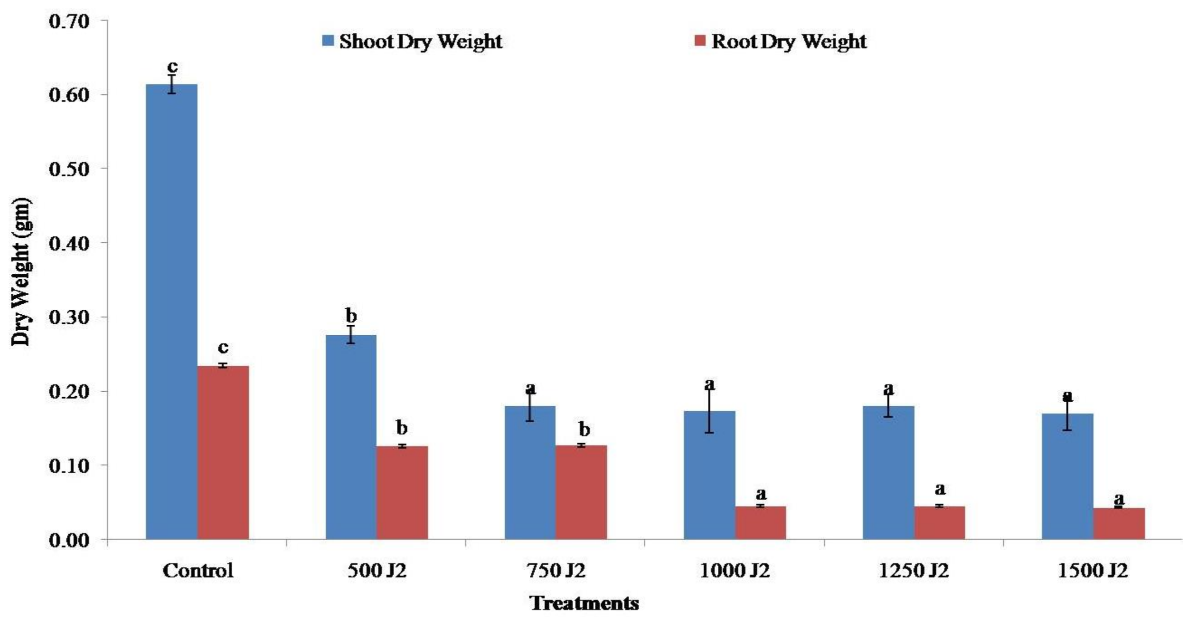

Figure 4. Effect of different levels of nematode inoculums on shoot and root dry matter. Mean values (±S.E.) with different letters differed significantly at P< 0.05.

reported that the inoculum level of 1000J2 of *M. incognita* per plant caused significant reduction in growth characters of French bean and pea. Akhtar et al. (2005) reported that increasing the initial inoculum levels of *M. incognita* resulted in a corresponding decrease in number of leaves and that the inoculum level of 500 J2/kg soil was

Table 1. Root gall index (RGI) when plants inoculated with different numbers of nematodes J2. Mean values (±S.E.) with different letters differed significantly at P< 0.05.

Treatments	Number of root galls	RGI
Control	00.00±0.00[a]	0
500 J2	165.00±4.93[c]	4
750 J2	156.67±4.33[c]	4
1000 J2	92.67±2.60[b]	5
1250 J2	91.00±3.61[b]	5
1500 J2	89.33±2.40[b]	5

pathogenic to mung bean. According to Sikora and Fernandez (2005), increase in the nematode populations and the subsequent reduction in the growth and yield of crops are directly influenced by the initial density of the nematodes in the soil. The length of plants was decreased in the nematode infected plants, this was likely due to damage caused by the increasing numbers of nematodes that invaded plant roots, and probably ceasing the nutrient and water uptake (Karssen and Moens, 2006). Presence of galls on roots is a primary symptom associated with *M. incognita*. The increasing level of nematode inoculum has been attributed to gall formation and secondary root proliferation (Carneiro et al., 1999; Abrao and Mazzafera, 2001). The RGI was increased in the plants which were infected with higher numbers of nematode; similar results were reported in different genotypes of tomato (Maleita et al., 2012) and incucumber and tomato (Charegani et al., 2012).

Conflict of interests

The author(s) did not declare any conflict of interest.

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