

# Effect of Inoculum Density of *Meloidogyne incognita* and Plant Age on the Severity of Root-Knot Disease in Tomato

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## ABSTRACT

The influence of three initial inoculum densities (2000, 4000, 6000 of root-knot nematode, *Meloidogyne incognita*) and plant age on root-knot disease of tomato were studied in greenhouse. Significant reduction in the plant height, number of leaves, fresh and dry weight of shoot and root was observed as initial inoculum level was increased. Comparatively little effect was observed on five weeks old nursery transplanted plants as compared to those 3 and 4 weeks old, where heavy losses to plants were observed. With the increase of initial inoculum densities, number of galls and egg masses increased.

**Key Words:** Nematode; *Meloidogyne incognita*; Tomato; Inoculum density

## INTRODUCTION

Nematode infection is one of the important diseases lowering tomato production in Pakistan. Among nematodes, root-knot disease caused by *Meloidogyne incognita* (Kofoid & White, 1919; Chitwood, 1949) is the most destructive. Tomato plants affected by root-knot nematodes exhibit slow development and stunned appearance. The leaves become yellowish green to yellow, tend to droop and the plants wilt. The roots become galled and the presence of these galls is the most characteristic symptom of infection. In severe infections, there may be complete loss of plant vigour resulting into heavy yield losses. The influence of nematode numbers on plant growth and yield can often be expressed as a linear regression of growth or yield on log nematode numbers. It is possible that competition at high densities of nematodes population for invasion and feeding sites reduces the yield proportionately as the population increases (Ahmad & Khan, 1988; Chindo & Khan, 1988; Wonang & Akueshi, 1990). This paper describes the effect of inoculum density of *Meloidogyne incognita* and plant age on the severity of root-knot disease in tomato.

## MATERIALS AND METHODS

Plants of tomato cv. Moneymaker were raised at weekly interval in formalin sterilized soil until 3, 4 and 5 week of age. These plants were then transplanted into earthen pots (one plant/pot) containing 2.5 kg of sandy loam soil. After one week of transplanting, the plants were inoculated with inoculum densities of 2000, 4000, 6000 J<sup>2</sup>s per pot. The non inoculated plants served as

control. Each treatment was replicated three times. The pots were placed in a CRBD in a glass house, where the temperature during the growth period ranged between 25-32°C. After eight week of inoculation, the plants were gently removed from their pots and the roots were washed free of soil under a tap. The data of following parameters were recorded and statistically analyzed: Plant height, Number of leaves/plant, Fresh weight of shoots, Dry weight of shoots, Fresh weight of roots, Dry weight of roots, Number of galls per plant, Number of egg masses/plant, Number of larvae/100 g of soil and Number of larvae/1 g of root.

## RESULTS AND DISCUSSION

A significant reduction in the plant height, number of leaves, fresh and dry weight of shoot and root was observed as initial inoculum level was increased (Table I). Comparatively little effect was observed on five weeks old nursery transplanted plants as compared to those 3 and 4 weeks old. With the increase of initial inoculum densities, number of galls and egg masses increased.

The effect of inoculum density on plant height revealed significant increase in the decrease of plant height over the non-inoculated plants with increase in the inoculum density. Inoculation of three week old plants resulted into 60.95, 74.60 and 81.05% reduction in plant height with 2000, 4000 and 6000 larval inoculum, respectively while inoculation of five week old plants resulted into 32.90, 46.60 and 57.99% reduction in plant height with 2000, 4000 and 6000 larval number per pot, respectively. The decrease in four week old plants was 46.13, 54.82 and 64.45% with 2000, 4000 and 6000

larval number per pot, respectively (Table I). There was a greater decrease in the number of leaves developed on tomato seedlings with an increase in the inoculum density of the nematode and similarly inoculation of plants at early age resulted into significantly greater decrease in the number of leaves developed than those inoculated at later/older age. Inoculation of 3, 4 and 5 week old tomato plants with 2000 larvae/pot suffered from 54.75, 39.48 and 28.85% decrease in the number of leaves developed per plant respectively while the inoculation of 3, 4 and 5 week old plants with 4000 larval number suffered from 71.48, 67.32 and 65.14% decrease in the number of leaves per plant. The inoculation of 3, 4 and 5 week old plants with 6000 larval number per pot caused 81.74, 76.37 and 75.99% reduction in the number of leaves. However, there was no significant difference in the effect of inoculum density of 4000 and 6000 larvae per pot on the decrease of number of leaves of plants inoculated at 3 or 4 week age (Table I). There was a significant decrease of fresh weight of shoot over the non-inoculated plants with increase in the inoculum density. The magnitude of this effect decreased with the age of the host plant inoculated. Inoculation of three week old plants resulted

into 67.07, 74.69 and 80.85% reduction in fresh weight of shoot with 2000, 4000 and 6000 larval inoculum, respectively while inoculation of five week old plants resulted into 45.75, 58.34 and 65.93% reduction in fresh weight of shoot with 2000, 4000 and 6000 larval number per pot respectively. The decrease in four week old inoculated plants was 56.72, 70.13 and 74.09% with 2000, 4000 and 6000 larval number per pot, respectively (Table I).

There was a greater decrease in the dry weight of shoot of tomato seedlings with an increase in the inoculum density of nematode. Inoculation of three week old plants resulted into 18.17, 46.79 and 66.46% reduction in dry weight of shoot with 2000, 4000 and 6000 larval inoculum, respectively; while inoculation of five week old plants resulted into 14.88, 42.35 and 61.65% reduction in dry weight of shoot with 2000, 4000 and 6000 larval number per pot, respectively. The decrease in four week old inoculated plants was 29.80, 51.76 and 61.57% with 2000, 4000 and 6000 larval number per pot, respectively (Table I).

There was greater increase in the fresh weight of roots over the non-inoculated plants with increase in the inoculum density (Table II).

**Table I. Decrease in various parameters of tomato seedlings exposed to different inoculum levels of *M.incognita* at different plant ages**

No. of larvae/pot of soil	3-week age	% decrease over control 3-week age	4-week age	% decrease over control 4-week age	5-week age	% decrease over control 5-week age
<b>Mean plant height (cm) of tomato seedlings</b>						
Control	79.14c	–	94.03b	–	117.12a	–
2000	30.90g	60.95	50.65e	46.13	78.58c	32.90
4000	20.10h	74.60	42.48f	54.82	61.54d	46.60
6000	14.99i	81.05	33.42g	64.45	49.20e	57.99
<b>Mean number of leaves per plant of tomato</b>						
Control	87.66c	–	103.00b	–	116.66a	–
2000	39.66e	54.75	62.33d	39.48	83.00c	28.85
4000	25.00fg	71.48	33.66ef	67.32	40.66e	65.14
6000	16.00g	81.74	24.33fg	76.37	28.00f	75.99
<b>Mean fresh shoot weight (g) of tomato seedlings</b>						
Control	54.85	–	59.66	–	68.25	–
2000	18.06	67.07	25.82	56.72	37.04	45.75
4000	13.88	74.69	17.82	70.13	28.43	58.34
6000	10.50	80.85	15.46	74.09	23.25	65.93
<b>Mean dry shoot weight (g) of tomato seedlings</b>						
Control	19.32c	–	27.01b	–	32.80a	–
2000	15.81cd	18.17	18.96c	29.80	27.51b	14.88
4000	10.28e	46.79	13.03de	51.76	18.91c	42.35
6000	6.48f	66.46	10.38e	61.57	12.58de	61.65

**Table II. Increase in various parameters of tomato seedlings exposed to different inoculum levels of *M.incognita* at different plant ages**

No. of larvae/ pot of soil	3-week age	% increase over control 3-week age	4-week age	% increase over control 4-week age	5-week age	% increase over control 5-week age
<b>Mean fresh root weight (g) of tomato seedlings</b>						
Control	7.18	—	8.5	—	10.44	—
2000	12.14	68.94	10.38	22.26	12.40	18.67
4000	14.29	99.02	11.99	41.22	13.78	31.99
6000	16.35	127.77	13.75	61.95	14.37	37.61
<b>Mean dry root weight (g) of tomato seedlings</b>						
Control	3.40e	—	3.43e	—	3.37e	—
2000	5.16bc	51.76	4.68cd	36.44	3.52e	4.45
4000	6.31a	85.58	5.50b	60.35	3.91e	16.02
6000	6.72a	97.64	6.50a	89.50	4.08de	21.07

**Table III. Effect on various parameters of tomato seedlings exposed to different inoculum levels of *M.incognita* at different plant ages**

No. of larvae/po t of soil	3-week age	4-week age	5-week age
<b>Mean number of galls of tomato seedlings</b>			
Control	0.00h	0.00h	0.00h
2000	91.00d	75.33e	55.00g
4000	123.66b	90.66d	63.66f
6000	146.33a	106.33c	75.00e
<b>Mean number of egg masses of tomato roots</b>			
Control	0.00f	0.00f	0.00f
2000	125.33cd	114.66d	97.33e
4000	174.66b	140.33c	129.00cd
6000	230.66a	174.00b	164.00b
<b>Mean number of nematodes/100 g of soil of tomato seedlings</b>			
Control	0.00h	0.00h	0.00h
2000	630.00c	441.00d	290.66g
4000	761.00b	535.33d	370.66f
6000	860.33a	641.66c	468.00e
<b>Mean number of nematodes/g of roots of tomato seedlings</b>			
Control	0.00h	0.00h	0.00h
2000	1249.00c	936.33e	699.33g
4000	1543.66b	1144.33d	852.66f
6000	1677.66a	1278.66c	978.00e

Figures having same letters do not differ significantly at 5% level of significance.

Inoculation of three week old plants resulted into 68.94, 99.02 and 127.77% increase in the fresh weight of roots with 2000, 4000 and 6000 larval inoculum, respectively; while inoculation of five week old plants resulted into 18.67, 31.99 and 37.61% increase in the fresh weight of root with 2000, 4000 and 6000 larval number per pot, respectively. The increase in four week old inoculated plants was 22.26, 41.22 and 61.95% with 2000,4000 and 6000 larval number per

pot, respectively (Table II). Inoculation of three week old plants resulted into 51.76, 85.58 and 97.64% increase in dry weight of roots with 2000, 4000 and 6000 larval inoculum, respectively; while inoculation of five week old plants resulted into 4.45, 16.02 and 21.07% increase in dry weight of roots with 2000, 4000 and 6000 larval number per pot, respectively. The increase in four week old inoculated plants was 36.44, 60.35 and 89.50% with 2000, 4000 and 6000 larval number per pot, respectively (Table II).

The influence of inoculum density on number of galls developed on each tomato seedling revealed that there was significant increase in the number of galls over the non-inoculated plants with increase in the inoculum density (Table III). The inoculation of three week old plants resulted into 91.00, 123.66 and 146.33% increase in number of galls with 2000, 4000 and 6000 larval inoculum, respectively; while inoculation of five week old plants resulted into 55.00, 63.66 and 75.00% increase in number of galls with 2000, 4000 and 6000 larval number per pot, respectively. The increase in four week old inoculated plants was 75.33, 90.66 and 106.33% with 2000, 4000 and 6000 larval number per pot, respectively (Table III).

Maximum number of egg masses were present in 6000 larvae per pot i.e. 230.66, 174.00 and 164.00 (mean values) in 3, 4 and 5 week old tomato plants, respectively; while minimum number of egg masses were present in 2000 larvae per pot i.e. 125.33, 114.66 and 97.33 (mean values) in 3, 4 and 5 week old tomato plants, respectively (Table III). Maximum number of nematodes per 100 gram of soil were present in 6000 larvae per pot i.e. 860.33, 641.66 and 468.00 (mean values) in 3, 4 and 5 week old tomato plants, respectively; while 2000 larvae per pot gave 630.00, 441.00 and 290.66 nematodes (means values) in 3, 4 and

five week old tomato plants, respectively (Table III). Comparison of treatments means indicated that there were no nematodes in non-inoculated plants which served control. Maximum number of nematodes per gram of roots of tomato seedlings were present in 6000 larvae per pot i.e. 1677.66, 1278.66 and 978.00 (mean values) in 3, 4 and 5 week old tomato plants, respectively; while 2000 leave per pot gave 1249.00, 936.33 and 699.33 (means values) in 3, 4 and 5 week old tomato plants, respectively. The results of influence of inoculum density and plant age on root-knot disease of tomato are also in conformity with Rajkumar and Krishnappa (1984), Yuen and Shokri (1985), Kassim and Hussain (1987) and Philis (1990)

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(Received 04 July 2000; Accepted 15 August 2000)