

# Influence of Plant Age, Light Intensity, Nematode Inoculum Level, and Their Interactions on Tomato Growth and Reproduction of *Meloidogyne hapla*

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The experimental design used was a  $2 \times 3 \times 4$  factorial involving two light intensities, three ages of plant, and four nematode inoculum densities. There were eight single-plant replicates for each of the 24 treatments. The experiment was run twice, and each time it was terminated 6 weeks after inoculation. Three different ages of plant were obtained by planting Rutgers tomato seeds at weekly intervals. After the last set

of seeds had germinated and were at about the first true-leaf stage, all plants in the three age groups were transplanted to 12-cm-diam clay pots filled with approximately 700 cc of sterilized sandy loam orchard soil. The plants were inoculated 5–7 days after transplanting. A fertilizer solution containing 23% N, 19% P, and 17% K was applied fortnightly. *Meloidogyne hapla* eggs were obtained (1) and added to four holes made in the soil around the base of the plant. The four inoculum densities were 0, 1,000, 10,000, and 100,000 eggs per pot. The low light intensity in the growth chamber was obtained by using a green Saran mesh

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screen shade to reduce 22,596 lux (2,100 ft-c) light intensity to 4,304 lux (400 ft-c). The high light intensity was the normal light intensity of the growth chamber, 22,596 lux. The growth chamber conditions were: temperature, 22 C; photoperiod, 12 h; and relative humidity, 50–55%. Severity of plant damage by the nematodes was assessed in terms of dry top weight and fresh root weight of the plant. Nematode numbers in the soil and roots were the indication of *M. hapla* reproduction. Roots were rated for galling before nematodes were extracted from them by blending a 2-g subsample of roots in 1% sodium hypochlorite for 30 seconds. Eggs and larvae were collected on a 500-mesh screen and rinsed into a dish for counting. Larvae in a 100-cc subsample of soil were extracted by a sugar-flotation technique (3). The F-test was used for statistical analysis with both random-effects and fixed-effects models. Results given here are based on the random-effects model unless stated otherwise.

The most important limiting factor for

tomato growth in both experiments was light intensity (Table 1). Under the conditions of the experiments, and using the random-effects statistical model, *M. hapla* and plant age did not limit tomato growth significantly. Increase in light improved the growth of older plants somewhat more than that of younger plants with less photosynthetic capacity, producing statistically significant light × age interactions. Plant weight reduction by *M. hapla* was greater at high than at low light intensity, but the reverse was true for shoot weights. These effects gave rise to statistically significant light × nematode inoculum-level interactions. Galling indices corresponded with nematode inoculum levels, irrespective of light intensity. With the less conservative fixed-effects model, all single effects and interactions were statistically significant. The most important limiting factors for reproduction of *M. hapla* were nematode inoculum level and its interaction with light (Table 2). Nematode population increase per nematode added was proportional

TABLE 1. Analysis of variance in shoot dry weight and fresh root weight of tomato plants infested with *Meloidogyne hapla*.

Source of variation	Shoot dry weight		Root fresh weight	
	Expt. 1	Expt. 2	Expt. 1	Expt. 2
Age (A)	-	-	-	-
Light intensity (L)	**	**	**	**
Inoculum level (I)	-	-	-	-
A × L	**	-	*	-
A × I	-	-	-	-
L × I	*	-	-	**
A × L × I	-	-	-	-

\*\*Significant at p = 0.01.

\*Significant at p = 0.05.

TABLE 2. Analysis of variance in number of eggs and larvae of *Meloidogyne hapla* extracted per root system, per soil volume, and per pot from *M. hapla*-infested tomato plants.

Source of variation	No./root system		No./100 cc soil		No./pot	
	Expt. 1	Expt. 2	Expt. 1	Expt. 2	Expt. 1	Expt. 2
Age (A)	-	-	-	-	-	-
Light intensity (L)	-	-	-	-	-	-
Inoculum level (I)	-	-	**	*	-	-
A × L	-	-	-	-	-	-
A × I	-	-	-	-	-	-
L × I	*	**	**	**	*	**
A × L × I	-	-	-	-	-	-

\*Significant at p = 0.05.

\*\*Significant at p = 0.01.

to the amount of root growth under the various conditions. At the termination of the experiment nearly all the nematodes were found within the tomato roots. The numbers found outside the root were somewhat greater at low light intensity than at high light intensity, particularly at the high inoculum level. Roots produced at the low light intensity were probably insufficient to support the high inoculum level.

There is some evidence (2) that placing a moderate stress on host plants may increase the reproduction of nematode parasites. We did not find that low light intensity had that effect with *M. hapla*. For studying nematode pathogenicity under

controlled conditions we believe that factorial experiments allow a more complete understanding than single-factor studies.

#### LITERATURE CITED

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