RESEARCH NOTES

Effect of Trichodorus christiei Inoculum Density and Growing Temperature on Growth of Tomato Roots[1]

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Trichodorus christiei generally causes stunting of lateral roots and localized swelling behind the meristematic region (1, 2, 4, 5, 6). Rohde and Jenkins (4) found accelerated cell maturation and no root cap or region of elongation in tomato roots parasitized by *T. christiei*. A modification of the technique described by Radewald, *et al.* (3), was used in the present investigation to study the influence of inoculum density of *T. christiei*, and temperature on the growth and development of tomato (*Lycopersicon esculentum* Mill.) roots.

Open-ended glass tubes (1 cm I.D. X 15 cm) were filled with vermiculite, supported in a vertical position in a 15-cm clay pot, and seeded with a tomato seed ('Rutgers'). Seven milliliters of a solution containing 1.5 g/liter of 23-19-17 NPK fertilizer and inocula of 0, 5, 50, 500, or 5,000 corn cultured *T. christiei* per tube in 0.2 ml of water were pipetted onto the vermiculite. Some free-living nematodes were present in the inoculum suspension. Each treatment was replicated eight times. The seedlings were maintained in a growth chamber with 27 C day temperature, 21 C night temperature, and 14 hr 2,000 ft-cd photoperiod. Three weeks after seeding, the contents of each tube were washed into a beaker, and the root systems separated from the vermiculite. The secondary roots were measured, counted and divided into two classes: (i) those shorter than or equal to 1 cm, and (ii) those longer than 1 cm. Branches of secondary roots were omitted. Counts of *T. christiei* from the vermiculite were made after ∿20 hr extraction by Baermann-pan method.

The combined effects of initial inoculum density and temperature were tested by keeping seedlings treated as previously described at three constant temperatures (20, 25 and 30 C) and 14 hr 800 ft-cd photoperiod for three weeks. Initial densities of 0, 50 or 750 *T. christiei* per tube were used.

An initial inoculum density of 5,000 *T. christiei* per seedling resulted in a significant increase in the number of secondary roots of tomato seedlings less than or equal to 1 cm in length, and a significant decrease in the number of secondary roots longer than 1 cm in length (Table 1). Inoculum densities of 500, 50 and 5 *T. christiei* per seedling had no significant influence on the numbers of short ($\leq$ 1 cm) and long ($>$ 1 cm) secondary roots. No effect on the total number of roots was found, except at the lowest initial density where an unexpectedly large total number of secondary roots developed. In all cases the final population densities of *T. christiei* were much lower than the initial densities.

At 25 C, an initial inoculum density of 750 *T. christiei* per seedling significantly increased the number of short secondary roots (Table 2). This inoculum density had no similar influence on root growth and development at either 20 C or 30 C. An initial density of 50 *T. christiei* per seedling had no effect at any of the 3 temperatures. In the presence of *T. christiei* significantly greater numbers of long secondary roots developed at 20 C than at 30 C. This

TABLE 1. Influence of *Trichodorus christiei* inoculum density on the initial three weeks of growth and development of tomato seedling roots.

Initial nematode density/ seedling	Final nematode density/ seedling	Secondary roots, no. $\leq$1 cm	Secondary roots, no. $>$1 cm	Total no. secondary roots
0	0 b[1]	7.1 b	21.5 a	28.6 a
5	1 b	11.0 ab	27.0 ab	38.0 b
50	7 b	10.9 ab	19.1 ab	30.0 a
500	11 b	11.6 ab	15.6 ab	27.1 a
5,000	196 a	18.9 a	9.4 b	29.3 a

[1] Column means followed by the same letter are not significantly different (P=0.05) according to Tukey's HSD test.

Received for publication 28 April 1971.

[1] From an M.Sc. thesis presented to Cornell University. Supported in part by NSF Grant No. GB06928.

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TABLE 2. Influence of temperature and *Trichodorus christiei* inoculum density on the initial three weeks of growth and development of tomato seedling roots.

Temp (C)	Initial nematode density/seedling	Final nematode density/seedling	Secondary roots, no. $\leq$1 cm	Secondary roots, no. $>$1 cm	Total no. secondary roots
20	0	0 b[1]	2.7 c	24.5 ab	27.2 abc
	50	9 b	7.6 abc	27.2 a	34.8 a
	750	58 a	8.5 abc	22.4 ab	30.9 a
25	0	0 b	5.9 bc	17.3 abc	23.2 abcd
	50	13 b	6.8 abc	14.9 abc	21.7 bcd
	750	68 a	13.8 a	16.1 abc	29.9 ab
30	0	0 b	4.8 bc	10.1 bc	14.9 d
	50	1 b	9.1 abc	3.5 c	12.6 d
	750	14 b	11.4 ab	6.4 c	17.8 cd

[1] **Column means followed by the same letter are not significantly different (P=0.05) according to Tukey's HSD test.**

phenomenon did not occur in the absence of the nematode. At 30 C the total number of roots was significantly lower than at 20 C. The final nematode densities were again lower than the initial densities.

An initial inoculum density of 500 *T. christiei* per plant had no influence on the growth and development of the root system, whereas 750 *T. christiei* per plant significantly increased the number of secondary roots shorter than 1 cm. Therefore, the tolerance limit, as determined by lateral root growth, was between 500 and 750 *T. christiei* per plant. Temperature affected both the nematodes and the plants. Final nematode densities were lower at 30 C than at 20 C and 25 C. At 30 C the root systems, as measured by the total number of secondary roots, were smaller than at 20 C.

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