Effects of the Temperature and Duration of the Initial Incubation Period on Resistance to *Meloidogyne incognita* in Tomato[1]

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Resistance to infection by *Meloidogyne incognita* (Kofoid and White) Chitwood in tomato is conferred by the dominant gene *Mi* under moderate temperatures, but it has been shown that a constant high soil temperature of 32 C will nullify the resistance (2,3,5). Furthermore, high soil temperature during the first 2 or 3 days after 100% penetration can determine the course of nematode development; for example, resistant (*Mi*) Nematex plants inoculated with second-stage juveniles and maintained at 32 C for 3 days, and subsequently held at 27 C for 1 month, contained abundant galls and eggs (2). In this report we examine the effects of various lengths of initial exposure

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time to 32.5 C or 25 C on the resistance in tomato to root-knot nematode.

Lycopersicon esculentum Mill. cv. Floradade with the recessive allele *Mi*^{s} for susceptibility to *M. incognita* and cv. Nematex-22 with *Mi* and *L. peruvianum* var. *dentatum* Dun. PI 129149-2(sib)-5-4 were used. Nematex-22 was derived from a single plant selection in a preliminary screening (1), and the selection from PI 129149 was made at the Agricultural Research and Education Center, Bradenton, Florida.

The *M. incognita* Race 1 population was collected in Gilchrist County, Florida (6). The inoculum was extracted using sodium hypochlorite (4) to produce a suspension of eggs and juveniles as previously described (1). Twelve days after sowing, 12 tomato seedlings per treatment were transplanted to 12-cm-d plastic pots filled with autoclaved sandy soil. Twelve days after transplanting, the soil was inoculated with 200 *M. incognita* (eggs and juveniles) per seedling by pipetting the nematode suspension into a hole 0.5 cm in diameter and 2 cm in depth near each plant.

After inoculation, seedlings were either maintained at 32.5 C in controlled temperature tanks 0, 3, 6, 9, 12, or 30 days and then transferred to 25 C to complete a 30-day incubation period, or they were maintained at 25 C for 0, 3, 6, 9, 12, or 30 days and then transferred to 32.5 C to complete a 30-day incubation. After 30 days of incubation, nematode reproduction was assessed by counting the number of egg masses per plant under direct sunlight. The greenhouse air temperature during the incubation period ranged from 19 to 30 C.

Floradade had a higher nematode reproduction than Nematex-22 and PI 129149-2 (sib)-5-4 in all temperature treatments following initial exposure to 32.5 C. Floradade showed numbers of nematode egg masses per plant varying from 108 to 91 over the six treatments. Nematode reproduction after initial exposure for 9–12 days at 32.5 C was significantly different from the other four treatments.

No egg masses developed on Nematex-22 and PI 129149-2(sib)-5-4 at 25 C for 30 days (Table 1). Nematex-22 exhibited a lower reproduction rating than PI 129149-2(sib)-5-4 in all incubation treatments except 30 days at 25 C (Table 1).

Floradade supported the highest nematode reproduction in all treatments involving initial exposure to 25 C. In all treatments except 0 or 30 days initial exposure at 25 C, Nematex-22 had higher numbers of egg masses than PI 129149-2(sib)-5-4 (Table 2). This was the reverse of the results with initial exposure to 32.5 C.

After exposure to either 12 or 30 initial days at 32.5 C, Nematex-22 did not show significant differences between these treatments (Table 1). This suggests that only 12 days of exposure to a soil temperature of 32.5 C may be needed to determine the response of tomato genotypes to race 1 of the root-knot nematode, *M. incognita*. By using only 12 days for the maximum initial exposure at 32.5 C, one could increase the number of plants screened per tank.

Egg mass production did not differ on

Table 1. Numbers of egg masses produced on tomato seedlings cv. Nematex-22 or PI 129149-2(sib)-5-4 inoculated with 200 *M. incognita* Race 1 (eggs and juveniles) per plant and then incubated for various lengths of intial exposure time at 32.5 C.

Incubation period (days)			
Initial period 32.5 C	Subsequent period 25 C	Egg masses per plant root system*	
		Nematex-22	129149-2(sib)-5-4
0	30	0.0 d	0.0 d
3	27	1.3 c	4.9 c
6	24	6.7 b	29.6 ab
9	21	6.9 b	21.1 b
12	18	12.5 a	38.1 a
30	0	16.0 a	24.9 b

*Values are the means of 12 replicates. Values in each column of egg masses not followed by the same letter differ significantly at $P = 0.05$ according to Duncan's multiple-range test.

Table 2. Numbers of egg masses produced on tomato seedlings cv. Nematex-22 or PI 129149-2(sib)-5-4 inoculated with 200 *M. incognita* Race 1 (eggs and juveniles) per plant and then incubated for various lengths of initial exposure time at 25 C.

Incubation period (days)		Egg masses per plant root system*	
Initial period 25 C	Subsequent period 32.5 C	Nematex-22	129149-2(sib)-5-4
0	30	16.0 c	24.9 ab
3	27	36.8 a	19.0 b
6	24	29.9 ab	26.0 a
9	21	24.1 b	6.8 c
12	18	12.9 c	6.3 c
30	0	0.0 d	0.0 d

*Values are the means of 12 replicates. Values in each column of egg masses not followed by the same letter differ significantly at $P = 0.05$ according to Duncan's multiple-range test.

PI 129149-2(sib)-5-4 when grown initially for 6, 9, or 30 days at 32.5 C (Table 1). Selection PI 129149-2(sib)-5-4 grown for 12 days at 32.5 C supported a higher number of egg masses than the treatment at 30 days, but the 12-day treatment was not significantly different from the 6-day treatment at this soil temperature. This higher variability compared with Nematex-22 may reflect higher genetic variation in *L. peruvianum* resulting from outcrossing due to self-incompatibility.

The six lengths of initial exposure time of Floradade to 25 C resulted in nematode reproduction varying from 108 to 102 egg masses, with no significant differences between treatments. In contrast, the number of egg masses produced by Nematex-22 and PI 129149-2(sib)-5-4 generally decreased as the number of days of initial exposure at 25 C increased (Table 2).

To quantitatively evaluate resistance in tomato when using an inoculum density of 200 *M. incognita*, it is necessary to maintain the inoculated plants at 32.5 C for the first 12 days of a 30-day incubation period.

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