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Response of Peach Scion Cultivars and Rootstocks to *Meloidogyne incognita in Vitro* and in Microplots[1]

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Abstract: The response of the peach scion cultivars, Jerseyqueen, Redhaven, Compact Redhaven, and Rio Oso Gem and rootstocks 'Lovell' and 'Nemaguard' to inoculation with *Meloidogyne incognita* was compared in vitro and in microplots. One or more parameters monitored in vitro correlated with at least one parameter monitored in microplots, 4 years after tree planting (1989). A range of responses was observed from highly susceptible in Lovell to resistant in Nemaguard. In vitro and microplot data suggest high and moderate levels of resistance to *M. incognita* in Compact Redhaven and Redhaven, respectively. Both Jerseyqueen and Rio Oso Gem were susceptible to *M. incognita,* but not as susceptible as Lovell. The response of self-rooted peach cultivars and rootstocks to *M. incognita* in vitro appears to be a reliable method for predicting the reaction of each to these nematodes under field conditions.

Key words: Meloidogyne, nematode, peach, *Prunus persica,* resistance, root-knot nematode, screening, tissue culture.

Tissue culture technology offers the potential for rapid selection of plants resistant to pests and plant diseases under laboratory conditions (4). These techniques have proven highly efficient for selection of peach (*Prunus persica* (L.) Batsch) for resistance to bacterial leaf-spot, *Xanthomonas campestris* pv. *pruni* (5–7). In 1989, an in vitro screening procedure was developed to test tissue-culture propagated peach cultivars for resistance to plant-parasitic nematodes (9). In this study, a nematode-resistant rooted plantlet was transferred to hormone-free medium and inoculated with *Meloidogyne incognita* (Kofoid & White) Chitwood. The nematodes penetrated the roots but failed to develop past the J3 or J4 life stage. The ability to detect root-knot nematode resistance on hormone-free medium suggested that this was a feasible screening technique.

To further test the feasibility of this screening procedure, the present study compared the response of several self-rooted peach cultivars and rootstocks to *M. incognita* in vitro and in field microplots.

Material and Methods

In vitro cultures: Peach rootstocks 'Nemaguard' and 'Lovell' and scion cultivars Rio Oso Gem, Jerseyqueen, Compact Redhaven, and Redhaven were propagated and rooted (6). Nematode inoculum was obtained from stock cultures of *M. incognita* race 3 maintained on sterile root explants of *Lycopersicon esculentum* Mill. cv. Rutgers (9).

Peach plantlets ca. 2 cm high with 1-cm-long roots were inoculated aseptically in vitro with five egg masses of *M. incognita.* Each combination of inoculated and uninoculated plantlets was replicated three times, with 3–5 plantlets per treatment. Plantlets were incubated in a growth chamber at 28 C under cool white fluorescent lamps (40 $\mu E \cdot s^{-1} \cdot m^{-2}$, 16-hour photoperiod). Shoot length, dry shoot weight, and dry root weight were recorded after 5 weeks. Shoots and roots were dried at 60 C for 24 hours in a convection oven. The number and size of galls on the infected roots was determined. Galls were determined to be "small" when <3 mm long and "large" when >10 mm long.

Microplot tests: After 8 weeks in pots in the greenhouse, peach trees propagated by tissue culture (3) were transferred to fiberglass microplots, 78 cm d, 3 m deep, and centered 3 m apart. The soil was a Keyport fine sandy loam (clayey mixed mesic Ultisol, 2% slope; pH 5.9–6.1). Six to

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10 trees per cultivar were planted in August 1985, one tree per microplot, and were inoculated in April 1986 with ca. 10,000 eggs and juveniles per tree. An equal number of uninoculated trees of each cultivar served as controls. Because of cold winter temperatures in Maryland, the nematodes did not overwinter, so each tree was re-inoculated each April as follows: 1987—ca. 25,000 eggs and juveniles; 1988—ca. 50,000 eggs and juveniles; 1989—ca. 75,000 eggs and juveniles.

All trees received applications of fertilizer and fungicide–insecticide treatments (8). Data were collected yearly on tree trunk diameter and yield per tree.

Nematode populations were monitored in April, late July, and October each year by collecting five soil cores at the tree dripline per microplot. Aliquots of soil, 100 g each, were processed by the sugar–centrifugation floatation technique (10), and the extracted nematodes were counted with a stereomicroscope.

Data analysis: Nematode counts were transformed using log (x + 1) before analysis. All data were subjected to an analysis of variance, and means were separated using least significant differences ($P \leq 0.05$) (11). Nontransformed data are presented in the tables and figures.

Results and Discussion

In vitro tests: The in vitro test results indicated that dry shoot and root weights were the most reproducible measurements for detecting differences between the control and infected plantlets. Shoot length varied within the cultivars and therefore was not as reliable a parameter.

Dry shoot ($P \leq 0.05$) and dry root weights ($P \leq 0.01$) of infected scion cultivars Jerseyqueen and Rio Oso Gem were significantly lower than the controls (Table 1). Furthermore, these two scion cultivars had large multiple galls, excess callus formation, and very reduced root growth. Infected Lovell had a greater dry shoot weight compared to the control, but the dry root weight was significantly less than the control because of excessive galling of this rootstock (Table 1). The dry shoot weight of infected and control Redhaven were similar; however, dry root weights of the infected plants were significantly less than the controls. The dry shoot and root weights of infected and control plantlets of Compact Redhaven and Nemaguard did not differ.

On the cultivars Jerseyqueen and Rio Oso Gem, large amounts of callus tissue formed around the galls, making individual gall counts impossible. The reaction of the plant roots to the nematodes was better measured by rating the galls based on size.

Microplot tests: Yield data were not collected in 1986 or 1987 because of poor fruit set on the young trees. In 1988, differences in growth and yield between infected and control trees were not apparent. However, in 1989, significant differences in tree diameter were observed between the control and infected Lovell and Rio Oso Gem, but not observed in the other cultivars (Fig. 1). Mean yields of infected Lovell were less ($P \leq 0.05$) than the controls, but this was not observed in the

Table 1. Dry weight of shoots and roots of in vitro propagated peach plantlets infected with *Meloidogyne incognita.*

Cultivar or root stock	Dry shoot weight (mg)				Dry root weight (mg)			
	Control	n†	Inoculated	n	Control	n	Inoculated	n
Jerseyqueen	457 ± 0.3	6	113 ± 0.4*	7	497 ± 0.2	6	310 ± 0.1*	7
Lovell	490 ± 0.7	6	525 ± 0.2**	9	446 ± 0.2	6	386 ± 0.2*	9
Redhaven	429 ± 0.2	4	438 ± 0.3	8	603 ± 0.3	4	335 ± 0.2*	8
Rio Oso Gem	545 ± 0.1	4	302 ± 0.3*	11	700 ± 0.2	4	332 ± 0.2*	11
Compact Redhaven	501 ± 0.1	6	478 ± 0.3*	8	601 ± 0.2	6	598 ± 0.3	8
Nemaguard	234 ± 0.1	6	367 ± 0.1	15	532 ± 0.1	6	631 ± 0.3	15

* ($P \leq 0.01$); **($P \leq 0.05$).
† n = number of plantlets per treatment.

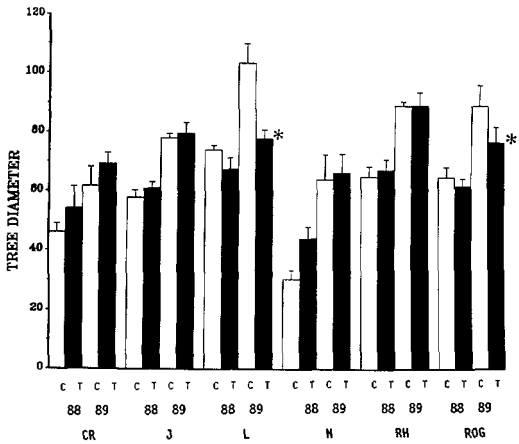

FIG. 1. Mean tree diameters (mm) of untreated (C) and *Meloidogyne incognita* infected (T) peach cultivars in microplots, 1988–89. COMP REDH—'Compact Redhaven'; JERSQ—'Jerseyqueen'; LOVE—'Lovell'; NEMA—'Nemaguard'; REDH—'Redhaven'; ROGI—'Rio Oso Gem'. *($P \leq 0.05$).

other cultivars (Fig. 2). No differences in tree diameter were detected between infected or control trees of Compact Redhaven (Figs. 1,2); however, yield of infected trees was higher ($P \leq 0.05$) than the controls.

Nematode counts were not significantly different between Jerseyqueen, Lovell, and Redhaven nor between Rio Oso Gem and Compact Redhaven. All counts were different ($P \leq 0.05$) from Nemaguard,

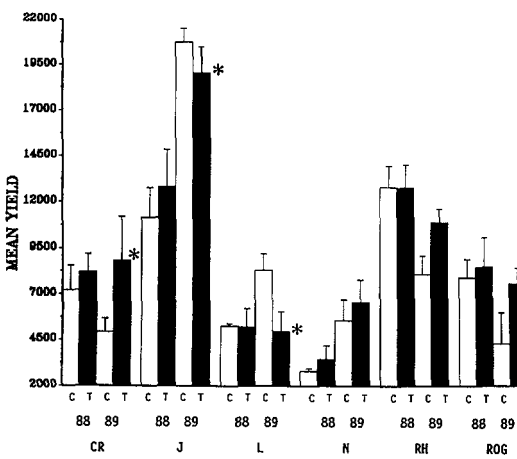

FIG. 2. Mean yields (g) of untreated (C) and *Meloidogyne incognita* infected (T) peach cultivars in microplots, 1988–89. COMP REDH—'Compact Redhaven'; JERSQ—'Jerseyqueen'; LOVE—'Lovell'; NEMA—'Nemaguard'; REDH—'Redhaven'; ROGI—'Rio Oso Gem'. *($P \leq 0.05$).

which did not support any nematodes. Nematode counts in October 1989 (Table 2) were similar to counts in October 1987 and 1988 (not shown). Nematode counts were never very high due to extremely dry summers, with the most representative counts reflected in October samples.

In comparing in vitro screening to field results, observations on size of galls caused by nematodes in vitro, together with shoot and root weights of infected plants, correlated with at least one parameter measured under field conditions, 4 years after tree planting (1989). A range of responses was observed from highly susceptible in Lovell to resistant in Nemaguard. Infected Lovell exhibited heavy galling and decreased root weights in vitro and high nematode counts, reduced yields, and decreased tree diameter in microplots, when compared with controls. While not as susceptible as Lovell, Jerseyqueen and Rio Oso Gem exhibited decreased root and shoot weights in vitro, high and moderate nematode counts, respectively, and either reduced yields or decreased tree diameter in microplots, when compared with controls. Moderate and high levels of resistance to *M. incognita* were exhibited by Redhaven and Compact Redhaven, respectively. Infected Redhaven exhibited decreased root weights and minimal galling in vitro when compared with controls, while in microplots, although high nematode counts were recorded, infected and control trees exhibited similar yields and tree diameters. Infected Compact Redhaven exhibited de-

TABLE 2. Number of *Meloidogyne incognita* juveniles recovered from microplots planted with in vitro propagated peach trees in October 1989.

Cultivar or rootstock	Juveniles†	n‡
Jerseyqueen	200 a	8
Redhaven	193 a	8
Lovell	133 a	8
Rio Oso Gem	98 b	7
Compact Redhaven	72 b	6
Nemaguard	0 c	8

Means not followed by the same letter are different from each other at $P \leq 0.05$ according to LSD.

† Juveniles per 100 cm^3 soil.

‡ Number of trees sampled.

creased root weights and minimal galling in vitro, and moderate nematode counts in microplots, when compared with controls. There was no difference between infected and control Compact Redhaven trees with regard to tree diameter, but infected trees produced significantly more fruit than controls. Infected and control Nemaguard did not differ in any of the parameters compared in this study.

The results suggest that the parameters observed in vitro 5 weeks after infection can forecast reactions of peach to *M. incognita* under field conditions. Although some differences between infected and control trees were detected after 3 years in the field (1988), differences became more apparent after 4 years (1989). Results reported herein for Lovell and Nemaguard are consistent with previous reports for these rootstocks (1,2).

This represents the first report on the response of self-rooted cultivars to *M. incognita* in microplots. None of the cultivars were as susceptible as Lovell and none were as resistant as Nemaguard. However, Compact Redhaven exhibited significantly greater levels of resistance compared with all cultivars, except Nemaguard, and the fruit production of infected trees was comparable to Nemaguard. Because Compact Redhaven exhibits a compact growth and cold tolerance (12), its potential as a peach rootstock warrants additional investigations.

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