Resistant Host Responses to Ten California Populations of Meloidogyne incognita

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Abstract: Resistant and susceptible cultivars of tomato, lima beans, cotton, and alfalfa were tested with 10 populations of *Meloidogyne incognita* from different California locations. Nine of the populations differed in aggressiveness on the nine cultivars tested. Two populations were especially aggressive toward resistant tomato cultivars. *Key Words:* resistant cultivars, tomato, lima bean, cotton, alfalfa, root-knot nematodes.

Tomato (*Lycopersicon esculentum*) cultivar 'VFN 8' has demonstrated resistance to *Meloidogyne incognita* and was grown on a moderate scale as a canning tomato before mechanized harvesting. An additional line, 'LA 1221,' was developed as a red cherry tomato with multiple resistance. Both cultivars are known to possess the *Mi* gene for resistance to *M. incognita*. Different populations of *Meloidogyne* spp. are known to vary in their capacity to attack host plants. Therefore, it was appropriate to test the susceptibility of these resistant tomato selections to populations of *M. incognita* from different areas of California (identified herein by source area). It would be of value also to compare the responses of other crop cultivars believed resistant to *M. incognita*, such as *Phaseolus vulgaris* [baby lima cultivar 'Mezcla' (7)], *Gossypium hirsutum* [cotton cultivar 'A 623 RNR' (8)], and *Medicago sativa* [alfalfa selection 'Ed-9'].

MATERIALS AND METHODS

Seeds were germinated and seedlings grown in sand in 19-cm-diam clay pots under greenhouse conditions and watered with one-half Hoagland's nutrient solution as needed. One month after germination, each susceptible seedling was inoculated with 1,000 second-stage larvae of a population of *M. incognita*, and each resistant seedling with 2,000 such larvae. Each treatment was replicated eight times, with one seedling per pot. The 10 *M. incognita* populations selected (Table 1) were all reared initially on susceptible tomato and found to give characteristic perineal patterns (2, 11). Populations giving deviant perineal patterns were discarded. Plants were harvested 1 month after inoculation, and the roots of each plant were evaluated qualitatively as galled or not galled. Galled roots were sampled for species confirmation, and the perineal patterns produced were consistently typical of *M. incognita*.

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TABLE 1. Number of plants whose roots were galled by different California populations of *Meloidogyne incognita*. A total of eight were examined for each cultivar.

Test plant	*Meloidogyne incognita* populations									
	Davis	Yountville	Santa Maria	Westley	Parlier	Davis Acrita	Tulare	Tustin	Arvin	Riverside
Tomato										
'VF 145' (S)	8	8	8	8	8	8	8	8	8	8
'VFN 8' (R)	1	8	0	5	0	1	0	0	1	0
'LA 1221' (R)	0	8	1	4	0	0	0	0	0	0
Cotton										
'SJ 2' (S)	8	6	0	8	8	8	8	8	8	8
'A 623 RNR' (R)	0	0	0	0	0	0	0	0	0	0
Baby Lima										
'Wilbur' (S)	8	8	8	8	8	8	8	0	8	8
'Mezcla' (R)	0	0	0	0	0	0	0	0	0	0
Alfalfa										
'Du Puit' (S)	8	8	8	4	8	8	0	4	8	8
'Ed-9' (R)	2	3	1	0	0	8	0	0	0	0

RESULTS

Table 1 shows the responses of resistant (R) and susceptible (S) lines of four plant species to infestations of 10 *M. incognita* populations. The susceptible tomato line was 100% infected by all 10 nematode populations. All plants of resistant tomato 'VFN 8' were galled by the Yountville population; none were galled by five of the populations; and the reaction of individual plants to four of the populations varied. All plants of the other resistant line, 'LA 1221,' were also galled by the Yountville population; none were galled by seven populations; and the reaction of individual plants to four of the populations varied. Repeated tests with the Westley and Yountville populations confirmed the initial findings. Galled resistant tomato plants repotted after indexing continued to grow until the nematode population increased enough to destroy the root system.

Resistant cotton and lima beans were not galled by any of the nematode populations. All plants of the susceptible cotton were galled by eight of the populations; none were galled by Santa Maria; and the reaction of individual plants to the Yountville population varied. Susceptible lima bean was galled only by the Tustin population.

All plants of the susceptible alfalfa were galled by seven populations; none were galled by Tulare, and the reaction of individual plants to Westley and Tustin varied. All plants of the resistant alfalfa were galled by Davis Acrita; none were galled by six populations; and the reaction of individual plants to six populations varied.

DISCUSSION

These observations with resistant tomato selections are consistent with observations Netscher (5) made on field populations of *M. incognita* from Africa that attack and reproduce on tomato varieties resistant to *M. incognita*. The genetics of tomato resistance have been developed primarily with single populations of *M. incognita*. Resistance appears to be controlled in tomato primarily by a single dominant gene, *Mi*, brought into varieties of *L. esculentum* by cross-breeding with *L. peruvianum* (1, 3, 4, 6, 9, 12). The issue is not yet settled, however, since Barham and Winstead (1) suggested that the *Mi* gene was incompletely dominant, whereas Harrison (4) suggested that resistance was controlled by a dominant gene or a block of genes acting as a unit. Sidhu and Webster (10), from work with three resistant tomato varieties, concluded that resistance was controlled by single dominant genes in two of the cultivars and by a single recessive gene in the third cultivar. Whether the genes were alleles or located at different loci was not established. The two resistant tomato lines 'VFN 8' and 'LA 1221' responded to five of the ten nematode populations in identical fashion: none galled by four, and all galled by Yountville. *L. peruvianum* supplied the resistance gene *Mi* in both normal tomato 'VFN 8' and red cherry tomato 'LA 1221.' Because the lines differ in response to five nematode populations but are identically susceptible to Yountville, it is difficult to think solely in terms of an *Mi* gene (3), a block of genes acting as a unit (4), or $LMiR_n$ genes (10). Cultivars 'VFN 8' and 'LA 1221' are known to be homozygous, so other factors or modifier genes may be involved in the unconditional resistance of tomato cultivars to the nominal species, *M. incognita*. Variations in percent roots galled suggest that such populations may be heterogeneous with respect to aggressiveness.

No population galled resistant cotton cultivar 'A 623 RNR,' having resistance that is not simply inherited (R. L. Shepherd, unpublished), or resistant baby lima cultivar 'Mezcla,' having resistance from four sources. The susceptible varieties demonstrated that nematode populations differ in aggressiveness. Santa Maria, which had no difficulty with susceptible tomato 'VF 145,' baby lima 'Wilbur,' or alfalfa 'Du Puit,' was ineffective on susceptible cotton, whereas Yountville, which had no difficulty with susceptible or resistant tomatoes or susceptible baby lima and alfalfa, was only partially effective on susceptible cotton. Tustin, which had no difficulty with susceptible tomato or cotton and little difficulty with susceptible alfalfa, was ineffective in galling susceptible baby lima. In susceptible alfalfa, Tulare was ineffective, whereas Westley and Tustin were partially effective. Results are less conclu-

sive with resistant alfalfa 'Ed-9.' Some confidence can perhaps be placed on its resistance to six populations and susceptibility to Davis Acrita, though partial resistance must be discounted since the original selection 'Ed-9' is partially segregating.

According to the data (Table 1), the Parlier population seems identical to the Riverside population. Thus, nine of the ten populations appear to differ in aggressiveness by the overall responses of eight lines of the four plant species, excluding the all-susceptible 'VF 145' tomato. Conversely, the mechanism by which resistance is expressed in the four plant species may be different for nine differing populations of the nominal species, *M. incognita.*

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