

Nematode Resistance in Peaches

resistance to two widespread species of root-knot nematode ranged from almost immunity to none in peach seedling study

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Two species of gall-forming root-knot nematodes—*Meloidogyne incognita* var. *acrita* and *M. javanica*—seem to be the most widespread of several kinds that parasitize California peaches. Consequently, first efforts toward selection of nematode-resistant rootstocks have been directed against these nematodes.

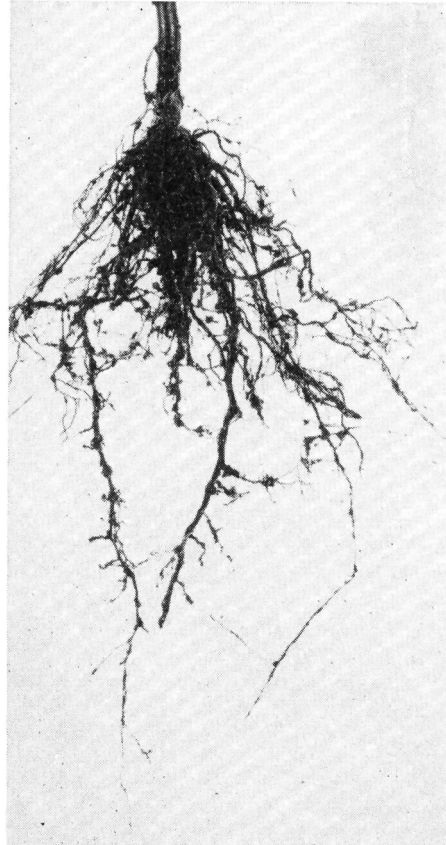
The old nematode resistant rootstocks—Shalil, Bokhara, and Yunnan—are resistant to *M. incognita* var. *acrita*, but susceptible to *M. javanica*. Seedlings of a newer rootstock—S-37—have been reported to be resistant to *M. javanica*.

Studies were made of the reaction of some of the resistant rootstocks and of the reaction of peach seedlings bred at Davis to these two root-knot nematode species.

Populations of each nematode species were established in galvanized iron greenhouse tanks filled with sterile soil. To infest the soil, grape roots infected with *M. incognita* var. *acrita* were placed in one tank and Shalil peach roots infected with *M. javanica* in the other. Nematode populations were increased by growing tomatoes. A uniform nematode population density was obtained by mixing the contents of each tank before planting peaches. Subsequent examinations indicated that *M. incognita* var. *acrita* was the only species present in one tank. Similar examinations made later showed a small admixture of *M. hapla* in the *M. javanica* tank. *M. hapla* is not known to reproduce on peach and was present in the tank in comparatively low density. Therefore, it is not believed to have greatly influenced the results obtained.

Duplicate lots of open pollinated seedlings of Shalil, Dwarf Hybrid No. 7, S-37, and Lovell were exposed to infection with *M. incognita* var. *acrita*. Each lot varied in number from seven to 20, usually 15 to 20. Seventeen F₂—second generation—populations of Bokhara crossed with white flowering peach, Snowball variety type, were also tested in this tank. Exactly the same progenies were used in the *M. javanica* tank—which also contained *M. hapla*—as were used in the other tank.

The peach seedlings were germinated in sterile sand and transplanted into the tanks in June 1955. They were dug and graded in November 1955, with the



Roots of a peach seedling severely injured by *Meloidogyne javanica*, a root-knot nematode.

amount of infection ranked in six classes: 0—no galls found; 1—very slight infection, usually one or two galls only; 2—slight infection, a few galls; 3—moderate infection, galls plentiful, but the roots not appreciably distorted or limited; 4—severe infection, many galls, the root system usually somewhat distorted or limited in growth; and 5—very severe infection, the root system with many large galls, distorted, and usually much limited in growth. This scoring method produces results which correlate well with gall counts. It has the advantage of allowing a large number of seedlings to be scored in a short time. An indication of vigor was also obtained by measuring the height of each seedling.

Seedlings of Shalil and S-37 were found to be immune or highly resistant to *M. incognita* var. *acrita* and were graded 0 for amount of infection. All Lovell seedlings were very seriously in-

Relative Resistance of Several Kinds of Peach Seedling to Two Species of Root-knot Nematodes

	<i>M. incognita</i> var. <i>acrita</i> tank		Ave. grade of infection in the <i>M. javanica</i> tank
	No. of seedlings given the following grades:		
	Grade 0	Grade 1-5	
Lovell	0	16	3.3
Shalil	39	0	2.6
S-37	28	0	2.8
Dwarf Hybrid No. 7	28	9	2.3
F ₂ progenies of (Bokhara x White flowering peach)			
54.48	5	2	2.0
54.49	17	3	1.5
54.50	18	3	1.9
54.51	18	2	2.4
54.52	17	1	2.5
54.55	5	1	2.5
54.57	38	1	2.8
54.60	15	1	2.3
54.47	20	0	1.6
54.53	20	0	2.7
54.54	19	0	2.6
54.58	20	0	1.9
54.59	7	0	2.3
54.61	20	0	1.9
54.62	20	0	2.7
54.63	20	0	2.3
54.259	21	0	2.0

Grades: 0—no galls; 1—very slight infection; 2—slight infection; 3—moderate infection; 4—severe infection; 5—very severe infection.

fectured—with an average grade of 4.6. The Dwarf Hybrid No. 7 seedlings segregated for resistance, nine of 37 being infected. Nine of the 17 F₂ hybrid populations were uniformly resistant to this nematode—grade 0—while eight segregated for resistance. The segregating populations give 133 resistant seedlings—grade 0—and 14 susceptible ones. In the segregating populations infection of the susceptible seedlings was usually severe—over two thirds graded 3-5.

Two facts were noticed: 1, open-pollinated—usually self-pollinated—seedlings of Shalil, S-37, and several hybrid populations gave only resistant seedlings; and 2, the degree of infection in susceptible seedlings of segregating populations is generally serious, but not usually so serious as is the infection in the uniformly susceptible Lovell seedlings.

The Lovell seedlings in the *M. incognita* var. *acrita* tank attained a height of only 29.3 cm—centimeters—compared to 103.5 cm for Shalil, 71.9 cm for S-37,

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Gains of Two Types of Lambs

Suffolk-Corriedale crosses gained faster and weighed more at weaning than Corriedale crosses during comparative study

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Suffolk-sired lambs from grade Corriedale ewes gained faster than Corriedale-sired lambs during a three-year study at the Hopland Field Station. Also, male lambs were heavier than females within their own breed.

Suffolk-sired wether lambs weighed an average of 8.0 pounds more than Corriedale wethers at weaning time. Suffolk-sired ewe lambs weighed an average of 6.5 pounds more than Corriedale ewe lambs.

Suffolk wethers averaged 5.5 pounds more than Suffolk ewe lambs and Corriedale wethers averaged 3.0 pounds heavier than ewe lambs of the same breeding.

Under the flock improvement program at Hopland, the best ewes are bred to the Corriedale rams for production of breeding flock replacements. The remaining ewes are bred to Suffolk rams for the production of market lambs. The two types of lambs used for the three-year study were the result of that breeding program.

The purpose of the study was to determine which of the two breeds produce heavier lambs at weaning time. However, there are factors other than lamb weights which must be considered when deciding which of the two breeds would fit better into any given operation.

One such consideration is the comparative initial cost of the rams. Records

of ram sales during the years 1952-1955 show that Corriedale rams were purchased at approximately half the price of Suffolks.

Another consideration is the comparative breeding life of the rams. The average period of high productivity for Suffolk rams under range conditions is believed to be approximately two to three years. Corriedale rams, under similar conditions, are believed to maintain their productivity for approximately six years.

Taking the initial cost and the productive life of the two breeds of rams into consideration, the cost to produce a Suffolk-cross lamb is much greater than the cost to produce a Corriedale-cross lamb. Converting the cost difference

back into pounds of lambs produced, the difference between the two breeds is very slight.

Another factor involved is whether or not the operation includes raising replacements or purchasing them from an outside source. If replacements are to be raised—by breeding the entire flock to Corriedale or other whiteface rams—a greater selection can be made for flock improvement. At least half of the flock should be bred to these rams to insure a sufficient number of replacement ewe lambs. This plan, however, allows only a limited degree of selection.

The plan of raising flock replacements has advantages, including flock improvement by selection for greater wool production, larger lambs, and a higher percentage of twins. Furthermore, the usual possibility of importing disease and parasites from outside sources is entirely eliminated.

Results obtained in this study indicate that the Suffolk-cross lambs are faster gainers and weigh more at weaning time than Corriedale-cross lambs.

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A Comparison of Weaning Weights of Suffolk-Sired and Corriedale-Sired Lambs During a Three-Year Study

Breed	Males	Females	Sex difference
May 22, 1952			
Suffolk	70.1	65.4	4.7**
Corriedale	60.1	58.5	1.6**
Breed difference ..	10.0**	6.9**	
June 9, 1953			
Suffolk	79.7	74.9	4.8**
Corriedale	73.0	68.2	4.8**
Breed difference ..	6.7**	6.7**	
June 7, 1954			
Suffolk	73.6	69.5	4.1*
Corriedale	67.6	63.8	3.8**
Breed difference ..	6.0**	5.7**	

* Significant at the 5% level.
** Significant at the 1% level.

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and 66.6 cm for Dwarf Hybrid No. 7. The vigor of the F₂ hybrid populations varied but many of them made satisfactory growth.

No seedling was found free of galls in the *M. javanica* tank but the populations showed considerable variation in average severity of infection. Therefore, average grade of infection was used as a measure for resistance.

Open pollinated seedlings of commercial and experimental peach stocks graded: Shalil, 2.6; Lovell, 3.3; S-37, 2.8; and Dwarf hybrid No. 7, 2.3. The 17 F₂ hybrid populations averaged 2.2 and individual populations ranged from 1.5 to 2.8.

The Lovell seedlings in the *M. javanica* tank attained a height of only 19.5 cm compared to 50.9 cm for Shalil, 38.9 cm for S-37, and 40.7 cm for Dwarf Hybrid No. 7. The vigor of the F₂ hybrid population varied, but many of them made satisfactory growth.

The results of the study indicate that a high degree of resistance, if not immunity, to *M. incognita* var. *acrita* is present in commercially available peach rootstocks such as Shalil and S-37. Resistance is also easily secured by hybridization or selection. Clones showing no segregation in their seedlings should be used for stock purposes.

No peach stock tested has shown a similar degree of resistance to *M. javanica*. However, seedlings from some clones showed a much lower average degree of

infection than those of other such clones. Further selection among seedlings and their progeny may enable production of highly resistant individuals.

Lovell, a widely used source of rootstocks, gave seedlings that were very susceptible to both nematode species. These seedlings proved to be more susceptible to *M. javanica* than the resistant commercial stocks and were uniformly very seriously infected by *M. incognita* var. *acrita*.

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