Susceptibility of Rootstocks To the Citrus Nematode

Restrictions placed by the EPA on nematicides used in California citrus have increased the importance of developing nematode-tolerant rootstocks. This article discusses 25 stocks and their reactions to the pest. Authors are C.D. McCarty, W.P. Bitters, and S.D. Van Gundy, all of University of California, Riverside.

THE CITRUS nematode exists in all citrus-growing areas of the world and can be one of the limiting factors in fruit production. All common species of citrus are susceptible to the citrus nematode.

However, the trifoliate orange, a near citrus relative, possesses a high degree of resistance to this nematode. Dr. J.W. Cameron and his co-workers at UCR's Citrus Research Center, have hybridized true citrus species with trifoliate orange to produce hybrids, some of which are resistant to nematodes, to be used as citrus rootstocks. Dr. R.C. Baines, also at UCR, discovered the existence of four biotypes of the citrus nematode which differ from one another only in their host preference for different citrus and related species.

Long-term screening trials to find citrus rootstocks tolerant to tristeza virus have been carried out by personnel at UCR. It would also be of benefit if citrus rootstocks were resistant to citrus nematode and to various root rot-causing organisms. Twenty-five rootstocks which have shown tolerance to tristeza, or might be useful as rootstocks for lemons although susceptible to tristeza when budded to other species of citrus, have been tested for their tolerance to three biotypes of the citrus nematode.

Materials and Method of Testing

Seeds of the rootstock to be tested were planted in heated germinating beds early in the spring. When the plants had grown to sufficient size they were transplanted to one gallon containers and moved into a greenhouse where the temperature was held at 80° F. Each rootstock variety was replicated 14 times in each treatment with each replicate consisting of a single plant. Seven replicates were inoculated with nematode eggs and larvae while seven replicates served as uninoculated controls.

Three nematode biotypes were used, each one being kept separate. The soil around individual potted plants was inoculated in mid-November with a mixture totaling 8,000 nematodes and eggs per pot. To increase the infestation the soil in the pots was reinoculated the following February with a mixture of 3,600 eggs and larvae. In the second inoculation the proportion of eggs to larvae for biotype 1 was 55 percent eggs, for biotype 2 - 53 percent eggs, and biotype 3 - 30 percent eggs.

Under a favorable temperature and nutrient regime, the plants grew vigorously. Some, such as the rough lemon varieties and alemow *(C. macrophylla)* reached the top of the greenhouse. Because of this rapid growth all plants were cut back in June to a height of 14 inches above the soil level. This pruning may have had an adverse effect on subsequent root and top growth making plant weight so variable that only counts of female nematodes infesting the roots were used as the criteria for rootstock tolerance. Or it may have been that the roots became potbound and growth was affected to the point where differences could not be expressed by plant weights.

One year after the second inoculation the plants were removed from the pots and the roots carefully washed. Duplicate 2-gram samples of the feeder roots of each were taken for nematode counts using a technique developed by Baines.

In brief, the roots were stored in Lacto-Phenol-Acid fuchin which stained the body of the nematode. After soaking for several days, each root sample was placed in a food blender with 200 ml of water and run at high speed for ten seconds to dislodge the nematodes. The contents of the blender were rinsed onto a 100 mesh screen with a 325 mesh screen beneath it. The root debris was stopped by the 100 mesh screen while the nematodes passed through it and were caught on the 325 mesh screen. The nematodes were washed into a beaker with water which was brought

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TABLE 1. Infestation of citrus nematode, *T. semipenetrans*, on the roots of citrus rootstock seedlings.

	Nematode Count - Biotype 1			Nematode Count - Biotype 2			Nematode Count - Biotype 3		
	Selection	Mean		Selection	Mean		Selection	Mean	
1	*Khasi papeda(Latipes)	6708	A[y]	Khasi papeda	3117	A[y]	Konejime	3345	A[y]
2	*Alemow(Macrophylla)	3555	B	C-32 citrange	2297	AB	Khasi papeda	3333	A
3	Miaray	3410	BC	Carrizo citrange	2209	ABC	Tosu	3276	A
4	*Kikudaidai(Omaliculata)	3178	BCD	Estes rough lemon	1880	ABCD	Carrizo citrange	3252	A
5	Estes rough lemon	3157	BCD	Troyer citrange	1726	ABCD	Rangpur lime	2158	AB
6	Rangpur lime	2556	BCDE	Alemow	1407	BCDE	Troyer citrange	2146	AB
7	Yuma Ponderosa lemon	2476	BCDE	Yuma Ponderosa lemon	1214	BCDE	Nasnaran	2079	AB
8	Konejime	1987	BCDEF	Kikudaidai	1202	BCDE	India lemon	2032	AB
9	Nasnaran(Amblycarpa)	1906	BCDEF	Hanaju	1050	BCDE	Kikudaidai	1740	ABC
10	Carrizo citrange	1888	BCDEF	Konejime	951	CDE	Miaray	1706	ABCD
11	Tosu	1884	BCDEF	Rangpur lime	924	CDEF	Yuma Ponderosa lemon	1599	BCD
12	Troyer citrange	1802	CDEF	Miaray	907	DEF	Limoneira rough lemon	1447	BCDE
13	Shunkokan	1672	DEF	Tosu	864	DEF	C-32 citrange	1393	BCDE
14	C-32 citrange	1472	EF	Nasnaran	861	DEF	Alemow	1232	BCDE
15	H-56 tangor	1209	EFG	Limoneira rough lemon	774	DEF	H-56 tangor	1188	BCDE
16	*Hanaju	1188	EFG	Kinkoje	689	DEF	Estes rough lemon	1157	BCDE
17	Limoneira rough lemon	1138	EFG	India lemon	592	EF	Hanaju	1124	BCDE
18	Kinkoje(Obovoidae)	912	FG	Argentine sweet orange	588	EF	Kinkoje	1027	BCDE
19	India lemon	839	FG	Cleopatra mandarin	477	EFG	Cleopatra mandarin	745	CDEF
20	Argentine sweet orange	775	FG	H-56 tangor	433	EFG	Argentine sweet orange	601	DEF
21	Cleopatra mandarin	447	G	Shunkokan	186	FGH	Shunkokan	520	EFG
22	C-35 citrange	2	H	Rubidoux trif. orange	50	GH	Rubidoux trif. orange	139	FGH
23	Swingle citrumelo sdlg.	<1	H	C-35 citrange	10	H	C-35 citrange	60	GH
24	Pomeroy trif. orange	<1	H	Swingle citrumelo sdlg.	<1	H	Pomeroy trif. orange	3	H
25	Rubidoux trif. orange	<1	H	Pomeroy trif. orange	<1	H	Swingle citrumelo sdlg.	<1	H

[y]Mean separation by Duncan's multiple range test at 1% level. Varieties with letters in common are not significantly different from each other.

*For lemons only, not tolerant to tristeza.

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A Season

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competition with the Japanese satsumas and with the other tangerines; we have an edge because of our flavor and our comparative seedlessness. I doubt that we will ever see any big acreages again, but we could still make profits on considerably more of them than we are now producing."

Much of the return to planting in the Valley will depend on the capabilities of the remaining nurseries. As the planting boom waned, many of them went out of business while others turned their attention to the demand for backyard plantings and growing replacements on order. Now replacement orders are coming faster then existing facilities can handle them, and some nurserymen are already looking at 1981 instead of 1980 deliveries.

"All in all," one of them reported, "this may not be such a bad thing. We have booms in this business on a regular basis and a grower is in such a hurry that he doesn't consider his choices. This has produced quite a few fiascos because of lack of planning. Now the industry will have to take the time to plant, because he can't dive right in without trees to plant."

Susceptibility

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to a volume of 100 ml. The 100 ml in the beaker was vigourosly agitated with a magnetic stirrer and two, 5 ml aliquots were removed for nematode counts which were made at 30x magnification.

Results

Duncan's multiple range test was used to test for significant differences as to nematode tolerance between the varieties. Results of the nematode counts are shown in Table 1. While there are significant differences in these counts the infestations were so great that none of the true citrus varieties, or those of the Papeda group (Khasi papeda, alamow) could be called nematode-tolerant. One variety, Khasi papeda, had such a high nematode infestation, especially of biotype 1, that it was considered highly susceptible. Four of the rootstocks tested, Rubidoux and

Pomeroy trifoliate orange, Swingle citrumelo seedling No.4475 and C-35 citrange were low enough in nematode infestation to be considered nematode-tolerant. In general, nematode infestation of each rootstock, relative to each biotype, was similar with the exception of biotype 3 which was more pathogenic to trifoliate orange.

Texans

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In addition, most of the early and midseason orange varieties had been harvested and Valencias were getting a great deal of attention following the December frost. Because of the high juice prices, growers had started picking early in damaged groves and TCX was already starting to process them in higher than usual volume.

During the January 2-3 period, temperatures as low as 19 were recorded in the Valley and in general stayed below freezing for 12-14 hours. "In other years, this would have been a total disaster and we might have been looking a few years down the road for our next crop," Fankhauser stated.

"This time, we were lucky but we were also better prepared. We had good weather after the freeze for salvage, but we also had the facilities for handling the fruit that was there. We have had a good spring to allow for recovery but we now know more about handling the trees.

"Following a freeze in Texas, the crepe hangers are usually out the next day writing us off for the next few years, but this is just not the case. We will be back this year with a pretty good crop and hopefully back to normal the following season."

Mutual Names Inman

JACK W. INMAN, 45, of Reedley, has been named Manager of Grower Relations for California Citrus Mutual.

The announcement was made by CCM President Adin A. Hester who pointed to Inman's lifelong association with the citrus industry as outstanding qualifications for the Mutual position.

Most recently, Inman was public relations manager for the Orange Cove-Sanger Citrus Association. Prior to that he served eight years as the San Joaquin Valley grower relations representative for Sunkist Growers, Inc.

Following his 1958 graduation from Cal Poly, Pomona, with a citrus fruit production major, Inman served a brief stint with the USDA as a soil scientist. He then joined the Sunkist organization in the Orange Products Division at Ontario.