IT IS A LONG ROAD FROM THE FINDING OF A NEW ROOTSTOCK TO THE REPLACEMENT OF A SOIL FUMIGANT

by
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Culminating eight years of small plot evaluations we recently reported the finding of three grape rootstocks with "broad nematode resistance." Our first four years were spent identifying the nematode susceptibilities of existing rootstocks (see Table 1). Meanwhile, Dave Ramming of the USDA Plant Breeding Station in Fresno, CA was in possession of more than 500 mature vines that had been collected over decades and occasionally submitted to various screenings. Knowing our specific needs, we set out to find sources of resistance to three very aggressive Meloidogyne populations. Our definition for resistance is a lack or near lack of reproduction by the nematode on the cultivar over a two-year period. Thirteen of the USDA cultivars met our objective so we looked further to identify, one species at a time, the breadth of their resistance to each of the other common nematode species on grape in California.

The notion that these three rootstocks or any others will replace methyl bromide is premature. First, methyl bromide solves the replant problem by killing nematodes and most everything else in soil. Although these rootstocks do not permit nematode reproduction they may not stop nematode feeding. Since remnant grape roots can survive in soil as much as a decade after vine removal, there can be an abundant supply of nematodes and viruses in the proximity of newly planted grape roots.

To answer the question of how well these potential rootstocks replace soil fumigation, at least three additional screenings are needed. First, using four or five different replant soils, how well do the rootstocks grow compared to nonreplant or fumigated soil? This test is now underway. Second, do these rootstocks tolerate nematode feeding? Tolerant rootstocks are the ones that grow as well in the presence of nematode feeding as in their absence. Freedom and Ramsey grape rootstocks, for example, actually grow significantly better (35%+) in the presence of limited nematode feeding. By contrast, cultivars of *V. vinifera*

commonly grow significantly less (12-50%) in their first year of exposure to nematode feeding. The third screening should be across a variety of common soil pests including Phylloxera *Daktalosphaeria vitifoliae*, Phytophthora spp. and *Armillaria mellea* as well as their performance in droughty soils, calcareous soils, shallow soils, etc. It has been our experience that field-level rootstock trials can go on in abundance for decades and provide only partial answers to specific soil and pest questions. We need to be more efficient at learning the limitations of rootstocks.

If there is inadequate resistance or tolerance by the rootstock to the replant problem, growers will continue to need either strip or spot treatments of soil fumigant before planting. Or, with broad nematode resistance planted to primarily nematode problem sites we may be able to use "softer" pre-plant treatments. For example, growers with an existing dripper system may be able to apply products at biocidal rates to mitigate some of the replant problem and then rely on broad nematode resistance for the lifetime of the vineyard. One point to be remembered is that resistance to nematodes is a helpful tool once the vineyard is established but there are no examples of it being useful in solving replant problems where vineyards or orchards are removed one year and replanted the next. The second point is that there are no universally acceptable rootstocks, whereas soil fumigants have a history of very broad acceptance among a range of high-value crops.

Table 1. Susceptibility or resistance of various grape cultivars to various nematode populations.

	Populations of *Meloidogyne* spp.									*Xiphinema* spp.				
Rootstock	Mi	Mj	Mm	Ma pt H	Ma pt F	Mc-L	Mc-D	Pv [1]	Ts [2]	Xi	Xa	Xc-1	Xc-2	Cx [3]
Ramsey	R	R	R	HS	HS	S	R	R	S	9	71	-	-	100
Freedom	R	R	R	HS	HS	R	S	SS	S	2	10	S	-	50
Dogridge	R	R	R	HS	HS	-	-	S	S	24	15	-	-	123
1613C	R	R	MR	HS	HS	S	S	SS	S	7	72	-	-	164
Harmony	MR	R	R	HS	HS	S	S	SS	S	24	52	-	-	35
Teleki 5C	SS	MR	S	HS	HS	-	-	S	S	9	72	-	-	65
Oppenheim-4	SS	MR	S	S	-	-	-	S	S	6	43	-	-	65
Schwarz.	S	MR	S	HS	HS	-	-	SS	S	5	13	-	-	42
039-16	S	S	HS	S	S	-	-	S	S	2	5	S	-	-
99R	HS	S	S	S	-	-	-	S	SS	54	28	-	-	71
3309C	HS	S	HS	HS	HS	-	-	SS	S	20	44	-	-	136
Thomp. S.	S	S	HS	HS	S	S	HS	S	S	100	100	100	-	100
Flame S.	S	S	HS	S	S	S	S	S	S	154	32	-	-	185
Rubired	S	S	S	S	-	-	R	S	SS	365	51	-	-	59
K51-32	R	SS	S	S	-	-	-	R	S	2	52	-	-	272
Grenache	-	-	-	-	-	-	-	-	-	-	-	-	-	251
USDA Selections														
6-19B	R	R	R	SS	-	R	MR	R	R	15	2	1	30	12
10-17A	R	R	R	R	-	R	R	R	R	2	-	1	16	24
10-23B	R	R	R	R	-	R	R	R	R	5	-	1	7	19
Ramsey x Schwarzmann Selections														
RS-9	R	R	R	R	R	R	R	-	-	-	-	-	-	-
RS-3	R	R	R	SS	-	-	-	-	-	-	-	-	-	-

Resistant	R = <0.2 nematodes/gr root
Moderate resistance	MR = 0.21 to 0.6 nematodes/gr root
Slightly susceptible	SS = 0.61 to 3.0 nematodes/gr root
Susceptible	S - 3.1 to 180 nematodes/gr root
Highly susceptible	HS = 180+ nematodes/gr root

- = no data

For ectoparasites population buildup is expressed as a percentage of that level built up on Thompson Seedless. Levels of 100 are normal, levels of 10 or less indicate resistance.

[1] *Pratylenchus vulnus*

[2] *Tylenchulus semipenetrans*

[3] *Criconemella xenoplax*