Development of Nematode/Rootstock Profiles for 40 Rootstocks with the Potential to be an Alternative to Nemaguard

Project No.: **07-PATH2-McKenry**

Project Leader: Michael McKenry
USDA – ARS
Kearney Ag Center
9240 S. Riverbend Ave.
Parlier, CA 93648
(559) 646-6500
McKenry@uckac.edu

Project Cooperators: Roger Duncan, Farm Advisor, UCCE Stanislaus County
Paul Verdegaal, Farm Advisor, UCCE San Joaquin County

Objectives:

1. Establish a 150-day screen in field settings using 40 Prunus rootstocks against root-lesion nematode*, Pratylenchus vulnus,* and root-knot nematode, *Meloidogyne incognita* race 3.
2. Establish a three to five month greenhouse screen to determine the sensitivity of approximately 40 Prunus rootstocks to the rejection component that remains after nemaguard rootstock.
3. Evaluation of approximately 40 rootstocks against the rejection component in sand with or without ring nematode. This evaluation is expected to require two to three years.
4. Quantify nematode population levels present in various field settings where some of these rootstocks are already receiving horticultural evaluation.

Interpretive Summary:

At the time of this report we have completed a series of 2-year assessments that characterize host status of 40 different *Prunus* rootstocks grown in the presence of three important nematode genera. The resulting nematode-*Prunus* profiles provide information about *Prunus* parentages to avoid, those that provide resistance and a ranking of those that fall between these two host status levels. The most recent half of our ring nematode evaluations will continue until June 2008 as we collect ring nematode data out beyond 2 years. The rootstocks of greatest interest with regard to ring nematode data sets are Hansen 536 and Viking. The reason is that we are getting counts from longer-term farm advisor field trials that are in opposition to our 2-year studies. We need to confirm that these discrepancies are or are not related to longevity

of the experiments. For each of the different nematode genera there is included as a standard, seedlings of Lovell, Nemaguard and Pistachio.

In this report we present the profiles for root-knot nematode *Meloidogyne incognita,* a population that is rather aggressive to *Prunus* spp., root-lesion nematode, *Pratylencuhus vulnus,* and ring nematode, *Criconemoides xenoplax* (= *Mesocriconema xenoplax*). Our ring nematode population is from Parlier, CA and we have demonstrated it to be one of the more aggressive ring nematode populations when compared to coastal populations or to populations from Fresno or Livingston, CA.

Root-knot nematode - Table 1 depicts the relative host status of these rootstocks against root-knot nematode. Most notable is resistance to this nematode (<0.2 nematodes/gram of root after 2 years) is available to the first 30 rootstocks listed. Rootstock Empyrean 101 exhibits moderate resistance (0.21 to 0.6 nematodes / gram of root after 2 years). The remaining 9 rootstocks we refer to as susceptible (0.61 to 180 nematodes / gram of root). However, we also note there is a root-knot resistance mechanism in at least two of the 9 susceptible rootstocks that can in specific instances be counted upon for useful resistance. Rootstocks Krymsk 1 and Guardian exhibit susceptibility to root-knot at their root terminous but as roots age (60 to 80 days) galls are not found on older wood, thus this resistance mechanism has value if the field is relatively free of nematodes when the young trees are planted. For example, if these two rootstocks were replanted following Nemaguard in a relatively weed-free setting, they would not receive much root-knot nematode pressure and can be expected to perform quite well relative to this genus of nematodes. By comparison, Lovell rootstock when attacked by root-knot nematode will support nematodes on younger and older wood thus resulting in much higher nematode build-up and tree damage.   In fact, one can find active root galls on Lovell roots that are five years of age.

Beyond direct damage by root-knot nematode, we are interested in root-knot resistant rootstocks that gain their resistance from parentage other than Nemaguard. To this end, rootstocks such as Hansen 536, Bright's Hybrid-5, Empyrean 1, Viking, Lovell and Nemaguard were tested for their tolerance to the rejection component of the replant problem. This is accomplished by replanting one year after Nemaguard has been treated with Roundup and the land then fumigated or not. It is Hansen 536 that grows the same whether fumigated or not. These findings were presented in last year's report as tolerance to the rejection component of the replant problem. We refer to this overall strategy as "Starve the soil ecosystem, replant different rootstock parentage".

Root-lesion nematode - Depicted in Table 2 are three rootstocks with resistance to *P. vulnus*. None of these three is suitable as a rootstock for almond. The next three to five rootstocks listed exhibit moderate resistance. This means the protection they offer may eventually be broken in field settings but their parentage should receive attention in future breeding programs. It is noteworthy from the position of Nemaguard in Table 2 that there are *Prunus* rootstocks that support 5 to 10 times as many *P. vulnus* / gram of root. With regard to this nematode, the almond and stone fruit industries of California have been provided a modicum of relief against *P. vulnus* through their use of Nemaguard.

In Table 2 we compare the host status of various rootstocks that farm advisors have planted out in randomized replicated trials elsewhere in the state and *P. vulnus* happened to be present. One example comes from a 3-year old planting and the other from a 7-year old planting. It is apparent that among this grouping of rootstocks, Nemaguard typically supports fewer *P. vulnus* per gram of root than many other selections under study. Root systems that are pronounced resistant, the first three listed, tend to stay that way in field settings but we currently have only one five-year example to verify this resistance in field settings. Unfortunately, none of the three top rootstocks against *P. vulnus* is suitable for almond production and the next few listed are peach x almond hybrids that generally have the failing of being quite susceptible to ring nematode, thus the Bacterial Canker Complex.

Ring Nematode

Depicted in Table 3 are the mean nematode counts collected from two separate two-year tests. Each tree of each rootstock listed received nematode sampling at 6-month intervals or at least three different times during each 2-year study. This may not be enough sampling because there are examples where the data from our 2-year examination do not correlate well with farm advisor examinations collected 3 to 7 years after planting. Specifically, our 2-year counts appear to overestimate the anticipated ring nematode counts associated with Viking and Atlas while the counts of Hansen 536 appear to be underestimates. In 2004-2005 we were aware that our 2-year tests might be overestimating Viking counts so we repeated our work with Viking in 2006-07 only to come up with similar counts, both being an apparent overestimate. We will continue sampling this final 2-year trial into summer 2008 or beyond in the hope of getting data sets that correlate better with longer-term testing in field settings.

When examining the host status of grape rootstocks against ring nematode we have obtained rather useful predictive value using the mean count from a 2-year test, but tree roots do grow differently, for example larger distances from root tip to root tip, particularly on vigorous rootstocks such as peach x almond hybrids. In addition, there may be some resistance mechanisms at work in Viking and Atlas that demand longer evaluation periods. Look for our final analyses in our final report in June 2008. In those we will express counts for the first three years versus those counts from the third year only.

It is more difficult to identify plant resistance to ectoparasitic nematodes compared to the endoparasitic. Finding and counting of higher nematode populations within roots is a good indicator that one specific plant is a better host for the nematode than some other plant. In addition, nematode absence from roots is a good indicator of resistance. With ectoparasites our only tool is counts from soil and roots may or may not be in close proximity. In extensive studies with grape rootstocks we learned that for ectoparasitic nematodes resistance is associated with population levels that are approximately 5% of that achieved on own-rooted susceptible plants. At population levels of 10% of the own-rooted, we term the interaction as moderate resistance. In an 8-year field study those plants with moderate resistance to ectoparasitic nematodes can occasionally show high populations throughout the annual soil sampling periods. By contrast, population levels of ectoparasitic nematodes that are actually resistant do not fluctuate very much from one year to the next. In the data sets that make up Table 3 there are population fluctuations from one sampling period to the next. Lovell rootstock gives us the most consistent population readings from sampling to sampling but at levels of about 40% of those of Nemaguard. Population levels of 40% are much too high to be referred to as resistant. At this juncture Lovell in our 2-year tests is the closest of 36 *Prunus* rootstocks to consistently exhibit ring nematode population levels lower than those from Nemaguard. But, based on field evaluations where Lovell, Viking and sometimes Atlas can be compared together, the latter two rootstocks come closer to achieving population levels of 5 to 10% that of Nemaguard. A 2-year test may not be of adequate duration for some rootstock selections.

Table 1. Ranking of *Prunus* rootstocks against *M. incognita*

	A 2 year study nematodes/gr root	
Pistacia atlantica	0	
Nemaguard	0	
Garnem	0	
Bright's Hybrid-4	0	
Julior	0	
Bright's Hybrid-1	0	
Hansen 536	0	
Flordaguard	0	
Torinel	0	
Empyrean 2	0	
Hiawatha	0	
Cornerstone	0	
Viking	0	
Empyrean 1	0	
Okinawa	0	
Cadaman	0	
Pumiselect	0	
Ishtara	0	
Monegro	0	
Atlas	0	
Nickels	0	
Flor x Alnem	0	
Krymsk 8	0	
RedGlow	0	
Citation	0	
MRS 2-8	0	
HBOK 50	0	
Flor x weep peach	0	
Bright's Hybrid-5	0	a
HBOK-10	0.08	a
Empyrean 101	0.29	a
Empyrean 3	0.91	ab
Challenger 9	11.6	bc
Guardian	12.1	bc
Krymsk 1	15.9	bc
Paramount	17	bc
Lovell	31	d
Krymsk 2	31.4	d
Challenger 7	42.9	e
Krymsk 86	51.6	e

Table 2. Ranking of *Prunus* rootstocks against *P. vulnus*

	A 2-year study nematodes/gr root	as % of Nemaguard 2-year trial	Soil counts reported as a % of those on Nemaguard 3-year field trial	 7-year field trial
Krymsk 2	0.03	0.40%		
Krymsk 1	0.17	2.4		
Pistacia atlantica	0.2	2.8		
Garnem	0.3	4.2		
Bright's Hybrid -4	0.5	7		
Bright's Hybrid -5	0.6	8.4		
Hansen 536	0.61	8.6	22	187
Bright's Hybrid-1	0.63	8.9		189
Paramount	1.2	16.9		
Challenger 9	1.6	22.5		
Flordaguard	1.6	22.5		
HBOK-10	3.3	46		
Empyrean 2	5	70.4	294	
Torinel	5.3	75		
Guardian	6.2	87.3	111	138
Hiawatha	6.8	96		
Nemaguard	**7.1**	**100**	(actual # 1.8) **100**	(actual # 305) **100**
Lovell	**7.4**	**104**	**411**	**247**
Cornerstone	8.5			
Viking	8.9		211	100
Empyrean 1	9		1133	
Okinawa	9.7			
Cadaman	10.8		1344	
Krymsk 86	11			
Pumiselect	11.7			
Ishtara	13.7			
Citation	17.4			
Monegro	17.7			
Atlas	23.9		1177	204
Nickels	26.3		22	183
Flor x Alnem	27.2			
Krymsk 8	28.9			
Redglow	32.3			
MRS 2-8	37.7			
HBOK-50	39			
Flor x Weep peach	40			
Challenger 7	51.6			
Empyrean 101	57.6			
Julior	71.4		38,611	
Empyrean 3	72.8			

P=0.05

Table 3. Ranking of *Prunus* rootstocks against *Criconemoides xenoplax*

	2-yr soil counts expressed as a % of Nemaguard	Values reported as a % of that on Nemaguard 3-yr field trial	7-yr field trial	7-yr field trial
Lovell 04-05	**48**	1	26	
Lovell 05-06	**34**			
Flordaguard	40			
Hiawatha	56			
UCB1 Pistachio	58			
Guardian	61	111	44	
Pumiselect	63			
Bright's Hybrid -1	67		153	147
Bright's Hybrid-5	68			
Torinel	71			
Hansen 536	73	7300	119	430
E54-043	75			
Viking 05-06	78			
Krymsk 1	94			
Viking 04-05	95	0	13	0
Cadaman	96	94		
Nemaguard 04-07	**100**	(38.1) **100**	(423) **100**	(375) **100**
Del Rey Plum	108			
MRS 2-8	109			
Marianna 2624	113			
Empyrean 1	117	13		
Cornerstone	117	6200		
D63-182	118			
Nickels	119	578	104	159
Krymsk 86	121			
E54-043	130			
Monegro	140			
Ishtara	148			
Garnem	193			
Atlas	234	0	95	9
Empyrean 2	323	92		
Julior	406	4870		