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

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Interpretive Summary:

We are well on the way to having a Nematode-Rootstock Profile for root-knot and root-lesion nematodes against 45 rootstocks and ring nematode against 35 rootstocks. This profile will provide a numerical separation of rootstocks into resistant or susceptible based on two years of evaluation in field settings. As we confirm our findings on the dozen or so rootstocks with greatest potential they are also being evaluated for their tolerance to feeding by root-knot and root-lesion nematodes. More specifically, we need to know the need for fumigation prior to planting in the presence of nematodes. As examples, Viking and Cadaman rootstocks have grown best in fumigated soil but Krymsk 1 and Myrobalan 29C appear to grow the same whether fumigated or not. Recall however that the replant problem can be a result of: 1) soil pests or diseases, 2) Physical and chemical problems of soil, 3) nutritional needs at planting time in addition to 4) the rejection component.

Five of the most attractive rootstocks are now receiving evaluation for their tolerance to the rejection component of the replant problem. This component of the replant problem does not involve soil pests or diseases and can debilitate root systems the first year or two after tree replanting, after which they initiate rapid growth development. This is the reason we set out to find rootstocks like Hansen 536 that could be an alternative to Nemaguard but not require soil fumigation. Fortunately, Hansen 536 also carries resistance to root knot nematodes and is not a great host of root lesion nematodes.

We have now completed nematode evaluations within half a dozen large *Prunus* rootstock trials located statewide. Data from these sites are available through the appropriate farm advisor listed above but will also be shown in a single chart that compares our two- year data sets with data from these 6 to 8 year-old commercial settings. In the bigger picture, we have now placed into public view five examples of

how to replant with minimal use of soil fumigants. We call this approach: "Starve the soil ecosystem then replant with different rootstock parentage".

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.

Materials and Methods:

Objective 1. Twenty trees of each of 40 rootstocks were planted in an open field inoculated with *Pratylenchus vulnus* and *Meloidogyne incognita* in 2004. Nematode population development on each of the trees was evaluated four times over the next 2 years. In 2005 another set of four rootstocks received similar evaluation. All findings are reported as nematodes per gram of root and data subjected to ANOVA. The objective of the study was completed in fall 2006 except that in spring 2007 we learned from its breeder that the rootstock named Mirobac was actually Krymsk 8. We will receive the true Mirobac in 2008 because it may have value to almond growers due to its reported nematode control value.

Objective 2. Tree numbers were never in adequate supply to complete this greenhouse evaluation. However, in spring 2006 the best-performing rootstocks from the above objective were planted into one of two field sites. Hansen 536, Bright's Hybrid 5, Viking, Empyrean 1, and Nemaguard were planted using 8 reps and 4 trees per rep into a site with a history of Nemaguard rootstock and therefore the rejection component without the nematode component of the replant problem. Half the trees were planted into soil fumigated in fall 2005 and the other half non-fumigated with each fumigated row adjacent to a non- fumigated. In a second field site one dozen of the top performing rootstocks were planted into a site with a history of *P. vulnus* and *M. incognita* but no rejection component. Here too, every other planting row had received pre-plant fumigation to remove the nematode populations from half the plants. In this site we are evaluating our top dozen trees for their tolerance to nematode feeding (tree growth measurements) but will also collect nematode samples to confirm their level of nematode resistance as determined in Objective 1. This experiment involves three trees per rep with 8 replicates fumigated and 8 reps non-fumigated. Selected trees include: Nemaguard, Empyrean 2, Monegro, Torinel, Myrobalan 29C, Marianna 2624, Krymsk 8, Flordaguard, Viking, Krymsk 1, Lovell, and Cadaman.

Objective 3. From 2004 through 2005 eighteen of the *Prunus* rootstocks were grown in microplots in the presence of ring nematode, *Mesocriconema xenoplax,* with each of four individual tree replicates receiving soil sampling for the ring nematode in fall, spring, and the following fall. Nematode counts were summarized and each compared to the build-up of this nematode on Nemaguard. This microplot setting was fumigated in early 2006 and replanted to 18 additional rootstocks to begin another set of 2-year evaluations. Again, all numbers will be compared to those achieved by Nemaguard.

Objective 4. Our methodology is to interact with farm advisors who already have existing field trials with various Prunus rootstocks. These cooperators may or may not have planted into nematode infested sites. We first visit the site and gather preliminary soil samples and if a particular nematode is well distributed across the block we will intensively sample each of the rootstocks to determine if there are population differences associated with the rootstock. Some of these farm advisor trials have been planted for 6 to 8 years and they have provided everything from minimal value to immense value as they provide field confirmation with the nematode rootstock profiles we have developed in Objectives 1 and 3. Data are compared as a percentage of that obtained from Nemaguard and placed on a chart directly adjacent to the findings from our smaller field station or microplot studies.

Results and Discussion:

Thirty-four of the 45 rootstocks we have evaluated against an aggressive *Meloidogyne incognita* population from Kearney Ag Center have exhibited resistance. This root-knot population comes from 30 yr-old kiwifruit and we did not realize how aggressive it was until this study. For example, Guardian and several other rootstocks touted to have root knot resistance were not resistant. Many of these rootstocks with resistance also contained some Nemaguard in their parentage, but some did not.

Two of the 45 rootstocks exhibited resistance to *Pratylenchus vulnus* and they were Krymsk 1 and Krymsk 2. Unfortunately, these two are a host for our root-knot population but Krymsk 1 was less of a host than Krymsk 2. We currently have an interest in Krymsk 1 as a dwarfing stock that will be of interest to stone fruit growers in medium textured soils but it is likely not a rootstock for almond growers. Although none of the other rootstocks ranked as resistant to *P. vulnus* (<0.2nematodes/gram of root), there was an interesting separation with Nemaguard being about 10th in our list of 45 rootstocks after a 2-year study. Against this nematode there were rootstocks such as Flordaguard, Bright's Hybrid-5, Hansen 536, Viking, Cornerstone, Empyrean 1, Empyrean 2, Cadaman, Monegro, and Torinel that exhibited a host status for this nematode that was similar to that of Nemaguard. These require further study to confirm their similarity to Nemaguard against *P. vulnus* but also to determine if they are tolerant to nematode feeding. Tolerance studies are being accomplished through Objective 2 and we can already see that Viking, Cadaman, and Marianna in the first year do better in fumigated soil than in non-fumigated, but Krymsk 1 and Myrobalan 29C are more tolerant of nematode feeding (see figure 1 and Table 1).

Against *M. xenoplax* the peach x almond hybrids are among the best hosts in the farm advisor trials as well as in our microplot trials. The poorest host thus far is Lovell and it supports half the nematode population of Nemaguard. However, Viking has commonly outperformed Lovell in farm advisor trials and in some, but not all of our microplot samplings. We are re-testing Viking again. Against this nematode Guardian performs almost as well as Lovell while supporting fewer *Meloidogyne* spp. Garnem was among the top of our list against *P. vulnus* and *M. incognita* but supported 4-fold the population of ring nematode when compared to Nemaguard. Our information on this nematode and *Prunus* rootstocks will double at the end of 2007.

Some of the more vigorous rootstocks are receiving evaluation against the rejection component of the replant problem in the absence of nematodes. In our newest study first year Hansen 536 once again shows minimal benefit from fumigation when following Nemaguard, use of Roundup, and a year of fallow (see figure 2). There may be other rootstocks in this category.

In March 2007 we placed into public view five examples of how to replant trees or vines without soil fumigation. We refer to this approach as **"Starve the soil ecosystem, then switch rootstock parentage"**. Two of our examples involved the replanting of almonds. It is important to note that this overall strategy has performed well whether replanting grapevines or *Prunus* spp. This finding indicates that the rejection component is very general in nature and much more than the damage caused by two or three specific soil pests. Commercial evaluations are the next step. Of course, we have to carefully pick and choose our targets using rootstocks with resistance and tolerance to any prevailing soil pest. For more on this subject, a goal since this study initiated, visit my website at www.uckac.edu/nematode

Recent Publications:

McKenry, M. V., T. Buzo and S. Kaku. 2006. Replanting stone fruit orchards without soil fumigation. Proceedings of the International Conference on methyl bromide alternatives and emission reductions. Paper #36 or www.uckac.edu/nematode

McKenry, M. V. March 2007. Management of the replant problem utilizing minimal soil fumigation.www.uckac.edu/nematode

Figure 1. Visible growth benefit observed by September of first year after planting into adjacent fumigated or non-fumigated sites. Growth differences are a result of first-year nematode feeding and not the rejection component of the replant problem.

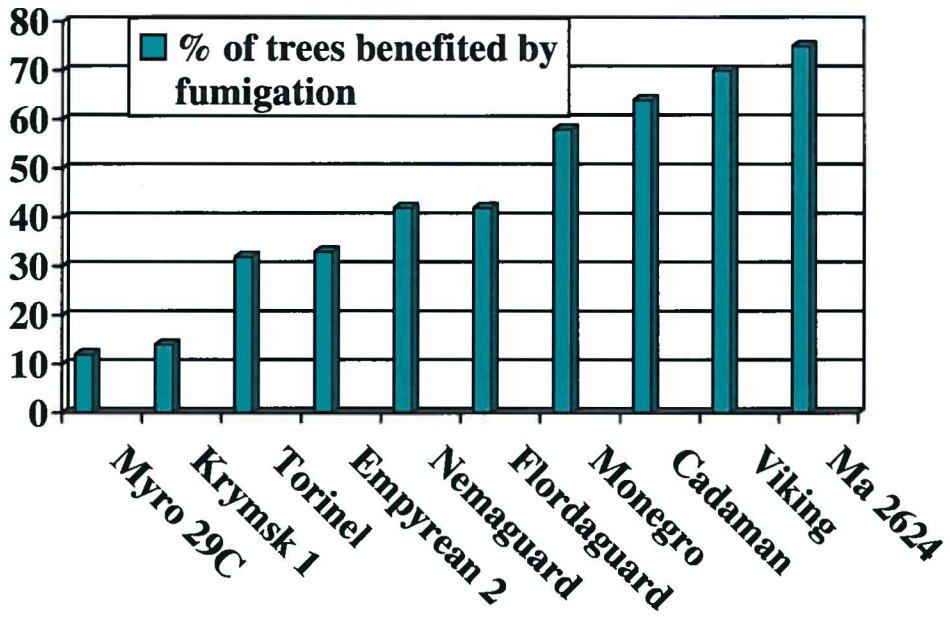

Table 1. First-year tree growth differences plus their host status for root-lesion nematode.

First year tolerance to feeding by *P. vulnus* and *M. incognita*--non replant				
		need for fumigation		**First year *P. vulnus***
	rootstock	**was significant P=.05**		**per gram of root**
1	Krymsk 1	0 of 8 replicates		3
2	Myrobalan 29C	0 of 8 reps		19
3	Torinel	1 of 8 reps		111
4	Flordaguard	1 of 8 reps		16
5	Lovell	1 of 8 reps		111
6	Cadaman	2 of 8 reps		76
7	Empyrean 2	3 of 8 reps		72
8	Nemaguard	3 of 8 reps		80
9	Monegro	4 of 8 reps		41
10	Marianna 2624	5 of 8 reps		37
11	Viking	6 of 8 reps		23
12	Krymsk 8	0 of 4 reps		many poor trees 35

Figure 2. Visible growth differences observed after planting into adjacent fumigated or non-fumigated sites following Nemaguard. There are no nematodes at this site.