Field Confirmation of the Value of a New Approach to Replanting Stone Fruits

Project Leader: Michael McKenry

Abstract

Our ability to predict the likelihood and intensity of the replant problem has never been adequate. In a 1999 text entitled "Management of the Replant Problem" (RP) this author suggested the intensity of the rejection component of RP might be related to the greater amount of root exudates emanating from root systems that were fed upon by root piercing organisms including nematodes. Readers of that text were reminded that root knot nematode attacking tomato roots could increase root leakage by 100-fold. Two major field experiments were initiated in 2009 at KAC. The plum replanting was made at a site previously on Nemaguard that lacked nematode feeding. Meanwhile, the almond replanting was previously on Nemaguard but was abundant with nematode feeding. It is possible that leakage caused by plant parasitic nematode populations, whether they cause direct plant damage or not, can provide a useful indirect assessment as to the intensity of the replant problem. The advice would be to switch to a different Prunus rootstock parentage whenever <u>any</u> plant parasitic nematode is in abundance. Nemaguard hosts pin nematodes in abundance, in fact four times as many as Viking rootstock. Pin nematode is not responsible for quantifiable direct damage to Nemaguard or Viking roots. However, by increasing root leakage, they do not feed on weeds. They may be indirectly responsible for much of the rejection component of RP. If this is true we now have a tool to assess for the intensity of the rejection component of RP in field settings. This annual report, though still incomplete, provides new nematode profiles for each of fifteen Prunus rootstocks as well as some information about their tolerance to the rejection component of RP. It also includes information about two new Prunus rootstocks with at least one having several attractive features relative to stone fruit production.

Objectives

1) Using dwarfing rootstocks including HBOK and Krymsk 1, replant a 4-acre site at Kearney Ag Center using the "starve the soil ecosystem, switch rootstock parentage" approach compared to fumigation or no fumigation.
2) Using various rootstocks including Viking and HBOK, replant a 2.5-acre block of 20 yr old peach and nectarine at Kearney Ag Center using the "starve the soil ecosystem, switch rootstock parentage" approach compared to fumigation or no fumigation.

3) Finish several 2-year nematode screens involving the HBOK series plus Mirobac selections from Spain.

Procedures

In fall 2007, a 2% solution of Roundup was carefully sprayed to the foliage of two orchards using large droplets and a hand wand to deliver to one side and then the other without drift. This step has already been shown to be successful. During 2008, we identified specific soil pest problems associated with these two blocks and corrected those as needed by delivering various nematicides to any treatment site that is not to be fumigated. We have identified potential nematicides during recent studies with grape and walnut replants. In spring 2007 we grafted Krymsk 1 to a number of scions and by June budding time 2008 we found which scions are best for this rootstock relative to its grafting affinity. HBOK selections have broader grafting capability than Krymsk 1, and the comparison rootstock will be Nemaguard trained according to the Kevin Day method for reduced tree stature.

These rootstocks were planted in 2009 and in the future, the blocks will be turned over to Scott Johnson and Kevin Day to gather horticultural information on rootstock differences in association with fruit production. Scott and Kevin will only become involved where there appears to be suitable reason for them to conduct such studies; for example one site may be appropriate but not both sites.

During the first two years, these two blocks were diagnosed for potential field problems, rootstocks will be purchased and grafted and first and second year growth of trees and nematode populations monitored by McKenry. Data was analyzed by ANOVA and most important, this block became a demonstration plot for this new approach to replanting with minimal use of a fumigant.

Six accessions from the HBOK series became available from Ted DeJong and his lab at UC Davis. Three accessions from Spain were also made available for evaluation. Our search is for additional sources of resistance to root lesion and ring nematode among these two sources that became interesting to us after the writing of this proposal. Our screening techniques are the same as those reported for our 2004 – 2008 studies.

Results and Discussion

Our first objective was to field evaluate growth of Krymsk 1, HBOK-32, HBOK-28 and HBOK-50 rootstocks compared to Nemaguard, in a two-year field setting specifically hoping for extensive rejection component of the replant problem. There was not a nematode problem in this plum replant site. We do not yet have all the growth differences ready for write up, but the most notable observations were: 1) OwenT plum as the single scion across the block showed that Krymsk 1 was not as dwarfing as observed previously under other scions. Actual growth measurements are forthcoming but its innate dwarfing and sucker production capacity appears to be related to the scion selected. Suckers were not present after two years. 2) Every Krymsk 1 tree we have dug up across this planted block and elsewhere has expressed serious crown gall on its roots. We knew when we installed the plots that Krymsk 1 is sensitive to crown gall and also knew that crown gall was in the field as we removed the old orchard. At the present time we suspect that *Agrobacterium tumefasciens* was actually within each clone of Krymsk 1 that we planted. This concern needs to be dealt with if anyone is to move further with this potential dwarfing rootstock having resistance to *P. vulnus*. 3) The rejection component was not very active in this orchard site. 4) The dwarfing HBOK selections had several plums on each tree this year and though they were dwarfed trees they also had notably smaller root systems and actually began to lean a bit with prevailing winds.

Our second objective was to assess for the rejection component of the replant problem in an old peach/nectarine orchard which turned out to be rampant with root rejection as well as abundant with *P. vulnus*. First year damage to the trees by the rejection component was dramatic except where the soil had been fumigated. Then, beginning in the first fall the damage due to *P. vulnus* feeding and reproduction also began to become apparent. Fourteen months after replanting, Nemaguard roots were supporting 400 *P. vulnus*/250 cc soil, while Viking was supporting double that and HBOH-50 was supporting 2.5 fold that of Nemaguard. Our ranking for the host status of Viking is 1.2 x that of Nemaguard, so a 2-fold population development was more than expected. We have known that Nemaguard roots are a great host for pin nematode but did not expect that pin nematode is not hosted well by HBOK-50 or Viking. Pin nematode is competitive to other nematodes attacking grape and plum roots, so we believe we have our first quantification of the value of pin nematode as a competitor against *P. vulnus*. This finding warrants our longer attention to the biology occurring in this field relative to eventual tree growth/yield. We need to keep it one more year.

Two years were spent evaluating fourteen potential Prunus rootstocks in sandy soil. As reported in 2009 this soil contains our most aggressive population of ring nematode, *Criconemoides xenoplax* population 30, as well as our most aggressive population of root-lesion nematode, *Pratylenchus vulnus* population 30. All the Prunus rootstocks listed in Table 1 were already known to be a non-host for root-knot nematode. The findings reported in Table 1 are ranked with the best selection against ring nematode listed on top. Unfortunately, HBOK-29 is too good a host for root-lesion nematode. By contrast, both HBOK-1 and HBOK-144 are capable of reducing populations of ring nematode without increasing populations of root-lesion above levels we are familiar with from Nemaguard.

Table 1. Host status of *Prunus* spp for two aggressive nematode species

	C. xenoplax		*P. vulnus*	
	/250 cc	% of Nem	/ g root	% of Nem
HBOK-29	89	25%	255	445%
HBOK-1	111	31	48.7	85%
HBOK-144	165	46	32	56
UCB-1	**177**	**49**	**12.4**	**22**
HBOK-17	216	60	143	250
HM2	239	66	136	220
Pac 9908-02	264	73	74.2	129
HBOK-121	267	74	395	689
HBOK-122	322	89	32.2	56
HBOK-15	354	98	8.1	14
Nemaguard	**361**	**100**	**57.3**	**100**
P19UDUD-N	367	102	210	366
Pac 941	524	145	42	73
Pac 9917-26	534	148	44.9	78

% of Nem = host status as % of Nemaguard

The percent population ranking of 31 by HBOK-1 compared to that of 100 by Nemaguard indicates HBOK-1 supports ~ 1/3 the ring nematode population supported by Nemaguard. For comparison the reproduction percentages for Lovell and Viking as compared to Nemaguard are 40 and 40-90, respectively. Viking ranges from 40 in mid summer to 90 in October as its resistance mechanism appears to be less heat stable than that of HBOK-1 or Lovell. For comparison, Viking and HBOK-1 are both better choices than the root-knot susceptible Lovell rootstock, but in sandy soil HBOK-1 performs as well as any previous rootstock against Bacterial Canker.

HBOK-144 has a ranking against ring nematode of 46 compared to 100 for Nemaguard. Thus, it supports almost half as many ring nematodes as Nemaguard. An advantage of HBOK-144 is that it performed better against our most aggressive root lesion nematode than HBOK-1, but both performed better against this nematode than Nemaguard. Note in Table 2 the host status of these rootstocks in a sandy loam soil containing a more common *P. vulnus* (population 45) is less aggressive than population 30 that was shown in Table 1.

Table 2. Host status of various *Prunus* spp to *Pratylenchus vulnus* in sandy loam soil

	P. vulnus pop.45	
Rootstock selection	per g root	% of nem
UCB1	**9.6 a**	**8**
HBOK-144	18 a	16
Flordaguard x KV18-46	29 a	25
Prunus sapalta 28-10	30 a	26
PAC 941	42 b	36
HBOK-121	45 b	39
HBOK-1	47 b	41
Flordaguard x KV22-15	52 b	45
HBOK-15	63 b	55
HBOK-17	66 b	57
HM2	97 b	84
Nemaguard	**115 b**	**100**
PAC 9908-02	118 b	103
PAC 9917-26	128 b	111

Another characterisitic of HBOK-144 is that like Viking it appears to possess about 10% more vigor than Nemaguard, while HBOK-1 appeared 10% less vigorous than Nemaguard in a setting where it had been grafted to Ross peach scion. Based on vigor differences, our current opinion is that HBOK-1 appears attractive to the stone fruit industry at the current time and the vigor imparted by the apparently more vigorous HBOK-144 rootstock to various stone fruits is yet to be determined at this time. Another attractive feature of HBOK-1 is the efficiency with which it produced Ross peach in a six year trial involving Bacterial Canker which killed many of the other rootstocks. Pruning weights were moderate but yield in lb/tree gave it a ranking of #1 out of 21 rootstock selections (Almehdi et. al).

Our 2010 attempt to identify Prunus rootstocks with tolerance to the rejection component includes the following rootstocks: Bright's Hybrid 5, Bright's Hybrid 106, PAC 9917-26, Hansen 536, Cadaman, PAC 941, HM2, PAC 9908-02, Viking and Atlas. Growth differences for each of these in fumigated and non fumigated settings will be available in early 2011. HBOK-1 is headed to several commercial settings to determine its tolerance to the rejection component of RP.