UPDATE ON A PREPLANT METHYL BROMIDE ALTERNATIVES TRIAL IN A WALNUT REPLANT SITE

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A walnut preplant fumigation trial was established in northern Kings County, CA. The field site is a uniformly deep, well drained Nord fine sandy loam formed from alluvial parent material. Permeability is moderate. Water holding capacity is high. Effective rooting depth is greater than 60". The 40 acre site was a 50 year-old walnut orchard consisting of Hartley and Franquette cultivars which were removed during the winter of 2006-2007. The site was repeatedly chiseled to a depth of 4 feet to bring up as much of the old root system as possible. Following root removal, the field was laser leveled, bordered every 40 feet, and irrigated in preparation for planting silage corn that was harvested in early August of 2007.

Preliminary nematode sampling in February of 2007 consisted of four composite samples, each consisting of ten subsamples taken at a depth of 24". Results showed 136, 363, 233, 281 *P. vulnus* per 250 cc of soil using sieve/mist chamber extraction.

Prior to fumigation, the site was ripped to a depth of six feet on four-foot centers in the direction of the tree rows (east/west). This was then followed by a six foot slip plow which used the ripper shanks to achieve maximum penetration and modification. Measurement of soil moisture and assessment of pretreatment nematode populations occurred one week after soil modification and two days prior to fumigation. The fumigation treatments were applied November 2, 2007.

The experimental design is a six by six Latin Square with a plot size of 75' x 160' and 12 trees/plot (13.14 acres). The following six treatments were established:

1. Untreated Control (2.07 acres)
2. Methyl Bromide broadcast @ 400 lb/ac (2.07 acres)
3. Telone II @ 33.7 gal/ac strip treated (10' swath) & shanked at 28" (2.07 acres)
4. Telone II @ 33.7 gal/ac broadcast & shanked at 28" (2.07 acres)
5. Telone II @ 33.7 gal/ac broadcast and shanked at 20", Plus 175 lb/ac Chloropicrin broadcast and shanked at 28" (2.07)
6. Telone II @ 33.7 gal/ac broadcast and shanked at 20", Plus Methyl Bromide @ 125 lb/ac at 28" depth (2.07 acres)

In addition, each plot was split to test the performance of newly developed walnut clonal rootstock material VX211 against conventional seedling paradox. A third clonal rootstock source, Vlach, was also included as the buffer between each plot. On February 28, 2008, each plot was sampled in one-foot increments to a depth of five feet for both nematodes and phytopathogenic agents.

The trial was planted twice. The first planting, April 16, 2008, employed unchilled clonal plant material propagated the previous February. It proved incapable of initiating vigorous growth past its two leaf stage. On April 23, 2008, an emergency request to the USDA was initiated for post-entry quarantine site status for this project. This allowed use of robust and chilled clonal Vlach and VX211 from Spain (Vitrotech) but distributed by Burchell Nursery, Modesto, California. On May 8, 2008, all the original clonal plants were replaced. Due to corn silage having been planted between the tree rows, a drip irrigation system was installed to meet the specific water requirements of the young walnuts.

On August 12, 2008, eight days after the corn was harvested, the trees were measured for height. The untreated trees were significantly shorter (36 inches) than the fumigated trees (an average of 41 inches). The data also showed the paradox seedlings and VX211 clonal trees to be similar in height (38 versus 41 inches), but the Vlach were significantly taller (48 inches).

On December 17, 2008, and May 7, 2009, the trial was re-sampled for nematodes and biological populations. Each plot was sampled in three locations to a depth of five feet in one-foot increments. The three sample sites per plot were composited by depth and evaluated by USDA, Parlier. A single sample per plot was also evaluated at UC Davis for phytophathogenic agents. Nematode analyses show that the fumigated plots presently remain almost completely free of any parasitic nematodes, even though the untreated plots are distributed uniformly across the experiment. The untreated plots show injurious lesion nematode levels above 100 per 250cc of soil throughout the five feet sampled.

On December 18, 2008, the trial was measured for height and trunk caliper. Results showed highly significant tree height differences between the treated and untreated plots (65.6 inches versus 48.7 inches). There was no height difference within the fumigated treatments. Caliper diameters were also significant (20 mm for the untreated versus 24.8 mm for the treated). Significant height and caliper differences were also recorded for the three rootstocks. Paradox seedlings were the smallest (55.5 inches tall and 21 mm in diameter), and VX211 was the largest (70.6 inches tall and 27 mm in diameter). The clonal Vlach used as buffer trees between the plots was 65.6 inches tall and 24 mm in diameter.

On January 16, 2009, 24 dead trees were replanted with one-year-old, dormant, bear-rootstock using the same parentage as the original tree. On February 14 and 15, the rootstocks were grafted to the Tulare walnut cultivar. Severe spring weather (two freezes and a record hot period) reduced graft take to a disappointing 84%. Regrafting and June patch budding improved take only slightly. The untreated plots represent a significant percentage of the tree loss during the first two years of the trial. Seedling paradox has also performed the poorest, and it represents 77% of the rootstock needing replacement after the second season.

On August 4, 2009, the corn silage, grown for a second season between the tree rows, was harvested.

On October 29, 2009, from 4:00 am to 6:45 am, temperatures unexpectedly dropped to 32^0 F. The absence of any signs of endodormancy raised the possibility of cold injury to the active cambial tissue, which could cause loss of part or the entire main shoot developed during the season. To minimize this risk, all 600 trunks were hand sprayed with white latex paint two days after the freeze. Research shows this reduces dehydration and subsequent loss of cambial activity from cold damage if performed shortly after the cold event. Fortunately, no damage was evident during the spring of 2010.

On November 9, 2009, trunk caliper measurements were taken to compare treatment and rootstock growth effects. Tree height could not be taken for comparison to 2008 data, because the trees had to be topped prior to the corn harvest. The largest rootstock is Vlach (33.2 mm) followed closely by VX211 (31.0mm). The trees on paradox seedling were significantly smaller than the two clonal stocks (22.1mm). No significant differences in tree caliper size presently exist between the five fumigated treatments (average 32.4mm). However, the untreated trees are significantly smaller than those receiving fumigation (28.6mm).

On December 3, 2009, a backhoe was commissioned to remove the dead and poorly performing trees. In cooperation with Dr. Mike McKenry, each tree was sampled for nematode analysis. The results are shown in Tables 1 and 2.

Table 1. Average lesion nematodes per tree removed December 3, 2009

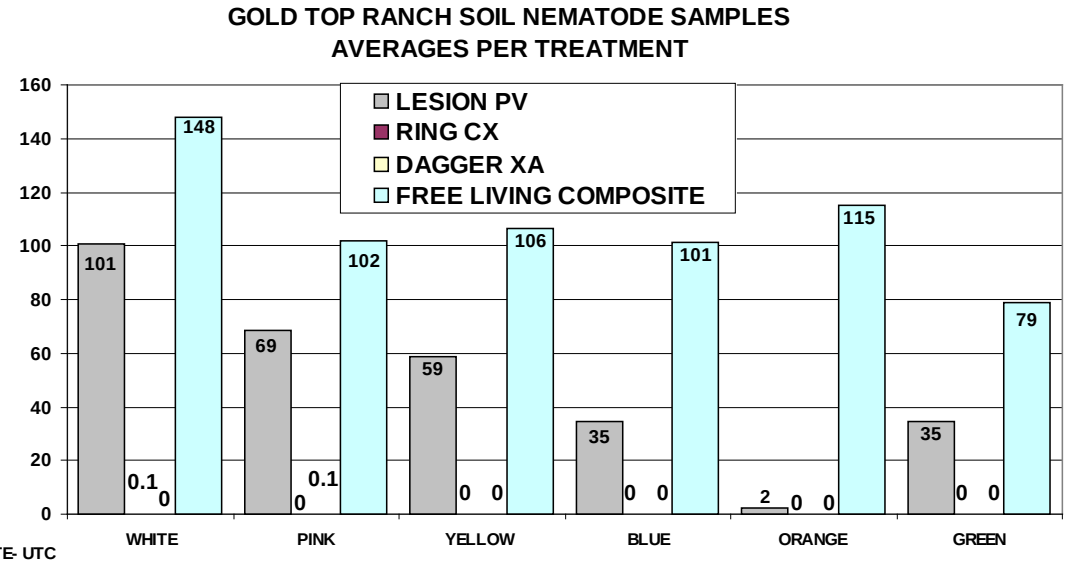
Treatment	Nematodes per tree (root samples)
1. Untreated	83.7
2. Methyl Bromide Broadcast @ 400 lb/ac	4.7
3. Telone II @ 33.7 gpa strip (10') shanked @ 20"	9.3
4. Telone II @ 33.7 gpa broadcast & shanked @ 20"	0
5. Telone II @ 33.7 gpa broadcast, shanked @ 20" plus 175 lb/ac chloropicrin broadcast, shanked @ 28"	6.6
6. Telone II @ 33.7 gpa broadcast, shanked @ 20" plus 125 lb/ac methyl bromide broadcast, shanked @ 28"	23.6

Table 2. Average lesion nematode per rootstock removed December 3, 2009

Rootstock	Nematodes per tree (root samples)
1. Paradox	34.2
2. VX211	16.1
3. Vlach (buffer trees)	71.8

On December 14, 2009, each of the 36 plots was soil sampled for nematode analysis in one-foot increments to a depth of five feet. Each sample represented a composite of three locations next to the more susceptible paradox rootstock. Chart 1 shows that lesion nematode is still highest in the control treatment, but all the fumigated treatments except the Telone II in combination with chloropicrin are beginning to experience some infestation 773 days after treatment.

Chart 1. Effect of various fumigation treatments on parasitic and free living nematode populations 773 days following treatment on November 2, 2007. Averages based on three composite samples taken in one-foot increments to a depth of five feet. Sampled December 14, 2009.

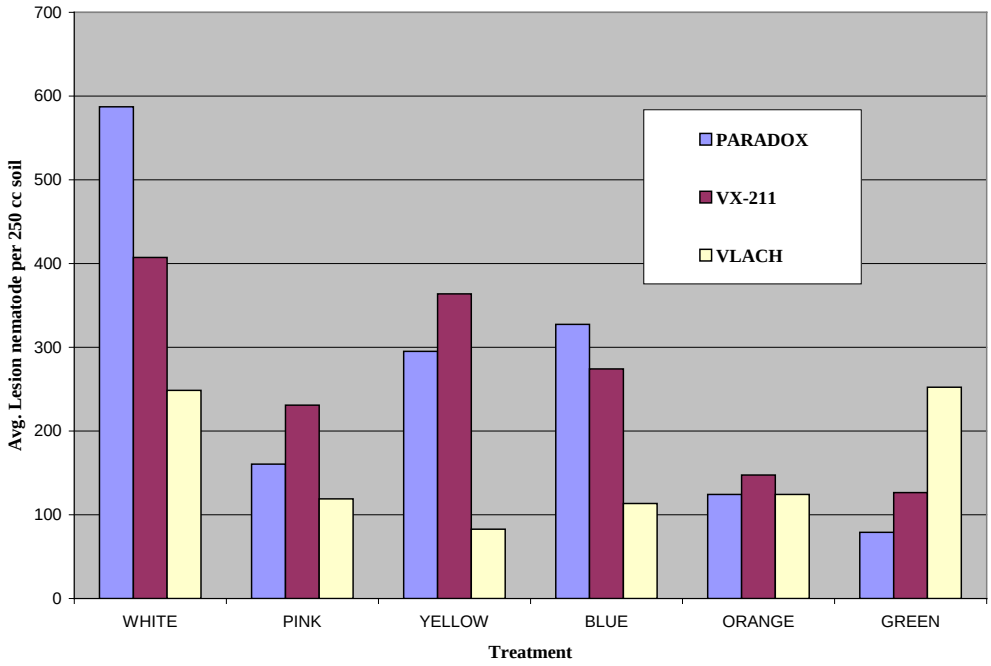


WHITE- UTC
PINK- Mehtyl Bromide Broadcast @400 lb/ac
YELLOW- Telone II @ 33.7 gal/ac strip treated (10' swath) & shanked at 20"
BLUE- Telone II @ 33.7 gal/ac broadcast & shanked at 20"
ORANGE- Telone II @ 33.7 gal/ac broadcast & shanked at 20" + 175 lb/ac Chloropicrin broadcast & shanked at 28"
GREEN- Telone II @ 33.7 gal/ac broadcast & shanked at 20" + Methyl Bromide @ 125 lb/ac 28" depth

On January 11, 2010, 76 paradox, 21 VX211, and seven Vlach rooted nursery trees grafted to Tulare were replanted at their proper sites. They were then immediately hand watered, and painted the next day.

On November 17-19, 2010, an extensive nematode sampling was performed on each of the three rootstocks and 36 plots in one foot-increments to a depth of five feet. Samples from each stock were submitted separately and daily to the laboratory to prevent any chance of misidentification. The results are shown in Chart 2.

Chart 2. Effect of fumigation on lesion nematode populations in three walnut rootstocks three years following treatment. Sampled November 17, 2010. Averages represent three composited sites per stock in each of six replications sampled in one-foot increments to the five foot depth.



White: Untreated Control
Pink: Methyl Bromide broadcast at 400 lb/ac.
Yellow: Telone II at 33.7 g/ac strip-treated (10' swath) and shanked at 20 inches.
Blue: Telone II at 33.7 g/ac broadcast and shanked at 20 inches.
Orange: Telone II at 33.7 g/ac broadcast and shanked at 20 inches plus Chloropicrin at 175 lb/ac shanked at 28 inches.
Green: Telone II at 33.7 g/ac broadcast and shanked at 20 inches plus Methyl Bromide at 125 lb/ac shanked at 28 inches.

The data show that the nematode populations have risen substantially in all plots since the last sampling 338 days ago (see Chart 1). The untreated plots remain highest in lesion numbers, and the Telone II plus chloropicrin plot remains the lowest. The methyl bromide, Telone II plus chloropicrin, and Telone II plus methyl bromide treatments are generally similar and lower in lesion populations than the Telone II only treatments. Thus far, the Telone II strip and broadcast treatments are no different in lesion nematode number. The Vlach clonal paradox rootstock shows a trend towards lower lesion levels than the VX211 clonal paradox. These data are surprising, since Dr. Michael McKenry, UC Nematologist, Riverside/Kearney Agricultural Center, Parlier, has reported VX211 tolerance to Pratylenchus under tank-trial conditions. His finding is supported by the levels recorded between VX211 and seedling paradox in the untreated plots of this trial, but there is no difference between them in the treated plots. The low lesion levels recorded in the Vlach may also be an anomaly created from fumigation overlap in the buffer area where these trees were planted.

Unfortunately, space did not allow all three rootstocks to be included in the actual plot area. Further investigation into the rootstock/Pratylenchus interaction is planned under the direction of Dr. McKenry.

On January 27, 2011, trunk caliper diameters were taken approximately 12 inches above the soil surface on all trees. Replanted trees were excluded in the data summary. Chart 3 shows the highly visible reduction in tree size from not fumigating. As mentioned previously in this report, the untreated plots also represented a very high percentage of the tree loss after the first two growing seasons (77.5%). Tree size in all the fumigated plots is very similar, with the strip treatment of Telone II being 5.3% smaller than the average of the other treated plots.

Chart 3. Effect of fumigation on the growth of three walnut rootstocks 1182 days (3.24 years) following planting. Averages represent twelve trees in each of six replications. January 27, 2011.

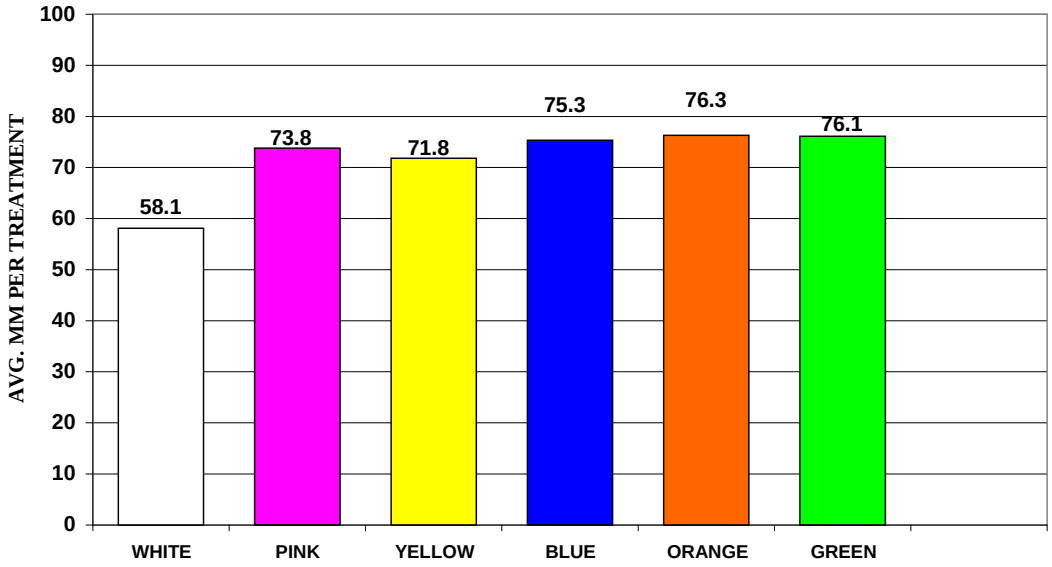


Chart 4 compares the average growth of each rootstock over all the treatments. It shows the danger of lumping the untreated trees with the treated, since the general average masks the very visible field effect of greater survival and uniformity of high vigor from fumigation. However, this chart does show that the surviving paradox seedlings are presently growing almost as well as the other stocks. A photoelectric light bar scan of the entire trial was performed this August to further delineate any differences in rootstock and treatment canopy size. Ultimately, Yield data collection may commence as early as next season, depending upon fruit set.

Chart 4. Growth comparison of Tulare English walnut on Vlach,VX211, and paradox rootstocks 994 days (2.72 years) after planting. Averages represent rootstock trunk diameter taken from six untreated plots and 30 fumigated plots. Sampled January 27, 2011.