VINEYARD REPLANT DISORDER – RESULTS AFTER 1, 2, AND 4 GROWING SEASONS

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Field evaluation of potential methyl bromide alternatives for perennial crops must determine not only efficacy of pathogen control at the time of planting the new vineyard, but also the efficacy of pest control and impact on crop growth and yield during the early growth and fruiting years. This paper reports the on-going performance of field trials planted in 1998, 2000, and 2001. Complete details on experimental design and previous years' data were reported at the 1999, 2000, and 2001 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions.

Field Trial of Chemical, Genetic, and Cultural Alternatives for Vineyard Replant Disorder – Planted 1998. Drip applied treatments were applied in January, 1998 and shanked treatments in April, 1998 to a 65-year-old Thompson Seedless vineyard, located at the USDA Parlier, CA research station following removal of the vines in fall, 1997. The treatments are described in Table 1. Each treatment was replicated 5 times in a randomized complete block design. In July 1998, each plot was planted with three grape variety/rootstock combinations; own-rooted Thompson Seedless, Merlot on Harmony rootstock, and Merlot on Teleki 5C rootstock.

Soil samples were collected to a depth of 24 inches from each treatment/rootstock combination in October, 2001 and processed by sugar flotation-centrifugation. Nematode populations are given in Table 2. After four growing seasons, the Telone/Vapam combinations have achieved control comparable to methyl bromide of both the rootknot (*Meloidogyne spp.*) and citrus (*Tylenchulus semipentrans*) nematode populations for all nematode/rootstock combinations except Telone in 100 mm water for the citrus nematode/Thompson Seedless combination. Nematode populations appear to be higher on Thompson Seedless roots growing in plots treated with Telone delivered in 100 mm water than in plots treated with Telone delivered in 60 mm water. With the exception of rootknot nematode on Thompson Seedless, iodomethane also controlled nematodes as well as methyl bromide. The one-year fallow significantly reduced rootknot nematode on Teleki 5C. The rootknot nematode populations on Harmony rootstock were nearly undetectable for all treatments, as would be expected for a rootknot nematode resistant rootstock. The citrus nematode populations were higher on Harmony than the other two rootstocks.

In February, 2002 caliper measurements of the vine trunk above the graft union were made. Thompson Seedless vines in the methyl bromide and all Telone/Vapam combinations were larger than vines grown in the untreated, the 1-year fallow, and the 1-year fallow+cover crop plots. Vines grown in the iodomethane plots were intermediate in size. Merlot vines grown on Teleki 5C rootstock were largest in the plots treated with Telone/Vapam combinations and smallest in the 1-year fallow. Merlot/5C vines grown in methyl bromide, iodomethane, and untreated control plots were intermediate in size. Merlot vines grown on Harmony rootstock were largest in the plots treated with methyl bromide and Telone/Vapam.

Thompson Seedless vines were harvested in August, 2001 and Merlot vines were harvested in September. Yield (kg berries/vine) in the plots treated with methyl bromide was significantly greater than in plots treated with 1-year fallow + cover crop. All other treatments were intermediate. Brix (soluable solids) and berry pH were not significantly different across treatments for any rootstock. Harvest 2002 has not yet occurred.

Long-term Fallow for Vineyard Replant Disorder Field Trial – Planted 2000.

Vines were removed from a 65-year-old Thompson Seedless vineyard in Fall, 1996, 1997, 1998, and 1999 (untreated control and methyl bromide plots). Plots were laid out in a randomized complete block design with 5 replications of each treatment, and planted in June of 2000 with own-rooted Thompson Seedless, Thompson Seedless on Harmony rootstock, and Thompson Seedless on Teleki 5C rootstock.

Soil samples were collected in October, 2001 to a depth of 24" from each treatment/rootstock combination and processed with sugar flotation/centrifugation. After 2 growing seasons, rootknot and citrus nematode populations on Thompson Seedless were significantly lower in plots treated with methyl bromide compared to all other treatments. Rootknot populations in plots planted to Teleki 5C were lowest in methyl bromide plots and highest in untreated control plots. There was no difference in rootknot nematode populations across treatments on Harmony rootstock, but citrus nematode was lowest in methyl bromide treated plots and highest in 3-year fallow plots.

In February, 2002 caliper measurements of the vine trunk above the graft union were made. Thompson Seedless own-rooted vines were smallest in the untreated control, increased with increasing length of fallow, and were largest in methyl bromide treated plots. There was no difference in Thompson Seedless on Teleki 5C trunk diameter across all treatments. Thompson Seedless on Harmony was largest in methyl bromide treated plots, intermediate in the 1-year fallow, and smaller in all other treatments.

Field Trial of Chemical Alternatives for Vineyard Replant Disorder – Planted 2001. Vines were removed from an 85-year-old, plant-parasitic-nematode-infested Thompson Seedless vineyard located at the USDA Parlier, CA research station in fall, 2000. All treatments (Table 3) were applied in mid April, 2001. Each treatment was replicated 5 times in a randomized complete block design. In June, 2001 own-rooted Thompson Seedless, Thompson Seedless on Freedom, and Merlot on 1103P were planted. Results for Thompson Seedless will be presented here. Relative ranking of treatments was the same for the other rootstocks.

Soil samples were collected to a depth of 24 inches from each treatment/rootstock combination in November, 2001 and processed by sugar flotation-centrifugation. Nematode populations for the Thompson Seedless plots are given in Table 4. There were no significant differences in rootknot nematode populations in the untreated control, the herbicide treatment, and the two azide treatments. Of the remaining treatments, all but the drip applied chloropicrin were not significantly different from methyl bromide in rootknot nematode populations. Citrus nematode populations were highest in the untreated control and the herbicide plots, intermediate in the azides and chloropicin plots, and essentially non-detectable in the rest of the treatments. Vines were pruned in February, 2002 and pruning weights are given in Fig. 1. Methyl bromide and propargyl bromide plots had the heaviest pruning weights. Although phytotoxicity was observed in iodomethane plots in the first growing season, no phytotoxicity was observed in the second growing season.

Conclusions

After four growing seasons, iodomethane and the Telone/metam sodium combinations appear to be good alternatives to methyl bromide for vineyard replant when both rootknot and citrus nematode are present. The Harmony rootstock continues to support only minimal populations of the rootknot nematode, even in the untreated plots, but supports higher populations of the citrus nematode than either Thompson Seedless or Teleki 5C. After 2 growing seasons, nematode populations in some long-term fallow treatments are lower than the untreated control, but not as low as in methyl bromide treated plots. After one growing season, several alternative chemicals resulted in nearly undetectable nematode populations, but vine growth was not as vigorous as in the methyl bromide treated plots.

Table 1. Treatments applied in a 1998 vineyard replant trial.

Untreated control
Methyl bromide (400 lbs/acre = 28 gal/acre), shanked, tarped (the treated control)
1-year fallow
1-year fallow plus a sorghum-sudangrass hybrid cover crop
Iodomethane (400 lbs/acre = 21 gal/acre), shanked, tarped
Telone EC (35 gal/acre or 310 lbs/acre of 1,3-D) in 60 mm water through a buried drip tape plus Vapam (26 gal/acre of 42% metam sodium) through microsprinklers

Telone EC (35 gal/acre or 310 lbs/acre of 1,3-D) in 100 mm water through a buried drip tape plus Vapam (26 gal/acre of 42% metam sodium) through microsprinklers

Table 2. Nematode populations per 100cc soil sampled October 2001, mean of 5 replications, in a vineyard replant trial planted in 1998. Statistical analyses conducted on log transformed (ln(n+1)) data. Data presented are the antilogs of the means. Means for each nematode genus/rootstock combination followed by the same letter are not significantly different at the $P = .05$ level

Treatment	***Meloidogyne sp.***			***Tylenchulus semipenetrans.***		
	Thompson Seedless	**Teleki 5C**	**Harmony**	**Thompson Seedless**	**Teleki 5C**	**Harmony**
Untreated Control	144 ab	261 a	0.8 a	638 a	301 a	913 a
1-year Fallow	215 a	49 b	0.0 a	352 a	434 a	1123 a
1-year Fallow plus cover crop	145 ab	190 a	0.1 a	463 a	342 a	723 a
Methyl Bromide (400lbs/acre)	1 def	0.3 c	0.0 a	0.4 c	4 b	2 b
Iodomethane (400lbs/acre)	27 bc	0.0 c	0.1 a	4 bc	1 b	25 b
Telone II EC (in 60mm water)+ Vapam	0.2 ef	0.6 c	0.0 a	3 c	1 b	6 b
Telone II EC (in 100mm water)+ Vapam	6 cde	0.2 c	0.0 a	6 b	3 b	7 b

Table 3. Treatments applied to a 2001 grapevine replant trial.

Untreated Control
Methyl Bromide, 400 lbs/acre, shanked, tarped, the treated control
Shank Iodomethane + Chloropicrin (240+240 lbs/acre)
Shank Propargyl Bromide - (200 lbs/acre)
Microspray Herbicide - Metam sodium (Vapam, 26 gal/acre)
Drip InLine (50 gal./acre) + Metam sodium (Vapam, 26 gpa) cap
Drip Chloropicrin (400 lbs/acre) + Metam sodium (Vapam, 26 gpa) cap
Drip Iodomethane + Chloropicrin (200+200 lbs/acre), water cap
Drip Propargyl Bromide, (180 lbs/acre), water cap
Drip Azide (300 lb/acre), water cap
Drip Azide (300 lb/acre), tarped

Table 4. Rootknot and citrus nematode populations per 100cc soil sampled November 2001, mean of 5 replications, in a vineyard replant trial planted in 2001. Statistical analyses conducted on log transformed (ln(n+1)) data. Data presented are the antilogs of the means. Means for each nematode genus followed by the same letter are not significantly different at the $P = .05$ level.

Treatment	*Meloidogyne sp.*	*Tylenchulus semipenetrans*
Untreated	323.5 a	120.6 a
Methyl Bromide	0.0 c	0.0 c
Iodomethane + Chloropicrin – shank	0.0 c	0.1 c
Propargyl Bromide - shank	1.5 bc	0.0 c
Herbicide cap (metam sodium)	290.2 a	156.6 a
Drip InLine + Metam sodium cap	0.0 c	0.0 c
Drip Chloropicrin + Metam sodium cap	7.6 b	2.3 bc
Drip Iodomethane + Chloropicrin, water cap	0.9 bc	0.0 c
Drip Propargyl Bromide, water cap	0.0 c	0.2 c
Drip Azide, water cap	63.8 a	9.1 b
Drip Azide, tarped	134.1 a	5.8 b

Figure 1. Pruning weights of Thompson Seedless vines after one growing season in vineyard replant trial planted 2001. Data are the means of 5 replications. Bars followed by the same letter are not significantly different at the $P = .05$ level.