GRAPE REPLANT DISORDER - FIELD TESTS OF SOME POTENTIAL ALTERNATIVES

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"Replant disorder" is a general term for the decline in vigor in a newly replanted vineyard as compared to vines planted in "non-vineyard" soil. There can be various factors contributing to replant disorder, which undoubtedly vary between sites. Replant disorder appears to be worse in areas where old grape roots are abundant and has been associated with plant parasitic nematodes, phylloxera, and soilborne diseases. Live grape roots can survive for many years after a vineyard has been removed and can serve as a reservoir of inoculum for nematodes and pathogens. Another layer of complexity is the spatial and temporal variation in the many interacting biological, chemical, and physical factors. Not only are the pests not uniformly distributed, but factors such as soil texture, soil pH, topography, organic matter, and others which impact disease incidence and severity and the efficacy of control strategies are not uniformly distributed. Using a control strategy in the environment in which it is best suited, will result in more consistent outcomes. The current practice for replanting grapes into a vineyard with a known soilborne pest problem is to fumigate with either methyl bromide or 1, 3-dichloropropene (1,3-D). Importation and manufacture of methyl bromide will be phased out by 2005 in compliance with the U.S. Clean Air Act and the Montreal Protocol. Use of 1,3-D, or Telone, is limited in California by township caps. Our search for alternative treatments includes new application methods for currently registered compounds, unregistered materials, plant resistance, and cultural practices. This paper reports the results to date of one of our field trials.

An existing "Thompson Seedless" vineyard, located at the USDA Parlier, CA research site was selected for this field trial. The treatments are described in Table 1. Each plot was three rows wide and seven vines long. Data were collected from the middle five plants of each row. Each treatment was replicated 5 times. The telone/vapam treatments were applied in early January, 1998. The methyl bromide and methyl iodide treatments were applied in late April, 1998. In July of 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. The rootstocks vary in levels of resistance to nematodes, which are thought to play a role in replant disorder. Susceptible St. George rootstocks were interplanted between the primary vines to be used as bioassay plants to determine the infectivity of rootknot nematodes remaining in the soil.

Soil samples were collected at planting from each plot to a depth of 5 feet and assayed for plant parasitic nematodes. There was no significant difference between the numbers of rootknot nematode (*Meloidogyne spp.*) and pin nematode (*Paratylenchus spp.*) in the untreated control, 18 month fallow (18F), and 18 month fallow plus cover crop (18F+CC) treatments. Rootknot and pin nematode numbers were not significantly different among the methyl bromide (MB), methyl iodide (MI), and all four telone/vapam (T/V) combinations and were significantly less than the untreated control. Numbers of dagger nematode (*Xiphinema spp.*) were slightly higher in the untreated control and 18 month fallow than in the other treatments, but not significantly so. Total dagger populations were relatively low across all treatments. Ring nematode (*Criconemella spp.*) numbers were significantly higher in the 18F and 18F+CC plots than in all other treatments.

Table 1. Treatments applied to a "Thompson Seedless" replant field.

Treatment 1	- untreated control
Treatment 2	- 18 month fallow
Treatment 3	- 18 month fallow plus a sorghum-sudangrass hybrid cover crop
Treatment 4	- a shanked application of methyl bromide (400 lbs/acre = 28 gal/acre), tarped (the treated control)
Treatment 5	- a shanked application of methyl iodide (400 lbs/acre = 21 gal/acre), tarped
Treatment 6	- combination application of Telone II EC (35 gal/acre) in 60 mm water through a buried drip tape plus Vapam (26 gal/acre of 42% metam sodium) through microsprinklers
Treatment 7	- same as #6 except the Telone was applied in 100 mm of water;
Treatment 8	- same as #6, but with an 18 month fallow
Treatment 9	- same as #7 but with an 18 month fallow

A visual rating of weed abundance was made approximately three weeks after vines were planted (7 months after the T/V treatments and 3.5 months after the MB and MI treatments). The untreated control, 18F, and 18F+CC plots exhibited a dense cover of weeds. The T/V plots had a few weeds. The MB and MI plots were almost completely clean.

In February, 1999, the dormant vines were pruned back to 2 nodes above the graft union. Pruning weight per plant for Thompson Seedless vines was highest for MI plots, intermediate for the MB and T/V plots, and lowest in the untreated control, 18F, and 18F+CC plots. There were no differences in Merlot pruning weights for the Harmony and Teleki 5C rootstocks across all treatments.

Soil samples were collected to a depth of 24 inches in late May 1999, approximately one year after planting, 18 months after the telone/vapam applications, and 13 months after the methyl bromide and methyl iodide applications. There were no detectable plant parasitic nematodes in any of the plots treated with methyl bromide, methyl iodide, or the telone/vapam combinations. These treatments were grouped together in Table 2. Nematode populations for the rest of the treatments are given in Table 2. Evaluation of bioassay samples collected this summer is ongoing. Data on plant growth and nematode populations will be collected for at least five years in order to determine the impact of the treatments not only on vegetative plant growth, but also on fruit yield and quality.

The telone/vapam combinations and methyl iodide have controlled the nematode populations as well as methyl bromide to date. The telone/vapam combinations applied through microsprinklers and subsurface drip tape are novel applications which reduce worker exposure to currently available chemicals, but are still subject to the California township caps. Methyl iodide is not currently registered. The 18 month fallow treatments appear to reduce the number of rootknot nematodes, but not other nematode genera. An 18 month fallow results in a loss of use (and income) of the vineyard for an additional year, but also removes the actively growing vine and upper roots as biological factors in the ecosystem for that year. The use of rootknot resistant rootstocks reduces the rootknot nematode populations, but not the citrus nematode level. Resistant rootstocks can be effective, but are more expensive than own-rooted vines and often not resistant to the diversity of pests that is encountered in a replant situation.

In the short term, novel applications of currently available chemicals appear to be the most likely alternatives to methyl bromide. These will serve as stepping stones during the transition to an integrated systems management approach based on an understanding of the interactions and spatial variability of biological, chemical, and physical factors in the agro-ecosystem. Such a system will include cultural, genetic, biological, and chemical management strategies to reduce or eliminate pests, enhance beneficial organisms, promote good plant growth, kill old roots deep in the soil that serve as pest reservoirs, and protect the environment.

Table 2. May 1999, nematode populations per 150cc soil sampled, mean of 5 replications. Means for each nematode genus/rootstock combination followed by the same letter are not significantly different at the p = .05 level.

Thompson Seedless - own rooted

Treatment	***Meloidogyne sp.***	***Criconemella sp.***	***Tylenchulus sp.***	***Xiphinema sp.***	***Paratylenchus sp.***
Untreated Control	126.0 a	9.2 a	225.6 a	3.2 a	34.0 a
18 Month Fallow	62.4 b	6.8 a b	293.2 a	0.8 a	23.6 a
18 Month Fallow plus cover crop	36.4 b c	8.4 a	268.0 a	2.4 a	15.2 a
MBr, MI, Telone+Vapam	0.0 c	0.0 b	0.0 b	0.0 a	0.0 a

Merlot/Teleki 5C

Treatment	***Meloidogyne sp.***	***Criconemella sp.***	***Tylenchulus sp.***	***Xiphinema sp.***	***Paratylenchus sp.***
Untreated Control	28.0 a	1.6 b	253.6 a	0.0 b	10.0 b
18 Month Fallow	17.6 a b	4.4 a b	267.2 a	4.4 a	8.8 b
18 Month Fallow plus cover crop	1.6 b	8.4 a	166.0 a b	0.0 b	28.8 a
MBr, MI, Telone+Vapam	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b

Merlot/Harmony

Treatment	***Meloidogyne sp.***	***Criconemella sp.***	***Tylenchulus sp.***	***Xiphinema sp.***	***Paratylenchus sp.***
Untreated Control	29.2 a	5.6 a	272.4 a	1.6 a b	18.0 a
18 Month Fallow	2.4 b	3.6 a b	166.8 a	0.4 b	8.4 a b
18 Month Fallow plus cover crop	25.6 a	0.8 b	212.4 a	2.8 a	5.2 b

MBr, MI, Telone+Vapam	0.0	b	0.0	b	0.0	b	0.0	b	0.0	b