FIELD EVALUATION OF NEMATODE CONTROL ALTERNATIVES FOR GRAPEVINE NURSERIES

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Soil fumigation with methyl bromide has commonly been used prior to planting field nurseries. The California Code of Regulations, section 3640, makes it "mandatory that nursery stock for farm planting be commercially clean with respect to economically important nematodes" (CDFA, 1996). Efficacy is required to a depth of 5-ft. for nursery certification. Historically, methyl bromide has been used effectively against soil pests over a range of soil types, temperature, and moistures resulting in greater flexibility of use and less risk of loss than is possible with many other soil treatments. Fumigation with 1,3-D can be acceptable under some field conditions, but its use is limited in California by township caps. Growers of perennial nursery crops, such as trees and vines, will need alternatives to methyl bromide in order to continue to produce clean planting material and meet CDFA's requirements following the ban on methyl bromide.

An 85-year-old, plant-parasitic-nematode-infested "Thompson Seedless" vineyard located at the USDA Parlier, CA research station was selected for a grape vine nursery field trial. Vines were removed in fall, 2000. Each treatment was replicated 5 times in a randomized complete block design. All treatments (Table 1) were applied in mid April, 2001. Soil moisture was relatively high at the time of the shank fumigations. Broadcast drip treatments were applied in 3 inches of water over a period of 16 hours using moderate-flow drip tapes spaced 24 inches apart and buried at a depth of 10 inches. The metam sodium treatment was applied through microsprays as an herbicide cap, not for nematode control.

Phytotoxicity Evaluation

Grapevine "sticks", calloused and acclimated to the outdoor environment, were planted at 18, 25, 32, and 40 days after treatment for the drip-applied materials and 25, 32, and 39 days after treatment for the shank-injected materials. Three varieties/rootstocks were used in each plot; Thompson Seedless, Cabernet Sauvignon, and Freedom. Three months after planting, the number of actively growing canes in each variety/treatment/planting date combination was determined. Failure of vines to survive can be related to the unseasonably hot temperatures on some planting dates, phytotoxicity caused by planting too soon after treatment, and soil nematode and pathogen populations. In general, the Cabernet plots had twice as many viable vines as the Freedom and Thompson Seedless plots. In the earliest planting (18 days after drip and 25 days after shank-injected treatments) of Cabernet, the highest survival was in the methyl bromide and metam sodium plots and the lowest in the drip-applied propargyl bromide. By the last planting, there was little difference between treatments in the survival of Cabernet. In the first planting of Thompson Seedless, the highest survival rate was in the methyl bromide plots and the lowest in the drip-applied propargyl bromide. By the last plantings, survival was still highest in the methyl bromide, but lowest in the azide with water cap. Metam sodium and azide with water cap had the highest vine survival and drip-applied propargyl bromide the lowest survival in the earliest planting of Freedom. By the last planting date, highest survival of Freedom vines was in the drip-applied iodomethane plots and the lowest in the untreated control.

Nematode Control

Soil samples were collected 6 weeks after treatment in one-foot increments down to a depth of 5 feet. Samples were extracted using the baermann funnel to recover only live nematodes. The predominant plant parasitic nematode genera found in the samples were *Tylenchulus*, the citrus nematode, and *Meloidogyne*, the rootknot nematode. Most treatments provided control equivalent to methyl bromide (Table 2). The exceptions were the herbicide (metam sodium) and tarped azide at all depths. Azide with water cap was numerically greater than the methyl bromide at the 36-48" and 48-60" depths, but the differences were not statistically significant. The reduced efficacy in the lowest soil zone could be related to insufficient water to deliver an effective dosage to the 5-ft. depth or insufficient rate of material to treat the entire 5-ft. deep soil profile.

Weed Control

Weeds were removed 3 months after treatment from a strip 20 inches wide and 4 ft. long centered on the plant row in each plot. The above-ground biomass was air-dried for 2 weeks and weighed. Best control was achieved with methyl bromide, the metam sodium herbicide treatment, drip treatments with the metam sodium cap, and shank applied materials (Table 2). The azide treatments gave intermediate control and the drip-applied propargyl bromide and drip-applied iodomethane without a metam sodium cap gave poor control.

Conclusion

Grapevine nursery growers would not select an 85-year old vineyard infested with plant parasitic nematodes as an acceptable site for a nursery establishment. Use of such a site for a nursery field trial represents one of the most extreme situations that a methyl bromide alternative might face. Even so, some shank and drip-applied materials appear to provide the necessary level of nematode control to the 5-ft. depth as required to meet nursery certification. Plants will be harvested in winter, 2002 and roots analyzed for nematodes to determine if the nematode control remained effective until harvest. Use of an herbicide in combination with some drip-applied treatments might be necessary for good weed control. Further testing is needed to determine the minimum planting interval following treatment to avoid phytotoxicity for each material and grapevine variety/rootstock.

A vineyard replant trial was super-imposed on the nursery field trial. Merlot on 1103P, own-rooted Thompson Seedless, and Thompson Seedless on Freedom was planted six weeks after treatment. Nematode populations and plant growth will be monitored for an additional 4 years to determine performance of these materials and application protocols for vineyard replant, as well as, nursery situations.

References

California Dept. of Food and Agriculture. 1996. Approved treatment and handling procedures to ensure against nematode pest infestation of nursery stock. Nursery Inspection Procedures Manual, Item #12. 18 pp.

Table 1. Treatments applied to grapevine nursery field trial, spring 2001.

Untreated Control
Methyl Bromide, 400 lbs/acre
Shank Iodomethane + Chloropicrin (200+200 lbs/acre)
Shank Propargyl Bromide - (180 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 2. Effect of treatments on nematode and weed control. Citrus nematode populations per 100cc soil 6 weeks after treatment, mean of 5 replications. Weeds measured 3 months after treatment, mean of 3 replications. Means for each depth followed by the same letter are not significantly different at the *P* = .05 level.

Treatment	Citrus Nematode by Soil Depth					Weeds (g)
	0-12”	12-24”	24-36”	36-48”	48-60”	
Untreated	838.3 a	1204.9 b	498.7 b	416.7 b	8.4 c	537.4 c
Methyl Bromide	0.0 c	0.0 c	0.0 d	0.0 c	0.3 c	0.0 a
Iodomethane + Chloropicrin – shank	110.4 bc	1.1 c	0.8 d	0.0 c	0.0 c	38.5 a
Propargyl Bromide - shank	0.0 c	0.0 c	0.3 d	0.0 c	0.0 c	146.9 ab
Herbicide cap (metam sodium)	1194.2 a	1861.5 a	2815.6 a	889.0 a	302.4 b	9.7 a
Drip InLine + Metam sodium cap	2.1 bc	1.1 c	0.5 d	0.0 c	0.0 c	80.5 a
Drip Chloropicrin + Metam sodium cap	0.0 c	0.0 c	4.0 d	3.6 c	2.2 c	66.9 a
Drip Iodomethane + Chloropic, water cap	0.3 bc	0.3 c	0.0 d	0.5 c	0.0 c	620.2 c
Drip Propargyl Bromide, water cap	0.0 c	0.0 c	1.1 d	0.0 c	0.3 c	492.4 bc
Drip Azide, water cap	31.4 bc	0.0 c	34.8 cd	88.4 bc	190.3 c	303.2 abc
Drip Azide, tarped	724.4 b	816.9 b	474.1 bc	1361.4 a	1455.2 a	348.4 abc