METHYL BROMIDE ALTERNATIVES FOR TREE, VINE, AND ROSE FIELD NURSERIES

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Soil fumigation with methyl bromide has commonly been used prior to planting field nurseries to insure a high quality product and to meet the California Code of Regulations that makes it "mandatory that nursery stock for farm planting be commercially clean with respect to economically important nematodes" (CDFA, 1996). Delivery of treatment to a depth of 5-ft. is required for nursery certification. Historically, methyl bromide has been effectively used to comply with the nursery regulations. Growers of perennial nursery crops, such as trees, vines, and roses, 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.

Grapevine Field Nursery Trial – Planted 2001. An 85-year-old, plant-parasitic-nematode-infested Thompson Seedless vineyard located at the USDA Parlier, CA research station was selected for a grapevine 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. The metam sodium treatment was applied through microsprays as an herbicide cap, not for nematode control. Thompson Seedless, Cabernet Sauvignon, and Freedom canes were planted in June 2001.

In February 2002, the nursery vines were dug and evaluated for root health. Results were similar for Thompson Seedless (results presented here) and Cabernet. Freedom is a rootknot nematode resistant rootstock and did not exhibit any galling. Galled roots were found on Thompson Seedless plants in the untreated, metam herbicide, azide/tarped, azide/water cap, and the shank-applied propargyl bromide plots (Fig 1.). Galled roots were found in only one of the 5 shank-applied propargyl bromide replicates and are likely the result of faulty application. Roots were incubated for 7 days at 27C to allow for hatch and recovery of rootknot nematode juveniles, *Meloidogyne spp*. Very few nematodes were recovered from the dormant roots in any treatment, including the untreated control. Soil nematode populations were evaluated in November 2001 and results are reported in the vineyard replant paper by Schneider et. al at this conference.

Rose Field Nursery Trial – Planted 2001. A rose field trial was initiated in Wasco, CA. The previous cotton crop, rootknot nematode resistant variety "Nemex", was removed in August, shank treatments applied in September and drip treatments in Oct. Each treatment (Table 2) was replicated 6 times in a randomized complete block design. Dr. Huey rose rootstock was planted at the end of Nov. Soil samples were collected at planting in one-foot increments down to a depth of 5 feet.

Populations of *Pythium spp*. were determined only in the upper 12". All treatments significantly lowered the populations of *Pythium spp* compared to the untreated control. Nematodes were extracted from samples using the baermann funnel to recover only live nematodes. The predominant plant parasitic nematode found in the samples was the stunt nematode, *Tylenchorhynchus spp.* (Table 2). Low populations of rootknot nematode, *Meloidogyne spp.*, and stubby root nematode, *Paratrichodorus spp.* were also found. There were no significant differences in nematode control in the top 36" between methyl bromide and all chemical treatments, although nematodes were detected in some samples. In the 36-48" soil depth, plant parasitic nematodes were not detected in the methyl bromide, shanked and dripped Midas, and metam sodium treated plots. All other chemical treatments, except the 200 lb. rate of chloropicrin, were not significantly different from methyl bromide, even though nematode populations were detected. The 200 lb. rate of chloropicrin was not significantly different from the untreated control at the deepest two soil depths. At the 48-60" depth, nematode populations were below detectable levels in the methyl bromide and drip-applied Midas plots. Iota, a biological material, was not significantly different from the untreated control at any soil depth.

Grafted roses are a 2-year crop. Although rootknot nematode populations are reduced by the use of the rootknot resistant Nemex cotton prior to planting roses, growers often see rootknot nematode appear in the second growing season. We will continue to monitor nematode and fungal pathogen populations over the 2-year period, and evaluate plant quality at harvest.

Tree, Vine and Berry Field Nursery Trial. A field trial was initiated in a commercial nursery in Visalia, CA. The previous corn crop was removed in September and treatments applied in October. Each treatment (Table 3) was replicated 4 times in a randomized complete block design. Tarped treatments were applied using a noble plow with a shank depth of 10". The telone rig had shanks 21" deep, spaced 20" apart. The deep shank rig, used for methyl bromide and iodomethane, had shanks 20" deep, spaced 66" apart. A diverse selection of trees, grapevines, and raspberries and blackberries was planted in March. At-planting soil samples were collected 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 found in the samples was the rootknot nematode, *Meloidogyne spp.* (Table 3). Nematode populations in all chemical treatments were statistically the same as methyl bromide at all depths and were virtually undetectable. A few nematodes were detected in the top soil depth of some deep shank, untarped treatments and in the lower depths of the shallow injection of Telone C35. Significant rootknot nematode populations were found in all soil depths in the untreated control plots. Soil samples will be collected in fall 2002 to determine efficacy of these treatments after one growing season.

Conclusions

Iodomethane/pic (shank and drip) and drip-applied Inline, chloropicrin, and propargyl bromide produced gall-free grapevines after one growing season that were

similar in quality to plants in methyl bromide treated plots. Nematode populations at planting have been reduced to undetectable levels down to a depth of 5' by several shank and drip applied treatments, including iodomethane/pic, Telone C35, and chloropicrin. Other treatments, while not significantly different from methyl bromide, were found to still have nematodes present. These trials will continue to monitor efficacy of nematode and pathogen control through the cropping cycles.

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, shanked, tarped, the treated control
Shank Propargyl Bromide - (200 lbs/acre)
Shank Iodomethane + Chloropicrin (240+240 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 Azide (300 lb/acre), tarped
Drip Azide (300 lb/acre), water cap
Drip Iodomethane + Chloropicrin (200+200 lbs/acre), water cap
Drip Propargyl Bromide, (180 lbs/acre), water cap

Figure 1. Grapevine Field Nursery Trial. Proportion of plants with galled roots after one growing season. Values are the mean of 5 replications, shown with standard error bars.

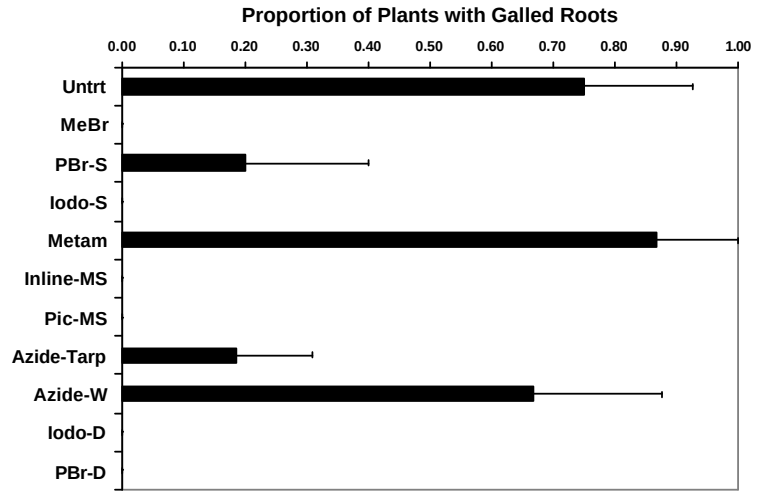

Table 2. Stunt nematode populations per 250cc soil sampled at planting in a commercial rose trial November 2001, mean of 6 replications.

Treatment	0-12"	12-24"	24-36"	36-48"	48-60"
Untreated	1.0 b[1]	29.5 a	29.8 a	18.4 a	5.8 ab
Methyl Bromide - 350 lb/acre, tarped - noble plow	0.0 b	0.0 b	0.0 b	0.0 c	0.0 c
30% Iodomethane 70% Chloropicrin - 400 lb/acre, tarped - noble plow	0.0 b	0.0 b	0.0 b	0.0 c	0.4 bc
Telone C35 - 48 gal/acre, tarped - noble plow	0.0 b	0.2 b	0.9 b	1.5 bc	6.2 ab
Telone C35 - 48 gal/acre, untarped - telone rig	0.0 b	0.6 b	0.3 b	3.1 bc	3.5 abc
Inline – 50 gal/acre, drip	0.0 b	0.0 b	0.3 b	0.2 c	2.4 abc
Telone EC – 35 gal/acre, drip	0.0 b	0.0 b	0.9 b	1.7 bc	6.9 ab
Chloropicrin – 200 lb/acre, drip	0.0 b	0.0 b	3.0 b	4.7 ab	13.3 a
Chloropicrin – 400 lb/acre, drip	0.0 b	0.3 b	1.4 b	2.1 bc	4.8 abc
Chloropicrin – 200 + 200 lb/acre, drip	0.0 b	0.0 b	0.0 b	1.7 bc	4.2 abc
30% Iodomethane 70% Chloropicrin - 400 lb/acre, drip	0.0 b	0.0 b	0.0 b	0.0 c	0.0 c
50% Iodomethane 50% Chloropicrin - 300 lb/acre, drip	0.2 b	0.0 b	0.0 b	0.0 c	0.0 c
Metam sodium – 75 gal/acre (42% a.i.), drip	0.2 b	0.0 b	0.0 b	0.0 c	10.0 a
Iota (a bacterial suspension from FUSION 360, Turlock, CA)	5.5 a	44.4 a	47.8 a	19.3 a	7.9 ab

[1] Statistical analyses conducted on log transformed (ln(n+1)) data. Data presented are the antilogs of the means. Means followed by the same letter are not significantly different at the $P = .05$ level.

Table 3. Rootknot nematode populations per 250cc soil sampled at planting in a commercial vine, tree, and berry field nursery trial in March 2002, mean of 6 replications.

Treatment	0-12"	12-24"	24-36"	36-48"	48-60"
Untreated Control	106.3 a[1]	189.1 a	441.6 a	310.1 a	21.3 a
Methyl Bromide - 500 lb/acre, tarped - noble plow	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Telone C35 - 35 gal/acre, untarped - telone rig	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Telone C35 - 40 gal/acre, tarped - noble plow	0.0 b	0.0 b	0.0 b	2.2 b	2.2 b
30% Iodomethane 70% Chloropicrin – 400 lb/acre, untarped - deep shank	1.7 b	0.0 b	0.0 b	0.0 b	0.0 b
30% Iodomethane 70% Chloropicrin - 400 lb/acre, tarped - noble plow	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
50% Iodomethane 50% Chloropicrin - 350 lb/acre, untarped - deep shank	1.8 b	0.0 b	0.0 b	0.0 b	0.0 b
50% Iodomethane 50% Chloropicrin - 350 lb/acre, tarped - noble plow	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
Chloropicrin - 350 lb/acre, untarped - telone rig	0.0 b	0.0 b	0.0 b	1.9 b	0.0 b
Chloropicrin - 400 lb/acre, tarped - noble plow	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b

[1] Statistical analyses conducted on log transformed (ln(n+1)) data. Data presented are the antilogs of the means. Means followed by the same letter are not significantly different at the $P = .05$ level.