MB ALTERNATIVES FOR THE CALIFORNIA PERENNIAL NURSERY INDUSTRY – A PAW PROJECT UPDATE

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The perennial crop nursery sector of the Pacific Area-Wide Pest Management Program for Methyl Bromide (MB) Alternatives has focused on open-field production of deciduous tree, grapevine, and garden rose planting stock in California. Concerns over plant parasitic nematodes and state regulations related to the Nursery Stock Nematode Certification program are the driving force behind soil fumigation in these nurseries. To be certified as nematode-free, nurseries must either use an approved treatment or undertake a comprehensive soil and root sampling program. If a certified treatment is not used and parasitic nematodes are detected in a nursery block at the end of the growing cycle, the planting stock is not certified and usually is destroyed.

The only MB alternative currently approved for meeting California's certification requirements is 1,3-dichloropropene (1,3-D). However, these products are only approved for use in nurseries with coarse-textured soils because the maximum rate allowed in California (332 lb/A) is not sufficient to provide adequate pest control in fine-textured soils. Although 1,3-D-based products are not allowed in all soil types, a significant portion of the perennial crop nursery industry could transition to these products and still meet nematode certification requirements.

Widespread adoption of 1,3-D in the nursery industry is limited by several factors including the need for much greater attention to proper soil preparation and moisture management. Township caps and large buffer zone requirements have been established due to human exposure concerns (bystanders, field workers, neighbors); these also limit 1,3-D fumigation in some areas. Alternative fumigants such as 1,3-D have more narrow pest spectrums than MB; adoption of 1,3-D in the nursery industry also is limited due to concerns about less effective weed and pathogen control compared to MB. Finally, air quality concerns in California will likely result in greater regulation on pesticides classified as volatile organic compounds (VOC), which may further reduce the ability of fumigant dependant agricultural sectors to convert from MB to 1,3-D for preplant fumigation.

Over the past five years, the perennial crop nursery sector project of the Pacific Area-wide (PAW) Program for Integrated Methyl Bromide Alternatives has focused on technical issues and regulations surrounding fumigant emissions, developing supplemental weed control tactics, and demonstrating currently available alternatives in commercial nurseries throughout the Central Valley.

Over time, the research has included:

- Evaluating alternative fumigants in perennial crop nurseries (various rates and combinations of methyl iodide, 1,3-dichloropropene, chloropicrin, DMDS, metam-sodium, etc).
- Evaluating alternative application techniques to enhance efficacy and reduce emissions (Buessing shank, drip-applications, new barrier films, etc) (eg. Tables 1 and 2)
- Screening and demonstrating herbicidal weed control and crop safety in commercial nurseries (preemergence and post-directed).
- Demonstrating alternatives in large-scale commercial field plots.

The research results have been summarized, interpreted and disseminated to scientist, regulators, growers and pest control advisors during field days, extension meetings, pest management conferences, and in journal articles throughout the program. A web-based outreach platform is also being developed to further extend information generated as a part of the PAW program.

Although research efforts, regulatory changes, and shifting economics have resulted in increased adoption of MB alternatives in this industry, many of the significant barriers summed up by Zasada et al. (2010) remain. Finding solutions that simultaneously meet: 1) the high pest control requirements in the nursery industry, 2) specific nursery certification requirements, 3) evolving regulatory requirements, 4) worker and bystander safety needs, and 5) federal and state fumigant registrations is a formidable task with no across-the-board solution.

The benefits of fumigating a few thousand nursery acres each year are amplified several hundred-fold when nursery stock free of damaging nematodes and pathogens is planted in production orchards and vineyards around the world. Cautious adoption of alternatives that integrate several strategies may well be warranted when one considers the potential long-term economic consequences of spreading nematode or disease problems via infested nursery stock.

Recent publications:

Jhala, A.J., S. Gao, J.S. Gerik, R. Qin, and B.D. Hanson. 2011. Effects of surface treatments and application shanks on nematode, pathogen and weed control with 1,3-dichloropropene. Pest Manage. Sci. (in press)

Hanson, B.D. S. Gao, J.S. Gerik, A. Shrestha, R. Qin, and J.A. McDonald. 2011. Effects of emission reduction surface seal treatments on pest control with shank-injected 1,3-dichloropropene and chloropicrin. Crop Prot. 30:203-207.

Zasada, I.A., T.W. Walters, and B.D. Hanson. 2010. Challenges in producing nematode- and pathogen-free fruit and nut nursery crops in the United States. Outlooks on Pest Management 21:246-250.

Table 1. Effects of surface seal treatments with 1,3-D on *Fusarim* and *Pythium* spp. propagules in a rose nursery in 2007 and tree nursery in 2008.

Treatment[z]	Rose nursery[x]		Tree nursery[x]	
	Fusarium propagules	*Pythium* propagules	*Fusarium* propagules	*Pythium* propagules
	------------------------ No. g^{-1} soil ------------------------			
Untreated	5.36 a	14.8 a	101.5 a	99.5 a
MeBr	0.00 b	0.00 b	0.0 c	0.0 c
1,3-D *fb* 1,3-D	0.00 b	1.94 b	NA[w]	NA[w]
1,3-D (HDPE)	0.39 b	0.86 b	6.2 b	0.2 c
1,3-D (VIF)	0.8 b	0.62 b	2.1 bc	0.0 c
1,3-D *fb* metam sodium	0.95 b	6.77 a	137.4 a	3.1 b
1,3-D (intermittent water seals)	0.00 b	7.5 a	65.7 a	11.4 b

[z]1,3-D, 1,3-dichloropropene; *fb*, followed by; HDPE, high-density polyethylene; MeBr, methyl bromide; VIF, virtually impermeable film.
[x]Least square means within columns with no common letters are significantly different according to Fisher's Protected LSD test where $P < 0.05$.
[w]NA, not applicable; 1,3-D *fb* 1,3-D treatment was not included in tree nursery trial in 2008.

Table 2. Effects of surface seal treatments with 1,3-D on broadleaf weed density in a rose nursery trial in 2007 and on broadleaf and grass weed density in a tree nursery trial in 2008.

Treatment[z]	Rose nursery[x]		Tree nursery[x]	
	Broadleaf (cv. Home Run)	Broadleaf (cv. Dr. Huey)	Broadleaf	Grass
	------------------------ weeds m^{-2} ------------------------			
Untreated	32.5 a	44.7 a	243.7 a	24.3 a
MeBr	0.6 c	0.4 c	5.4 c	0.0 c
1,3-D *fb* 1,3-D	11.8 b	1.9 c	NA[w]	NA[w]
1,3-D (HDPE)	2.3 c	0.6 c	6.0 c	0.0 c
1,3-D (VIF)	1.7 c	0.7 c	4.1 c	0.1 c
1,3-D *fb* metam sodium	15.2 b	3.3 c	23.3 b	0.1 c
1,3-D (intermittent water seals)	29.0 a	16.7 b	182.1 a	9.1 b

[z]1,3-D, 1,3-dichloropropene; *fb*, followed by; HDPE, high-density polyethylene; MeBr, methyl bromide; VIF, virtually impermeable film.
[x]Least square means within columns with no common letters are significantly different according to Fisher's Protected LSD test where $P < 0.05$.
[w]NA, not applicable; 1,3-D *fb* 1,3-D treatment was not included in tree nursery trial in 2008.