WEED AND PATHOGEN CONTROL WITH REDUCED METHYL BROMIDE RATES IN OPEN-FIELD NURSERIES

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Introduction:
The perennial crop nursery industry, a $165 million annual contributor to California's economy, usually produces tree and rose nursery stock in a 3-5 year cropping cycle that includes one or two years of cover crops between nursery crops. The nursery cycle begins with preplant soil fumigation in the summer prior to planting the nursery rootstock in order to control many soil-borne pests and ensure a vigorous start to the dormant-planted propagative material. The nursery stock, which may be budded with preferred scion varieties or grown as own-root plants, is harvested as bare-root stock 1-2 years after planting. Preplant fumigation with methyl bromide (MB) has been the most common treatment used in field grown nursery crops for control of plant parasitic nematodes, disease pathogens, and weed propagules. Although MB use was officially phased out in 2005 due to negative effects on stratospheric ozone, the fumigant is still allowed in certain crops under the provisions of annually requested Critical Use Exemptions. In California, nursery stock nematode-free certification requires a minimum of 300 lb/A MB in sandy soils or 400 lb/A in clay loam soils (33.6 or 44.8 g/m^2); however the United Nations Methyl Bromide Technical Options Committee (MBTOC) suggests that much lower rates of MB can provide equivalent weed, nematode and pathogen control when combined with chloropicrin (Pic) or when sealed with low permeability barrier films (LPBF).

Little information is available on the efficacy of the suggested reduced rate MB applications on pest control and crop productivity in perennial crop nursery production systems. California nursery producers and regulatory agencies need adequate information on the effects of reduced-rate MB applications and alternative chemicals before certification approval and wide spread adoption can be expected. Therefore, the objective of this research was to compare MBTOC standard presumptions for pest control and nursery crop productivity with reduced-rate MB applications sealed with virtually impenetrable films (VIF) compared to conventional MB application with high density polyethylene (HDPE) film

Materials and Methods:
Fumigants were applied using commercial application equipment (TriCal, Inc.) (Table 1). MB and iodomethane:Pic treatments were applied using a Noble plow rig set up to simultaneously install HDPE or VIF film. Telone (1,3-dichloropropene [1,3-D]) and Telone C35 (61% 1,3-D:35% chloropicrin) were applied with a conventional Telone rig and HDPE tarps were installed with the Noble plow rig. Individual plots were 10.5 by 100 ft in the garden rose trial and

12 by 100 ft in the tree nursery trial. The rose rootstocks were planted in three 50 ft long beds spaced 3.5 ft apart and the tree rootstocks were each planted in one 100 ft bed in each main plot (Table 2). Cooperating nursery operations maintained the nursery stock according to standard production practices for the one or two-year cycle.

Results and Conclusions:

Pathogen control: Both nurseries had insufficient resident populations of parasitic nematodes to evaluate. Instead, cloth bags containing soil infested with ~2000 citrus nematodes were buried at 12, 24, and 36 inch depths in each plot. Bags were recovered one month after fumigation and live nematodes extracted and counted. No citrus nematodes survived at any depth in any treated plot in either the garden rose or tree nursery trial. These data indicate the level of control achieved at the time of planting, but do not provide any information on the level of control present at harvest after the 1-2 year growing cycle. Nematode populations below the 36 inch depth or those below detectable limits in the top 36 inches can increase over the course of 1-2 years and result in plants that do not qualify for nursery certification. Soil samples for pathogen control evaluations were collected from the top 12 inches of soil in the spring following planting in the garden rose trial. *Pythium* spp. populations were lower than the unfumigated plots in all treated plots and there were no differences among fumigated plots. *Fusarium oxysporum* populations did not statistically differ among treated or untreated plots; however, treatments containing chloropicrin tended to have lower populations.

Weed control: At the garden rose nursery, weed populations and handweeding time in the spring following fumigation were greatly reduced by all fumigation treatments. Although not statistically different, Telone II tended to have the highest number of both annual bluegrass and broadleaf weeds and the highest handweeding time. In the tree nursery trial, all treatments reduced winter annual weed populations compared to the untreated control. Telone II and the lowest rate of MB:Pic had slightly higher annual bluegrass population compared to the MB standard and Telone II tended to have higher broadleaf weed populations as well. Handweeding time in the tree nursery was statistically similar among treated plots; although Telone II and Telone C35 were numerically highest.

No statistical differences were noted in quality, size, or number of saleable plants in either experiment likely due to the lack of parasitic nematode or soil pathogen pressure. Overall, the results of this research indicate that reduced MB rates sealed with low permeability barrier films can perform as well as standard MB rates sealed with HDPE film in sites with low nematode and pathogen pressure. However, long-term repeated use of low MB rates or alternative chemicals could reveal weaknesses not evident in single-cycle field trials. Great caution must be used when interpreting data such as these, especially for crops with very stringent pest and pathogen requirements such as certified propagative material.

Table 1. Fumigant treatments in two field trials near Wasco and Visalia, CA conducted in 2005-08 to evaluated reduced rates of methyl bromide in field-grown perennial crop nursery production.

Fumigant (%)	Rate	MB equivalent	Film	Treatment notes
	lb ai a^{-1}	g m^{-2}		
Untreated control	--	--	--	--
MB:Pic (98:2)	350	39	HDPE	California nursery certification requires 300 lb a^{-1} in sandy soils or 400 lb a^{-1} in clay loam soils.
MB:Pic (67:33)	350	26	HDPE	MBTOC - nutsedge control (VIF not avail.)
MB:Pic (98:2)	237	26	HDPE	
MB:Pic (98:2)	237	26	VIF	
MB:Pic (67:33)	266	20	HDPE	MBTOC - pathogen and weed control (VIF not avail.)
MB:Pic (67:33)	233	17.5	VIF	MBTOC - nutsedge control (VIF avail.)
MB:Pic (67:33)	200	15	VIF	MBTOC - pathogen and weed control (VIF avail.)
MB:Pic (67:33)	166	12.5	VIF	MBTOC – 2006 discussion
MB:Pic (67:33)	133	10	VIF	MBTOC – 2006 discussion
IM:Pic (50:50)	300	-	HDPE	Not currently registered in California
1,3-D (98)	332	-	HDPE	Registered for California nursery certification
1,3-D:Pic (61:35)	521	-	HDPE	Registered for California nursery certification

Table 2. Experimental site and cropping information in two open-field nursery trials treated with reduced-rate methyl bromide fumigation treatments.

Nursery	Garden rose nursery	Fruit/nut tree nursery
Location	Wasco, CA	Visalia, CA
Year	2005-08	2006-07
Fumigation date	Nov. 9, 2005	Oct. 16, 2006
Rootstocks	"Dr. Huey" (cutting) "Fragrant Lavender Simplicity" (cutting)	"Lovell" peach (seed) "Marianna 2624 plum (cutting)
Planting date	Dec. 2005	Nov. 2006
Harvest date	FLS – Dec. 2006 Dr. Huey – Jan 2008	Nov. 2007