EVALUATION OF REDUCED METHYL BROMIDE RATES AND ALTERNATIVE FUMIGANTS IN FIELD GROWN PERENNIAL CROP NURSERIES

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Introduction:
Preplant fumigation with methyl bromide (MB) has commonly been used in field grown ornamental crops to provide broad-spectrum control of plant parasitic nematodes, soil-borne disease pathogens, and weed propagules. In California field nursery production, 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). Many producers use a standard preplant fumigation treatment of 350 lbs/A (39 g/m^2 MB) of the 98:2 MB:chloropicrin (PIC) formulation. The Methyl Bromide Technical Options Committee (MBTOC) standard presumptions for recent evaluations of critical use nominations (CUN) suggest that reduced rates of 26 g/m^2 for nutsedge and 20 g/m^2 for pathogens and other weeds should be effective where low permeability barrier films (LPBF, i.e., virtually impermeable film [VIF]) are not available. Where LPBF is available, MBTOC standard presumptions suggest that MB rates of 17.5 and 15 g/m^2 should provide effective control of nutsedge and pathogens, respectively. Currently, California regulatory agencies do not permit use of low permeability barrier films in soil fumigation and relatively little research has been done under local conditions to determine the efficacy of reduced MB rates for control of nematodes, pathogens, and weeds under local conditions. This paper reports on the on-going performance of two field trials established in 2005 and 2006 with reduced rates of MB in garden rose and fruit tree nurseries.

Materials and Methods:
Two studies are on-going near Wasco and Visalia, California, USA. The first trial was established in a garden rose nursery in November 2005. Ten fumigation treatments and an unfumigated/untarped control (Table 1) were shank applied with commercial application equipment. Individual plots were 3.2 by 30.5 m and each treatment had five replicates arranged in a randomized complete block, strip plot design. Plots were tarped at or immediately following fumigant application with either a standard high density polyethylene (HDPE) film or a VIF film. Prior to fumigation, cloth bags containing seeds of common mallow (*Malva parviflora*), johnsongrass (*Sorghum halapense*), and common purslane (*Portulaca oleracea*) were buried 9 cm deep in each plot. Weed bags were recovered approximately one month after fumigation. Hardwood cuttings of “Dr. Huey” and “Fragrant Lavender Simplicity” rose were each planted in three 50 ft beds per plot in December 2005. Data were collected during the first growing season on control of native weed populations, bagged weed seed survival, and survival of soil pathogens (*Pythium spp.*, *Verticillium dahlia, and Fusarium oxysporum*). The crops were rated for vigor and growth during the growing season and will be commercially graded at harvest (fall 2006 for Fragrant Lavender Simplicity and fall 2007 for Dr. Huey).

A second study was established in a tree nursery in October 2006. Treatments applied were the same as previous (Table 1) except the iodomethane (IM) treatment was not included due to regulatory issues. This trial will be planted to peach and cherry rootstock in November 2006 and harvested in fall 2008. Data collection will be similar to the 2005 rose trial.

Results and Conclusions:
Control of *Pythium* spp. was similar among treated plots and all treatments were significantly different than the unfumigated control (Table 2). *F. oxysporum* populations were variable and no treatment was significantly different from the control; however treatments containing the highest amount of chloropicrin tended to have lower populations. No *Verticillium dahlia* was found in any fumigated or unfumigated plots in this nursery trial. Establishment of the hardwood cuttings of both rose varieties was better for all fumigated plots compared to the unfumigated control plots probably due to reductions in soil disease pathogens and early season weed competition.

No significant differences were observed in the viability of buried weed seed samples as measured by tetrazolium tests (data not shown). This is likely due to selection of weed species known to be difficult to control with any fumigant treatment. Winter annual weeds were controlled similarly among all fumigation treatments except for red stem fillaree (*Erodium cicutarium*) which was not controlled by any treatment (Table 3). Hand-weeding of winter annual weeds in mid-March required 3-4 times the amount of labor in the untreated plots compared to fumigated plots primarily due to dense infestations of common chickweed (*Stellaria media*), annual bluegrass (*Poa annua*), and shepherd's purse (*Capsella bursa-pastoris*). However, an application of a labeled preplant herbicide and timely cultivation likely would have greatly reduced labor requirements. Summer annual grass and broadleaf weeds were controlled similarly by all fumigation treatments. Yellow nutsedge (*Cyperus escelentus*) populations were variable such that no statistical differences were observed; however, the unfumigated control and Telone products tended to have more yellow nutsedge present compared to MB and iodomethane treatments.

The garden rose trial is also on-going for the remainder of the two-year production cycle to be concluded in winter 2007. No data have yet been collected on the 2006 fruit tree nursery experiment which will be ongoing until winter 2008.

Summary:
Under the conditions of this trial

- *Pythium* population reductions were similar among all fumigation treatments.
- Reduced MB rates with either HDPE or VIF film provided similar control of the weeds present as the grower standard treatment of MB 98:2 at 350 lb/A.
- Pest control was similar among VIF and HDPE film treatment.
- Telone II tended to have the poorest weed control although this usually was not statistically different.
- Iodomethane provided pest control comparable to methyl bromide.

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Table 1. Fumigation treatments in field grown perennial crop nursery trials near Wasco and Visalia, CA in 2005 and 2006.

Treatment		rate	film	g MB / m^2	notes
1	Untreated	--	--	--	
2	MB:Pic (98:2)	350 lb/A	HDPE	39	Calif. grower standard
3	MB:Pic (67:33)	350 lb/A	HDPE	26	
4	MB:Pic (98:2)	237 lb/A	HDPE	26	MBTOC std for nutsedge with HDPE
5	MB:Pic (98:2)	237 lb/A	VIF	26	
6	MB:Pic (67:33)	266 lb/A	HDPE	20	MBTOC std for pathogens and other weeds with HDPE
7	MB:Pic (67:33)	233 lb/A	VIF	17.5	MBTOC std for nutsedge with VIF
8	MB:Pic (67:33)	200 lb/A	VIF	15	MBTOC std for pathogens and other weeds with VIF
9 [a]	IM:Pic (50:50)	300 lb/A	HDPE	--	
10	Telone II	33.7 gal/A	HDPE	--	
11	Telone C35	48.5 gal/A	HDPE	--	

[a] Trt #9 iodomethane:chloropicrin was not included in 2006 trial.

Table 2. Effects of reduced methyl bromide rates and alternative fumigants on soil-borne pathogens in a garden rose nursery trial near Wasco in 2005-06

Treatment	rate	film	*Pythium spp* ----- June 2006 -----	*F. oxysporum*	Rose stand July 6, 2006
			----- cfu/g soil -----		# / 3 m row
Untreated	--	--	54.4 a[a]	544 a	11.3 b
MB:Pic (98:2)	350 lb/A	HDPE	3.2 b	918 a	14.8 a
MB:Pic (67:33)	350 lb/A	HDPE	2.4 b	176 a	14.6 a
MB:Pic (98:2)	237 lb/A	HDPE	9.6 b	918 a	15.0 a
MB:Pic (98:2)	237 lb/A	VIF	0 b	331 a	14.9 a
MB:Pic (67:33)	266 lb/A	HDPE	2.4 b	339 a	15.1 a
MB:Pic (67:33)	233 lb/A	VIF	7.2 b	436 a	14.1 a
MB:Pic (67:33)	200 lb/A	VIF	7.2 b	496 a	15.6 a
IM:Pic (50:50)	300 lb/A	HDPE	6.4 b	454 a	15.7 a
Telone II	33.7 gal/A	HDPE	5.6 b	520 a	15.5 a
Telone C35	48.5 gal/A	HDPE	1.6 b	204 b	15.0 a

[a] Means within a column with the same letter are not different according to Fisher's protected LSD test with alpha=0.05

Table 3. Effects of reduced methyl bromide rates and alternative fumigants on weeds in a garden rose nursery trial near Wasco in 2005-06

			------------ March 10, 2006 -------------				March 14, 2006	-------July 6, 2006 -------		
Treatment	rate	film	EROCI [a]	POAAN	CAPSS	STEME	Hand weeding	CYPES	Broadleaf [c]	Grass [d]
			---------------- # / 3 m bed --------------				hr/plot [b]	-------# / 3 m bed -------		
Untreated	--	--	19.8 a	171.6 a	125.4 a	5400 a	6.7 a	20.7 a	32.1 a	111.3 a
MB:Pic (98:2)	350 lb/A	HDPE	29.4 a	2.4 b	4.2 b	1.8 b	1.5 c	0 a	1.4 b	1.8 b
MB:Pic (67:33)	350 lb/A	HDPE	39.0 a	3.0 b	7.2 b	1.2 b	1.5 c	0 a	0.8 b	0.8 b
MB:Pic (98:2)	237 lb/A	HDPE	41.4 a	1.2 b	4.2 b	1.8 b	1.3 c	0 a	1.0 b	1.2 b
MB:Pic (98:2)	237 lb/A	VIF	39.6 a	2.4 b	4.8 b	3.6 b	1.6 c	0 a	2.0 b	2.2 b
MB:Pic (67:33)	266 lb/A	HDPE	31.8 a	0.6 b	4.8 b	1.8 b	1.7 c	0 a	0.5 b	0.5 b
MB:Pic (67:33)	233 lb/A	VIF	40.2 a	4.2 b	3.0 b	2.4 b	1.7 c	0.1 a	1.0 b	1.3 b
MB:Pic (67:33)	200 lb/A	VIF	36.6 a	1.8 b	6.6 b	1.8 b	1.4 c	0 a	0.6 b	0.6 b
IM:Pic (50:50)	300 lb/A	HDPE	49.2 a	1.2 b	12.0 b	5.4 b	2.1 bc	0 a	2.1 b	2.5 b
Telone II	33.7 gal/A	HDPE	23.4 a	12.6 b	40.8 b	4.2 b	2.9 b	13.0 a	1.2 b	15.7 b
Telone C35	48.5 gal/A	HDPE	35.4 a	1.8 b	3.0 b	0.6 b	2.0 bc	3.3 a	1.6 b	5.8 b

[a] Abbreviations: EROCI, *Erodium cicutarium*; POANN, *Poa annua*; CAPSS, *Capsella bursa-pastoris*; STEME, *Stellaria media*; CYPES, *Cyperus esculentus.* In the same column, means with the same letter are not significantly different at alpha=0.05.

[b] Individual plot size was 97.5 m^2

[c] Broadleaf is total broadleaf weeds consisting mainly of *Erodium cicutarium, Capsella bursa-pastoris, Malva parviflora, and Polygonum aviculare*

[d] Grass is total grass weeds primarily consisting of *Poa annua, Echinochloa colona, E. crus-galli, Panicum acillare, Paspalum dilatatum*, and *Digitaria* spp.