EFFICACY OF DRIP AND SHANK APPLIED MIDAS FOR STRAWBERRY PRODUCTION

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Midas, a combination of iodomethane (IM) and chloropicrin (Cp), has been suggested as a direct replacement to methyl bromide for pre-plant soil fumigation for California strawberry production. Several Midas formulations are available for soil fumigation: IM:Cp 33:67%, IM:Cp 50:50% and IM:Cp 98:2%. This study evaluated the efficacy of two Midas formulations (33% and 50%) applied by drip fumigation and bed shank injection for weed control and strawberry yield.

Methods

The experiment was carried out during the 2005 and 2006 growing seasons in two locations: the California Strawberry Commission research facility at the Monterey Bay Academy (MBA) near Watsonville, and at the USDA Spence research farm near Salinas, California. The experimental design was a randomized complete block design with five replicates in 2005, and four replicates in 2006. Fumigant treatments were applied at 200 lb/A and included 1) untreated control, 2) drip-applied MbCp 67:33%, 3) drip-applied Midas 33%, 4) drip-applied Midas 50%, 5) bed shank Midas 33%, and 6) bed shank Midas 50%. Drip fumigation was preformed in beds covered with 1.38 mil clear virtually-impermeable film (VIF, BromoStop™ Rimini, Italy). Shank-applied fumigants were injected at a depth of 10 inches with two chisels spaced 13.8 inches apart into pre-formed soil beds that were immediately covered with 1.38 mil VIF.

Weed evaluations: Weed counts were made on the 24-inch bed top before hand removal. Weeds were identified by species and weed densities were converted to percent of weed control compared to the untreated plots. To better understand the efficacy of the fumigant treatments in controlling weed seeds in the soil seed bank, nylon mesh seed bags were installed at soil depths of 2 and 6 inches prior to the 2006 fumigation. Seed bags contained 35 seeds of each of the following species: common chickweed *Stellaria media* (L.) Vill., common purslane *Portulaca oleracea* L., little mallow *Malva parviflora* L. and common knotweed *Polygonum arenastrum* Boreau. After fumigation, seed viability was determined by tetrazolium staining.

Strawberry yields: In each permutation of the experiment, strawberry transplants (Fragaria x ananassa L. var. Diamante) were planted four weeks after fumigation. Strawberry yields were evaluated by harvesting strawberries once or twice a week as needed. After each harvest, the berries were sorted and marketable and total berries were calculated. Data were converted to determine cumulative season-long yields (lb/A).

Results

All Midas treatments provided good overall weed control. At MBA, fumigant treatments provided at least 83% weed control in both the 2005 and 2006 seasons. Drip-applied MI:Cp 50:50 provided the best weed control at MBA in both the 2005 and 2006 seasons, controlling >96% of the weeds. At Spence farm, the fumigant treatments provided 48 to 83% of weed control in the 2005 season, and 79 to 87% of weed control in the 2006 season. All of the fumigants provided weed control that was not statistically different than Mb:Cp (Table 1). Post-fumigation survival of weed seeds from seed bags was similar in plots treated with Midas and Mb:Cp (Table 2). Weed species differed in their ability to survive the fumigant treatments. Some of the weed species, such as little mallow, were only partially controlled by any of the tested fumigants, while other weed seeds were controlled by all the fumigants tested, with less than 13% post-fumigation viability (Table 2) at both locations (Spence and MBA). In the four Midas studies, plots treated with Midas had similar marketable and total berry yields compared to yields in plots treated with Mb:Cp (Table 3). Both application methods (drip and shank) with formulations of Midas performed well. Once approved for use as a soil fumigant in California, Midas will be a drop-in replacement for MB:Cp in strawberry production. Midas 33% may be more cost effective while maintaining good pest control efficacy and adequate yields.

Table 1: Weed control provided by different fumigant treatments in the four studies compared to the total weed densities in untreated control plots[a]

Fumigant	Dose	Application method	MBA 2005	Spence 2005	MBA 2006	Spence 2006
	lb/A		Weed (% control)			
Untreated control	-----		0	0	0	0
Mb:Cp	200	Drip	95	83	94	84
Midas 33	200	Drip	94	48	92	87
Midas 50	200	Drip	98	78	96	N/A
Midas 33	224	Shank	83	81	94	87
Midas 50	224	Shank	83	60	94	79
ANOVA						
P value			0.004	0.022	<0.0001	0.001

[a] Total weed densities at the untreated control plots were: 1024832 weeds/A at the MBA 2005 study, 113643 weeds/A at the 2005 Spence study, 106636 weeds/A at the 2006 MBA study and 62273 weeds/A at the 2006 Spence study.

Table 2: Post-fumigation survival of common weed seeds for the 2006 studies at Spence and MBA.

Fumigant	Application method	Spence				MBA			
		Little mallow	Common purslane	Common chickweed	Common knotweed	Little mallow	Common purslane	Common chickweed	Common knotweed
		% viability							
Untreated control	-----	74.8 a	97.4 a	82.7 a	99.0 a	80.5 a	95.8 a	77.7 a	91.5 a
Mb:Cp	Drip	56.2 b	0.0 b	0.0 b	3.2 b	66.0 bc	0.6 b	0.8 b	12.8 b
Midas 33	Drip	52.6 b	1.6 b	0.0 b	0.0 b	58.9 bc	2.1 b	0.0 b	0.5 b
Midas 50	Drip	-----	-----	-----	-----	64.6 b	0.0 b	0.0 b	0.0 b
Midas 33	Shank	54.9 b	0.0 b	0.0 b	0.0 b	56.7 c	7.7 b	0.0 b	0.0 b
Midas 50	Shank	53.0 b	0.0 b	0.0 b	0.0 b	58.0 b	0.0 b	0.0b	0.0 b
ANOVA									
P value		<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001

Table 3: Strawberry marketable and total yields for the four studies.

Fumigant	Application method	MBA 2005		Spence 2005		MBA 2006		Spence 2006	
		Marketable	Total	Marketable	Total	Marketable	Total	Marketable	Total
		Yield as % of plot treated with MB:CP							
Untreated control	-----	83	83 a	74	75	63 a	65 a	75 a	80 a
Mb:Cp	Drip	100	100 ab	100	100	100 b	100 b	100 b	100 b
Midas 33	Drip	104	106 b	99	97	102 b	102 b	97 b	102 b
Midas 50	Drip	116	116 b	104	100	103 b	98 b	NA	NA
Midas 33	Shank	109	115 b	104	101	98 b	95 b	97 b	98 b
Midas 50	Shank	110	113 b	103	100	106 b	100 b	98 b	99 b
ANOVA									
P value		ns	0.024	ns	ns	<0.0001	<0.0001	0.016	0.002
Yields at plots treated with Mb:Cp = 100%		28699 lb/A	50231 lb/A	26489 lb/A	41637 lb/A	27719 lb/A	50552 lb/A	23463 lb/A	39861 lb/A