WEED CONTROL OPTIONS IN CALIFORNIA STRAWBERRY WITHOUT METHYL BROMIDE

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Introduction

Strawberry production in California is a two-component system consisting of nursery and fruit production, and methyl bromide has been used as the basis for weed control for both components. The phase-out of methyl bromide requires the development of alternative fumigant systems for both nursery and fruit production systems. Alternative fumigants in evaluation include chloropicrin alone, iodomethane plus chloropicrin mixture 50:50, 1,3-D plus chloropicrin mixture 65:35, and metam sodium. Iodomethane was evaluated in nurseries, and several emulsified fumigants were evaluated in a fruiting field. The objective of the work reported here was to evaluate the weed control efficacy of alternative fumigants in both nursery and fruiting fields.

Methods

Iodomethane evaluation in nursery production. The weed control efficacy of iodomethane was compared to methyl bromide in the spring and summer of 2000 at a low elevation nursery at Ballico, CA and a high elevation nursery at Susanville, CA. The effects of iodomethane on weed seed viability, weed densities and time required to hand weed were measured. Iodomethane was applied as a 50:50 mixture with chloropicrin (IM/Pic) at the rate of 350 lbs. per acre (lb./A). Methyl bromide and chloropicrin (MeBr/Pic) was applied for comparison as a 57:43 mixture at the rate of 400 lb./A at Ballico and 355 lb./A at Susanville. Each treatment was replicated four times and the plot size was 2860 ft^2.

The effect of fumigants on weed seed was tested by burying nylon mesh bags containing seed of common purslane (*Portulaca oleracea*), prostrate knotweed (*Polygonum aviculare*) and little mallow (*Malva parviflora*) prior to fumigation. Following fumigation, bags were retrieved and the percentage viable seed was determined using tetrazolium salts.

Emulsified fumigant evaluation in fruiting fields. Evaluation of emulsified fumigants was initiated in November 1999 in a fruit production field near Salinas, CA. Four weeks after fumigation, the mulch was removed and cultivar 'Selva' was planted in two rows at 12-inch spacing between plants. Emulsified fumigants were applied through two drip lines placed 8-inches apart in the middle of the bed. Drip-applied treatments were: 1,3-D plus chloropicrin mixture in an emulsified formulation (1,3-D + Pic EC) at 253 and 422 lb./A, metam sodium at 213 and 320 lb./A, chloropicrin alone (Pic EC) at 328 lb./A, 1,3-

D + Pic EC followed by (fb) metam sodium at 253 lb./A fb 213 lb./A, and 422 lb./A fb 320 lb./A, and Pic EC fb metam sodium at 328 lb./A fb 213 lb./A. Bed shank-applied materials were methyl bromide plus chloropicrin 67:33 (MeBr/Pic) at 400 lb./A, 1,3-D plus chloropicrin mixture 65:35 (1,3-D + Pic) at 410 lb./A and chloropicrin alone (Pic) at 300 lb./A. Each treatment was replicated three times and the plot size was three 52-inch beds wide by 100 ft. long.

The effect of emulsified fumigants on the native weed biomass was measured on February 24, 2000 by harvesting the weeds present on the center bed of each plot (250 ft^2). Weeds were identified by species and then biomass was determined. Weed seed bags containing common purslane, little mallow, and prostrate knotweed were placed in nylon mesh bags and buried in all plots prior to fumigation (data not shown).

Results

Iodomethane evaluation in nursery production. Percentage viable common purslane and prostrate knotweed seed was much lower for seed treated with IM/Pic or MeBr/Pic compared to untreated seeds at both sites (Table 1). Differences in percentage viable seed were not found between IM/Pic and MeBr/Pic treatments for common purslane or prostrate knotweed. At Susanville, percentage viable was lower for little mallow seed exposed to MeBr/Pic compared to untreated seed; however a 77.1% viable seed is not considered an acceptable level of control. A difference in little mallow seed viability was not observed at Ballico.

The effect of fumigants on emergence of native weed populations was evaluated by periodically determining the density of each weed species. Common lambsquarters (*Chenopodium album*) and little mallow were the most abundant weeds at Susanville (Table 2). Problem weeds at Ballico were carpetweed (*Mollugo verticillata*) prostrate spurge (*Euphorbia humistrata*) and filaree (*Erodium spp.*). Both IM/Pic and MeBr/Pic reduced the number of common lambsquarters, carpetweed and prostrate spurge for each date. MeBr/Pic reduced the number of filaree compared to IM/Pic for the first sample date, but differences were not found for the second count. The number of little mallow was lower in the MeBr/Pic treated plots compared to controls for the first weed count at Susanville, for other weed counts, there was not a difference.

Less time was required to hand weed plots treated with MeBr/Pic or IM/Pic at Ballico compared to untreated areas (Table 3). A difference was not found between MeBr/Pic and IM/Pic.

These results suggest that the weed control efficacy of IM/Pic 50:50 at 350 lb./A was approximately equal to MeBr/Pic 57:43 at 355 to 400 lb./A.

Emulsified fumigant evaluation in fruiting fields. All fumigant treatments significantly reduced common chickweed (*Stellaria media*) and shepherdspurse (*Capsella bursa-pastoris*) biomasses compared to the untreated check (Table 4). Bur clover (*Medicago polymorpha*) and little mallow biomass was greater in the MeBr/Pic treatment than in the untreated check. This was likely due to the germination stimulus on bur clover and little

mallow seed provided by MeBr/Pic. Results indicate that drip-applied 1,3-D + Pic EC provided better control of bur clover and little mallow than shank-applied 1,3-D + Pic. Similarly, drip-applied Pic EC provided better control of bur clover and little mallow than shank-applied Pic. The weed control provided by drip-applied 1,3-D + Pic EC at 253 or 422 lb./A was not improved by the addition of a sequential application of metam sodium at 213 or 320 lb./A, respectively. Similarly, the weed control provided by drip-applied Pic EC was not improved by a sequential application of metam sodium at 213 lb./A. Metam sodium alone at 213 or 320 lb./A provided poor to fair control of all species.

These results indicate that drip-applied 1,3-D + Pic EC provided better weed control than similar rates of shank-applied 1,3-D + Pic. Similarly, drip-applied Pic EC provided better weed control than shank-applied Pic. Sequential applications of metam sodium did not improve the weed control provided by drip-applied 1,3-D + Pic EC or Pic EC.

Table 1. The effect of iodomethane (IM) or methyl bromide (MeBr) in combination with chloropicrin (Pic) on common purslane, prostrate knotweed and little mallow seed viability. Results are from two field studies: Susanville high elevation and Ballico low elevation strawberry nurseries.

		% viable seed		
Fumigant	Rate (lb./A)	Common purslane	Prostrate knotweed	Little mallow
		Susanville (high elevation)		
IM/Pic 50:50	350	0.1 b	9.2 b	79.0 ab
MeBr/Pic 67:33	355	0.3 b	0.5 b	77.1 b
Untreated	0	84.9 a	84.1 a	83.9 a
LSD		24.5	26.8	5.3
		Ballico (low elevation)		
		Common purslane	Prostrate knotweed	Little mallow
MeI/Pic 50:50	350	0.0 b	0.0 b	75.2 a
MeBr/Pic 57:43	400	0.0 b	0.0 b	76.5 a
Untreated	0	78.7 a	80.3 a	71.3 a
LSD		27.8	27.8	9.1

Means followed by the same letter do not significantly differ (P=0.05, LSD).

Table 2. The effect of IM/Pic and MeBr/Pic on native weed emergence at Susanville and Ballico strawberry nurseries. Weeds were counted on three occasions (17 May, 20 June and 3 Aug.) at Susanville, and on two occasions (15 June and 18 July) at Ballico.

	Rate	Number of weeds per m^2					
Fumigant	(lb./A)						
		Susanville (high elevation)					
		Common lambsquarters			Little mallow		
		17 May	20 June	3 Aug.	17 May	20 June	3 Aug.
IM/Pic 50:50	350	37.6 b	5.6 b	2.4 b	5.2 ab	16.4 a	18.4 a
MeBr/Pic 67:33	355	5.2 b	1.2 b	0.0 b	1.2 b	19.6 a	10.0 a
Untreated	0	129.2 a	64.4 a	18.8 a	22.4 a	26.0 a	12.8 a
LSD		82.4	51.2	14.8	18.0	23.6	18.0
		Ballico (low elevation)					
		Carpetweed		Prostrate spurge		Filaree	
		15 June	18 July	15 June	18 July	15 June	18 July
IM/Pic 50:50	350	0.0 b	0.0 b	2.4 b	21.6 b	23.6 a	1.6 a
MeBr/Pic 57:43	400	0.0 b	0.0 b	0.4 b	11.6 b	9.2 b	3.6 a
Untreated	0	37.6 a	105.6 a	23.6 a	255.2 a	20.4 ab	1.2 a
LSD		28.0	7.8	10.0	109.6	13.6	2.7

Means followed by the same letter do not significantly differ (P=0.05, LSD).

Table 3. The amount of time (hrs/A) required to hand-weed following fumigation at Ballico

Fumigant	Rate (lb./A)	Time required to hand-weed (Hrs/A)
		Ballico (low elevation)
MeI/Pic 50:50	350	57.7 b
MeBr/Pic 57:43	400	45.7 b
Untreated	0	93.2 a
LSD		12.9

Means followed by the same letter do not significantly differ (P=0.05, LSD).

Table 4. Weed biomass and percentage weed control provided by shank-applied methyl bromide plus chloropicrin 67:33 (MeBr/Pic), 1,3-D plus chloropicrin mixture 65:35 (1,3-D + Pic), and chloropicrin alone (Pic) and drip-applied 1,3-D plus chloropicrin mixture 65:35 in a emulsifiable formulation (1,3-D + Pic EC), chloropicrin emulsifiable formulation (Pic EC) and metam sodium. Sequential treatments of 1,3-D + Pic EC or Pic EC followed by metam sodium were also tested. Weed biomasses (g) were determined by harvesting all weeds in the center bed of each plot (250 ft^2), weeds were then identified by species and weighed. Dominant species present were bur clover, common chickweed and little mallow. The total weed biomass includes bur clover, common chickweed, common groundsel, little mallow, shepherdspurse and yellow rocket.

Fumigant [a]	Rate	Method	Bur clover		Chickweed		Little mallow		Shepherdspurse		Total weeds	
	lb./A		biomass	%	biomass	%	biomass	%	biomass	%	biomass	%
Untreated	--	--	1405 de	0	10707 a	0	78 abc	0	3186 a	0	17367 a	0
MeBr/Pic 67:33	400	Shank	3922 a	-177	169 b	98	325 abc	-317	53 c	98	4567 bc	74
1,3-D + Pic	410	Shank	3291 abc	-134	147 b	99	287 abc	-268	69 c	98	3969 bc	77
1,3-D + Pic EC	253	Drip	1814 de	-29	228 b	98	356 a	-356	73 c	98	2757 bc	84
1,3-D + Pic EC	422	Drip	1413 de	-1	169 b	98	37 abc	52	15 c	100	1670 c	90
Pic	300	Shank	3561 ab	-154	1106 b	90	164 abc	-110	497 c	84	5745 bc	67
Pic EC	328	Drip	838 e	40	365 b	97	22 bc	72	150 c	95	1772 c	90
Metam sodium	213	Drip	1909 de	-36	3551 b	67	127 abc	-62	669 bc	79	7497 b	57
Metam sodium	320	Drip	1453 de	-3	1872 b	83	103 abc	-32	1306 b	59	7186 b	59
1,3-D + Pic EC fb metam sodium	253 fb 213	Drip	2127 cde	-51	827 b	92	17 bc	78	122 c	96	3205 bc	82
1,3-D + Pic EC fb metam sodium	422 fb 320	Drip	1274 de	9	51 b	100	29 abc	63	19 c	99	1450 c	92
Pic EC fb metam sodium	328 fb 213	Drip	1469 de	-5	362 b	97	51 abc	35	50 c	98	1912 c	89
LSD 0.05			1353		3571		332		773		4936	

[a] 1,3-D + Pic EC mixture or Pic EC alone was applied followed by (fb) a metam sodium treatment 5 days later, i.e., metam sodium was applied as a sequential treatment. .