WEED CONTROL EFFICACY OF DRIP IRRIGATION APPLIED CHLOROPICRIN, METAM SODIUM AND 1,3-D

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Introduction

Chloropicrin (CP), Sodium N-methyldithiocarbamate (metam sodium) and (1,3-dichloropropene (1,3-D) are possible replacements for methyl bromide (MB). All three chemicals are commercially available, but regarded as inferior to the MB/CP mixture for weed control. Shank injection is the standard practice for soil fumigation in strawberry production. An alternative method of fumigation is application of emulsified forms of fumigants through the drip irrigation system. This method of application has both economic and environmental benefits to offer. The objective of these experiments was to evaluate the weed control efficacy of three MB alternatives applied through the drip irrigation system.

Materials and Methods

Two field trials were conducted in 1999 in major strawberry production areas; near Salinas and Watsonville, CA. Soil was shaped into raised beds 30 cm high and 76 cm wide. Two drip tapes were buried 2 to 5 cm deep in each bed and located 10 cm on either side of the bed center. Emitters were 30 cm apart and flow rate was 0.87 L/hr at 1 bar.

Plastic mesh bags containing weed seed were buried in the field before fumigation. Each bag contained 50 seeds of three common strawberry weeds: common purslane (*Portulaca oleracea*), little mallow (*Malva parviflora*), prostrate knotweed (*Polygonum aviculare*). Seed samples were buried 5 cm deep near the center and at the side of the bed.

Emulsified forms of fumigants were applied preplant through the drip irrigation system into beds covered with polyethylene mulch. Nitrogen pressurized cylinders or a positive displacement pump equipped with metering values were used for application. 1,3-D was applied as Inline (58% 1,3-D and 33% CP) at 280 or 468 kg/ha. Metam sodium was applied as vapam HL, (42%) at 77 and 115 L/ha. CP was applied as chloropicrin EC (96% CP) at 220 kg/ha. Two sequential treatments were also applied 1) 1,3-D at 280 kg/ha followed five days later by 77 L/ha of metam sodium and 2) CP at 176 kg/ha followed by 77 L/ha metam sodium. Emulsified fumigants were applied in one of three volumes 26, 43 and 61 L m^{-2} of water. For comparison MB/CP (67:33) and Telone C 35 (61% 1,3-D and 35% CP) were shank applied at 467 kg/ha. Soil was covered with polyethylene mulch at the time of shank injection. Treatments were arranged in a randomized complete block design with 4 replications at Watsonville and three replications at Salinas. Plots were one bed wide by 3 m in length at Watsonville and 9.1 m long at Salinas

Seed samples were removed approximately 4 weeks after fumigation. Viability of weed seeds was tested using tetrazolium salts. The effect of treatments on native weeds was measured by collecting and measuring the fresh weight of the weeds from each plot.

Results and Discussion

None of the treatments provided effective control of little mallow seed. Percentage viable little mallow seed was not reduced relative to the untreated control by any treatment at either site (Table 1). At Watsonville drip applied 1,3-D reduced seed viability compared to MB/CP. At Salinas the percentage viable little mallow seed was higher than the untreated control for some of the 1,3-D treatments. Prostrate knotweed was more sensitive to treatments than little mallow. At Watsonville, all treatments reduced the percentage of viable prostrate knotweed seed buried at the center of the bed. The effectiveness of the treatments was less for samples buried at the side. Only MB/CP differed from the untreated. The degree of variation in results among samples buried at the side was large, but significant differences between locations were found. Metam sodium, drip applied CP and the lower rate of 1,3-D were less effective at the side of the bed than at the center. At Salinas all treatments except metam sodium alone reduced the percentage of viable prostrate knotweed seed. For seed buried at the side, the 1,3-D and shank applied treatments reduced the percentage of viable prostrate knotweed seed, but drip applied metam sodium and CP did not. Differences between sample location within the bed were not found at Salinas, but the trend for greater percentage viable seed from side samples was observed. Common purslane was the most sensitive of the three weed species to the treatments. At both MBA and Salinas all treatments reduced percentage viable seed of center buried samples. For samples buried at the side of the bed all treatment except metam sodium alone were effective.

Application water volumes between 26 and 61 L m^{-2} did not affect weed control provided by 1,3-D or metam sodium. A difference between the 280 and 468 kg/ha rates of 1,3-D rates were not found for prostrate knotweed or common purslane. For little mallow seed at Watsonville, the 468 kg/ha application was more effective than 280 kg/ha in two of the three volumes of water. The effectiveness of drip applied CP or 1,3-D was not improved by the additional application of metam sodium.

Drip applied CP and 1,3-D provided better control of the native weed population than their equivalent shank applied treatments (Table 2). Metam sodium alone provided fair weed control. Weed control was better when vapam was combined with CP or 1,3-D.

Weed seed differed in their sensitivity to fumigation. In this study the order from most to least sensitive was: common purslane, prostrate knotweed and little mallow. With the exception of metam sodium, treatments were as effective as MB/CP on weed seed. Differences in effects between seed buried near the center and at the side of the bed were found. Seed buried at the center had lower percentage viable seed. Differences in the physical properties of the fumigants and soil type and condition influence the movement of drip applied fumigants. These studies indicate that drip applied fumigants are more effective near the center of the bed than at the side.

Table 1. The effect of alternative fumigants on the viability of little mallow, prostrate knotweed and common purslane seed. Fumigants were applied through the drip irrigation system (drip-ir) or by shank injection. Drip applied fumigants were delivered in one of three volumes of water: 26, 43 and 61 L m^{-2}. Field studies were conducted at two sites: Watsonville (Watson) and Salinas, CA. Seed samples were buried near the center and at the side of a bed.

				Little Mallow				Prostrate Knotweed				Common Purslane			
		Applic.	Water	Watson		Salinas		Watson		Salinas		Watson		Salinas	
Fumigant	Rate	method	volume	center	side	center	side	center	side	center	side	center	side	center	side
	per ha		mm	% viable				% viable				% viable			
1,3-D	280 kg	drip-ir	25	85.5	84.8	79.7	80.7	0.3	82.5*	0.0	15.0	0.8	5.5	0.0	0.7
1,3-D	468 kg	drip-ir	15	75.0	78.0	77.3	80.7*	0.3	57.8	0.3	0.0	0.0	1.5	0.0	0.7
1,3-D	468 kg	drip-ir	25	77.5	76.5	87.0	73.3	0.0	47.5	5.0	1.0	0.5	0.3	0.0	0.0
1,3-D	468 kg	drip-ir	35	77.3	80.3	85.3	80.7	1.3	44.5	0.0	37.0	0.0	0.0	0.0	0.0
metam s.	77 L	drip-ir	25	80.5	83.8	79.3	73.3	11.8	85.0*	49.0	96.7	0.0	46.3	0.0	43.3
metam s.	77 L	drip-ir	25	84.3	77.3	82.0	84.7	6.5	87.8*	60.7	100.0	0.3	94.8*	0.0	30.0
metam s.	115 L	drip-ir	35	79.3	80.0	83.3	78.3	2.3	78.0*	74.3	83.7	1.0	71.8	34.0	60.7
CP	176 kg	drip-ir	15	80.5	84.3	77.3	76.7	4.0	83.8*	33.7	58.3	0.0	0.8	0.7	0.0
CP fb[z] metam s.	176 kg fb 77 L	drip-ir	25	79.8	75.5	83.7	78.7	0.3	61.3*	0.0	59.0	0.5	0.0	0.0	0.0
1,3-D fb metam s.	280 kg fb 77 L	drip-ir	25	82.5	78.0	83.3	84.3	26.3	27.8	0.0	50.0	0.3	0.0	0.0	34.0
1,3-D/CP	468 kg	shank	--	86.8	79.5	78.7	80.0	1.0	39.3	2.0	34.3	0.0	0.3	0.0	9.4
MB/CP	468 kg	shank	--	88.3	83.5	80.7	78.7	0.5	3.5	21.3	32.3	0.0	0.3	0.0	0.0
Untreated	--	--	--	82.8	80.0	74.0	70.0	98.3	79.8	94.3	100.0	70.8	72.8	96.0	90.7
LSD				8.0	10.0	9.7	11.7	21.2	54.2	45.6	58.8	18.9	33.3	24.3	47.6

* asterisks note a significant difference in results between samples buried at the center and side of the bed.

[z]fb=followed by

Table 2. Weed biomass and percentage weed control for fumigant treatments. Dominant weeds were California burclover, common chickweed, little mallow and shepherdspurse. Weed biomass data was collected at only for the Salinas field study.

Fumigant	Rate	Application method	Weed Biomass	Percentage[z] Weed Control
	per ha		kg	%
1,3-D	280 kg	drip-ir	2.2 cd[y]	84
1,3-D	468 kg	drip-ir	1.4 d	90
metam s.	77 L	drip-ir	6.5 bc	54
metam s.	115 L	drip-ir	5.1 bcd	64
CP	176 kg	drip-ir	2.1 d	85
CP fb metam[x] sodium	176 kg fb 77 L	drip-ir	1.9 d	87
1,3-D fb metam sodium	280 kg fb 77 L	drip-ir	2.3 cd	84
MB/CP	468 kg	shank	3.8 bcd	73
Untreated	--	--	14.1 a	100

[z] Percentage of untreated control.

[y] means followed by the same letter do not significantly differ.

[x] fb=followed by