EFFECTS OF MULCH TYPE ON THE EFFICACY OF DRIP-APPLIED SOIL FUMIGANTS

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INTRODUCTION

The recent introduction of emulsifiable (EC) formulations of 1,3-DC has made application of this material through drip irrigation to raised, mulched beds an potential alternative to methyl bromide for suppression of weeds and soilborne pathogens. The movement and distribution of emulsifiable 1,3-DC in mulched beds on sandy soils, and how these factors impact control of soil pathogens and nematodes, has not been investigated completely.

The purpose of this study was to evaluate the effects of emulsifiable 1,3-DC, applied via drip tape, on the survival of *Rhizoctonia solani*, *Fusarium solani*, *Pythium irregulare* at the center, midway from center, and edge of raised, plastic-mulched beds. Two types of plastic mulch, low-density polyethylene (LDPE) and virtually impermeable film (VIF – reported to improve retention of fumigant within the bed), were examined, and comparisons were made using one or two drip lines per bed. Effects of mulch type and number of drip lines on yield and root galling caused by *Meloidogyne incognita* were also evaluated.

MATERIALS AND METHODS

An experiment was initiated March and April 2003 at the Blackshank Farm in Tifton, GA on a Fuquay loamy sand (loamy, siliceous, thermic Arenic Plinthic Paleudults). Applications of 1,3-dichloropropene (65% v/v) plus chloropicrin (35% v/v) EC (emulsifiable concentrate) were made at a rate of 327 L/ha to raised, 76.2-cm-wide beds 3 weeks prior to transplanting of tomato (cv. Amelia). Beds were covered with either LDPE or VIF mulch and drip lines, either one in the center or two spaced equidistantly, were put un place prior to application of 1,3-DC EC. Reference treatments included methyl bromide (chisel injected at a rate of 336 kg/ha), and 1,3-D without chloropicrin (drip applied at 206 L/ha).

Treatment effects on the survival of fungi were determined by burying nylon-mesh packets containing 10 beet seed colonized with either *R. solani*, *F. solani*, or *P. irregulare*. Packets were buried at a depth of 7.62 cm at the centerline, midway between the centerline and edge, and the edge of each bed. Nematode counts (numbers of juveniles per unit of soil) were determined from soil samples taken at harvest, and tomato roots were evaluated for severity of root galling on a 0-10 scale where 0=no galls and 10=maximum galling. Tomatoes were harvested 3 times. Analysis of variance (ANOVA) was performed on the data, and treatment means were separated using Fisher's protected least significant difference test (FLSD).

RESULTS AND DISCUSSION

In general, survival of *R. solani*, *F. solani*, and *P. irregulare* were significantly reduced by applications of 1,3-DC made through drip tape and chisel-injected methyl bromide when compared to the untreated control (Table 1). Performance of drip-applied 1,3-DC EC was equal to chisel-applied methyl bromide regardless of location within the bed. No effect of mulch type on pathogen survival was observed for any organism at the bed center or midway between the bed center and the edge; however, where 1 drip line was used, survival of *R. solani* at the edge of the bed was less under VIF than LDPE. Where 1 drip tape was used to apply fumigant, survival of *R. solani* and *F. solani* was slightly higher at the edge of the bed. Although not considered to be fungicidal, 1,3-D, without chloropicrin, suppressed *P. irregulare* in packets buried closest to the drip line (bed center).

Yield of tomato was significantly reduced, compared to methyl bromide, by 1,3-DC applied via two drip lines under VIF, and for 1,3-D under VIF (Table 2). No differences in yield or gall index were observed between the untreated check and any treatment.

In conclusion, the number of drip lines used to deliver 1,3-DC had a greater effect than the type of mulch used to cover the bed in terms of pathogen survival, although small effects were observed in packets buried furthest from the drip line. The tendency toward increased survival of *R. solani* and *F. solani* at the edge (shoulder) of the mulched bed may indicate the potential for later-season infection by certain fungal pathogens. Given the lack of significant effects on yield, the additional expense incurred by the use of two drip lines or VIF mulch where 1,3-DC EC is applied may not be an economically viable practice.

Table 1. Survival of *Rhizoctonia solani*, *Fusarium solani*, and *Pythium irregulare* at three locations on raised, plastic-mulched beds after drip application of 1,3-DC EC prior to transplanting of 'Amelia' tomato.

Treatment[a]	No. drip tapes	Mulch type[b]	Pathogen survival (number viable / 10)[c]								
			R. solani			*F. solani*			*P. irregulare*		
			C	M	E	C	M	E	C	M	E
1,3-DC EC	2	LDPE	0 c	0 b	2 bc	0 b	0 b	0 d	0 b	0 b	0 b
1,3-DC EC	2	VIF	0 c	0 b	0 c	1 b	0 b	1 cd	0 b	0 b	0 b
1,3-DC EC	1	LDPE	0 c	2 b	4 b	0 b	2 b	3 b-d	0 b	0 b	0 b
1,3-DC EC	1	VIF	0 c	0 b	0 c	0 b	0 b	4 cd	0 b	0 b	0 b
1,3-D EC	1	LDPE	9 a	10 a	10 a	10 a	7 a	10 a	0 b	6 a	8 a
1,3-D EC	1	VIF	6 b	10 a	10 a	8 a	10 a	6 a-c	0 b	2 b	10 a
Methyl bromide	--	LDPE	0 c	0 b	0 c	2 b	2 b	2 cd	0 b	0 b	0 b
Untreated check	--	LDPE	8 ab	10 a	10 a	10 a	10 a	8 ab	5 a	4 ab	8 a

Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (P=0.05).

[a]1,3-DC=Emulsifiable concentrate containing 1,3-dichloropropene (65%) plus chloropicrin (35%) applied at 327 L/ha; 1,3-D=1,3-dichloropropene without chloropicrin, applied at 206 L/ha; methyl bromide 67% contained 33% chloropicrin by weight and was chisel-injected.

[b]LDPE=low-density polyethylene, VIF=virtually impermeable film.

[c]Survival of *Rhizoctonia solani*, *Fusarium solani*, or *Pythium irregulare* on beet seed. Packets containing pathogens were buried at three locations on raised, plastic-mulched beds: C=center of bed, M=midway between center and edge, and E=edge of bed.

Table 2. Effects of drip-applied 1,3-DC on yield (kg/plot) and root-gall indices (at 45 days) of tomato cv. Amelia.

Treatment[a]	No. drip tapes	Mulch type[b]	Yield (kg/plot)		Root gall index (0-10)[b]	
1,3-DC EC	2	LDPE	45.0	ab	0	a
1,3-DC EC	2	VIF	37.2	b	0	a
1,3-DC EC	1	LDPE	35.7	b	0	a
1,3-DC EC	1	VIF	42.9	ab	0	a
1,3-D EC	1	LDPE	41.8	ab	0	a
1,3-D EC	1	VIF	32.3	b	0.1	a
Methyl bromide	1	LDPE	50.5	a	0	a
Untreated check	1	LDPE	42.3	ab	0.7	a

Means followed by the same letter do not differ significantly as determined by Fisher's protected least significant difference test (P=0.05).

[a]1,3-DC=Emulsifiable concentrate containing 1,3-dichloropropene (65%) plus chloropicrin (35%) applied at 327 L/ha; 1,3-D=1,3-dichloropropene without chloropicrin, applied at 206 L/ha; methyl bromide 67% contained 33% chloropicrin by weight and was chisel-injected.

[b]Root Gall Index 0-10 scale whereby, 0 = no galls, 1 = very few small galls, 2 = numerous small galls, 3 = numerous small galls of which some are grown together, 4 = numerous small and some big galls, 5 = 25 % of roots severely galled, 6 = 50 % of roots severely galled, 7 =75 % of roots severely galled, 8 = no healthy roots but plant is still green, 9 = roots rotting and plant dying, 10 = plant and roots dead.

Herbicide (Treflan @ 0.75 lbs/acre) was applied before installing plastic beds in treatments 1, 2, 3, 4, 5 and 6.