Institute of Food and Agricultural Sciences
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Evaluating Nutsedge Control with Various Formulations And Rates of 1,3-dichloropropene Chemigated Using Drip Tape Under Two Polyethylene Mulches[1] 2002-02

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Abstract. Plasticulture is important to the success of the vegetable industry in Florida. Soil fumigation using methyl bromide and chloropicrin has been a standard. Due to the phase out of methyl bromide in 2005, effective alternatives to methyl bromide are needed to maintain profitability in vegetable production using plasticulture. The soil fumigant, 1,3-dichloropropene, has been at the focus of research for alternatives to methyl bromide in Florida. This study was conducted to evaluate the effectiveness of various formulations and rates of 1,3-dichloropropene and chloropicrin when chemigated into a drip irrigation system for the control of nutsedge using two types of polyethylene mulch. Significantly fewer nutsedges emerged through the VIF film compared to the low-density film when the soil was treated with InLine at both rates and when Telone C-35 was injected into the soil. No differences in nutsedge emergence were observed between the two mulches when no fumigant was used or when Telone EC was applied at 14 gallons per acre.

Introduction and Review of Literature

Plasticulture is important to the success of the vegetable industry in Florida. Soil fumigation using methyl bromide and chloropicrin has been a standard component for the plasticulture system (Overman and Martin, 1978; Overman and Jones, 1984; Maynard and Olson, 2001). EPA has legislated the phase-out of methyl bromide by 2005 and this has resulted in increased costs and reduced supplies. Effective

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alternatives to methyl bromide are needed to maintain profitability in vegetable production using plasticulture.

The soil fumigant, 1,3-dichloropropene, has frequently been the focus of research alternatives to methyl bromide (Gilreath et al., 1994; Gilreath et al., 1997; Gilreath et al., 1999; Jones et al., 1995; Locascio et al., 1997; Locascio et al., 1999; McSorley and McGovern, 1996; Stall, 1994; Stall and Gilreath, 1996). Most research with 1,3-dichloropropene in a plasticulture system has been conducted with a standard low density or high-density films. Few research studies have been conducted using virtually impermeable polyethylene films (Wang, 1997; Nelson et al., 2000). This study was conducted to evaluate the effectiveness of various formulations and rates of 1,3-dichloropropene and chloropicrin for the control of nutsedges (*Cyperus esculentus, C. rotundus)* when chemigated into a drip irrigation system. Two types of polyethylene mulch were used in this study to determine differences of effectiveness of fumigation.

Materials and Methods

Plots were established in the fall of 2001 in Lakeland fine sand at the North Florida Research and Education Center – Suwannee Valley near Live Oak, Florida. Soil was prepared by rototilling to a depth of eight inches. Soil was then overhead irrigated to provide adequate moisture for forming beds. Beds were established on 7.5 ft centers. Plots were arranged in a randomized split plot design with four replications. The fumigant formulations used were: no fumigant (untreated), 61.1% 1,3-dichloropropene and 34.7% chloropicrin (Telone C-35®), 60.8% 1,3-D and 33.3% chloropicrin (Inline®), and 91.7% 1,3-D and 8.3% inert ingredients (Telone EC®). To distinguish between the formulations, trade names will be used. The Telone C-35 treatment was applied at 35 gallons per acre (gpa) to plots via a tractor mounted fumigation rig on 20 Sept 2001. Injection placement was 12 inches deep into a preformed bed via shanks spaced every 12 inches. Mulch treatments were applied immediately after application of Telone C-35. All other treatments were applied using chemigation via a drip irrigation system under mulch treatments. Inline was applied at 23.4 and 33.1 gpa, and Telone EC was applied at 14.3 gpa. Mulch treatments (applied on 20 Sept.) were either low-density polyethylene film (Pliant Corp, Schaumburg, IL) or virtually impermeable polyethylene film (VIF) (Klerk's, Richburg, SC). Each mulch plot was 75 feet long. Final pressed beds were 36 inches wide and 6 inches high. Each bed had 2-drip irrigation tapes laid on the bed surface in a one-inch deep groove. The drip tapes were positioned 12 inches from each shoulder of the bed resulting in a spacing of 12 inches between drip tapes. Roberts RoDrip (San Marcos, CA) drip irrigation tape with emitters at 12 inch spacing and a flow rate of 24-gal/hr/100 ft was used. Chemigated treatments were applied on 24 Sept. 2001 using nitrogen gas as the propellant and metering devices supplied by Dow

AgroSciences (Cary, NC). Chemigation treatments were delivered over a total run time of 257 minutes.

Cabbage transplants were planted 14 and 21 days after chemigation in the center of each mulched plot as a bioassay. Five plants per plot were planted on each date. Soil moisture was maintained in all plots by drip irrigation. Soil moisture sensors (Watermark®, Irrometer Co., Riverside, CA) were used to schedule irrigation events to maintain soil moisture at 8-12 centibars at 12 inches in depth in the bed center. Observational soil temperature readings were periodically taken mid-day under the mulched plot area in the bed center at a depth of 3-4 inches. Final nutsedge counts were taken on 22 Oct 2001 in each mulch plot (75 x 3 ft) area. All data were subjected to analysis of variance procedures. Mean separation was performed using Duncan's Multiple Range tests. Significant differences between mulch types were analyzed using single degree of freedom orthogonal comparisons.

Results and Discussion

Soil temperatures under the mulch at 3-4 inches deep during the first three weeks after chemigation ranged between 90-105^{o}F (data not shown). Cabbage plants from both planting dates in all plots survived with no observed adverse effects of any fumigation or mulch treatment (data not shown). This indicated that adequate dissipation of the fumigants had occurred by 2 weeks after application. The cabbage plants were used only as an indicator and not grown to harvest.

Nutsedge plants had begun to grow and pierce the plastic mulch in plots to be chemigated on 24 Sept. These plots were formed on 20 Sept. but not chemigated until 24 Sept. Both yellow and purple nutsedge (*Cyperus esculentus L.* and *Cyperus rotundus L.*) were present in the plots, however, most plants (80%) were yellow nutsedge. Nutsedge plant counts taken on 22 Oct. showed mean populations ranged from 11 to 502 plants per 75 ft of running mulched bed area, or 0.04 to 1.68 plants per square foot of mulched area.

There was a significant interaction of mulch type by fumigant formulation. Mean separations of nutsedge control due to fumigant type were done separately by mulch type.

There were significantly fewer nutsedges emerging through the VIF film compared to the low-density film when the soil was treated with InLine at both rates, and when Telone C-35 was injected into the soil at 35 gpa (Table 1.). No significant differences in nutsedge emergence were observed between the two mulches when no fumigant was injected or when treated with Telone EC at 14.3 gpa.

The results were similar when evaluating nutsedge emergence through the VIF film. Both InLine treatment rates and the Telone C-35 treatment reduced the nutsedge emergence significantly. Only the InLine formulation applied at 33.1 gpa reduced nutsedge emergence significantly lower than the untreated check with the low-density film. The Telone C-35 injected at 35 gpa had fewer nutsedges emerging than did the InLine formulation when applied at 23.4 gpa.

These results show that the use of VIF improved the control of nutsedges by 1,3-D formulations except where the rate was too low for control (Telone EC). The rate of 1,3-D plus chloropicrin applied under the low-density film also was significant in the control of nutsedges. The InLine formulation applied at 23.4 gpa had significantly more nutsedges emerging than did the same formulation applied at 33.1 gpa.

This trial used two drip tapes per 36-inch wide bed. The pattern of fumigation within the bed appears to be sufficient from shoulder to shoulder (36 inches) using the presence of nutsedge as a measure of effective soil fumigation. The emergence or absence of nutsedge was uniform across the mulched bed area.

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Table 1. Comparisons of control of nutsedges among 1,3 dichloropropene formulations and rates by mulch type.

Fumigant Treatment	Rate (gal/acre)	Nutsedge (no. 1 ft^2) Mulch type LD[z]	VIF[y]	Sig.[x]
Untreated	0	1.46 ab[w]	0.80 a[v]	NS
Inline	33.1	0.50 c	0.04 b	**
Inline	23.4	1.68 a	0.20 b	**
Telone EC	14.3	1.46 ab	0.88 a	NS
Telone C-35	35.0	0.74 bc	0.06 b	**

[z] LD mulch was a low density polyethylene film (Pliant Corp.)
[y] VIF mulch was a virtually impermeable polyethylene film (Klerk=s)
[x] Significance of LD vs VIF by fumigant treatment by orthogonal comparisons
[w] Significant differences among fumigant treatments in LD mulch
[v] Significant differences among fumigant treatments in VIF mulch.