MOVEMENT OF DRIP-APPLIED 1, 3-DICHLOROPROPENE BEYOND THE WATERFRONT

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The sandy soils used for plastic mulch vegetable production in the Southeastern US are difficult to wet completely with drip irrigation systems. Recent research has focused on optimizing the distribution of drip-applied water in an effort to improve delivery of emulsified soil fumigants through these drip systems. Ajwa et al. (2001) demonstrated that 1, 3-dichloropropene (1, 3-D) diffused beyond the area wetted by drip-applied water. The studies reported here were conducted to gain a better understanding of 1, 3-D movement outside of the wetted area. We also wanted to determine the extent of biological activity outside of the wetted area and to examine the effect of application rate, application concentration and subsequent irrigation events on movement and activity of 1, 3-D.

Trials were conducted at the University of Georgia's Coastal Plain Experiment Station, Tifton, GA, and the University of Florida's Gulf Coast Research and Education Center, Bradenton, FL. Soil type at the Tifton location was a Fuquay loamy sand and at Bradenton, the soil type was EauGallie fine sand. Beds 32 in wide and 8 in tall were covered with black polyethylene mulch film. A single drip tube was installed in the center of the bed, just below the soil surface as the plastic mulch was applied. InLine®, an emulsified formulation containing 60.8% 1, 3-D and 33.3% chloropicrin, was injected into plots through the drip tubes. At Tifton, 35 gallons per treated acre was applied in concentrations of 1000 and 1500 ppm of 1, 3-D. In the Bradenton study, rates of 26 and 35 gallons per treated acre were applied at a concentration of 1500 ppm of 1, 3-D. In addition, the 35 gallon rate was applied at 1000 ppm. In both studies, an additional treatment of 35 gallons of InLine at 1500 ppm was applied and the drip system was operated for 3.5 hr at one and two days after the initial application. Blue marking dye (Signal®) was injected at 1 qt per 100 gal of water concurrent with all InLine injections. Plots were 27 ft long at Tifton and 20 ft long at Bradenton and were replicated four times in a randomized complete block design.

Concentrations of 1, 3-D in soil gas were determined using Gastec® detection tubes (#132HA or #132L) capable of detecting 2-450 ppm of 1, 3-D. Concentrations were measured in the bed center, mid-way between the bed center and bed shoulder, and at the bed shoulder. Measurements were taken from a ½ inch diameter, 6 in deep hole cored into each location. A Sensidyne® Gas Detection Pump (Model AP-1S) was used to draw 50 - 200 ml of air from each hole through the detection tube.

Plots were located in fields with dense populations of nutsedge (*Cyperus* spp.) as a biological indicator of the distribution of effective concentrations of 1, 3-D. At 7 days after application, plastic was removed from the plots and drip tube emitters were located. Width of nutsedge control was measured in a two-inch band centered on the emitter. A trench was then excavated across the bed at the level of the emitter and the width of the dye pattern was measured.

Concentrations of 1, 3-D in the soil air are given in Tables 1 and 3. In all cases, 1, 3-D concentrations were highest in the bed centers and lowest in the shoulders. Application of InLine at 35 gallons per acre in a concentration of 1000 ppm consistently resulted in significantly lower air concentrations than did application of the same rate in a concentration of 1500 ppm (Table. 1). Similarly, 26 gallons per acre resulted in significantly lower air concentrations than did 35 gallons per acre applied in the same concentration (1500 ppm). Irrigation events subsequent to application significantly reduced 1, 3-D concentrations at all bed locations in both trials with the exception of the bed shoulder at Bradenton (Table 3).

Width of water distribution and nutsedge control were similar across all treatments at Bradenton (Tables 2 and 4). At Tifton, reducing application concentration to 1000 ppm resulted in reduced width of nutsedge control although widths of water distribution were similar. Subsequent irrigations at Tifton increased the width of water distribution, but not the width of nutsedge control. In all treatments, width of nutsedge control was significantly greater than the width of water distribution, indicating that biologically active concentrations of 1, 3-D did move beyond the area wetted by drip irrigation water.

Results of these studies suggest that higher application rates and concentrations of InLine result in higher concentrations of 1, 3-D in soil air. Irrigations subsequent to application reduced soil air concentrations of 1, 3-D. Width of nutsedge control was significantly greater than width of water distribution in all cases, indicating that biologically active concentrations of 1, 3-D do move beyond the water front. However, only increased application concentration resulted in increased width of nutsedge control and only in the Tifton trial. In no case was control extended to the full width of the beds, and trials evaluating two drip tubes should be conducted to evaluate that method for improving width of control.

Reference

Ajwa, H., T. Trout, S. Nelson, and M. Schutter. 2001. Drip fumigation: water and fumigant distribution in soil. Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions 2001:50-1 – 50-2.

Table 1. Mean concentrations (PPM) of 1, 3-D in soil air during the first four days following drip application of 26 or 35 gallons of InLine applied at 1000 or 1500 ppm along the bed center. Evaluations were made at bed center and shoulder and mid-way between these two locations. Within trial locations, means followed by the same upper case letter within columns or the same lower case letter within rows are not significantly different according to Tukey's Studentized Range Test (P = 0.10).

	Bradenton, FL			Tifton, GA	
Location On Bed	35 gpa 1000 ppm	35 gpa 1500 ppm	26 gpa 1500 ppm	35 gpa 1000 ppm	35 gpa 1500 ppm
Center	42.6 A b	89.7 A a	40.8 A b	73.0 A b	78.0 A a
Mid-Way	29.8 B b	57.2 B a	26.2 B b	33.5 B b	57.2 B a
Shoulder	7.3 C b	10.9 C a	4.8 C b	6.3 C b	18.8 C a

Table 2. Width (inches)of water distribution and nutsedge control following drip application of 26 or 35 gallons of InLine applied at 1000 or 1500 ppm along the bed center. Within trial locations, means followed by the same upper case letter within columns or the same lower case letter within rows are not significantly different according to Tukey's Studentized Range Test (P = 0.10).

	Bradenton, FL			Tifton, GA	
Variable Measured	35 gpa 1000 ppm	35 gpa 1500 ppm	26 gpa 1500 ppm	35 gpa 1000 ppm	35 gpa 1500 ppm
Water Distribution	16.7 B a	14.0 B a	13.8 B a	13.0 B a	13.3 B a
Nutsedge Control	23.8 A a	26.9 A a	26.3 A a	26.1 A b	27.8 A a

Table 3. Effect of subsequent irrigations on mean concentrations (PPM) of 1, 3-D in soil air during the first four days following drip application of 35 gallons of InLine applied at 1500 ppm along the bed center. Evaluations were made at bed center and shoulder and mid-way between these two locations. Within trial locations, means with the same upper case letter within columns or the same lower case letter within rows are not significantly different according to Tukey's Studentized Range Test (P = 0.10).

Location	Bradenton, FL		Tifton, GA	
On Bed	Irrigated	Non-Irrigated	Irrigated	Non-Irrigated
Center	50.4 A b	89.7 A a	56.2 A b	78.0 A a
Mid-Way	38.2 B b	57.2 B a	43.2 A b	57.2 B a
Shoulder	7.6 C a	10.9 C a	9.6 B b	18.8 C a

Table 4. Effect of subsequent irrigations on width (inches) of water distribution and nutsedge control following drip application of 35 gallons of InLine applied at 1500 ppm along the bed center. Within trial locations, means with the same upper case letter within columns or the same lower case letter within rows are not significantly different according to Tukey's Studentized Range Test (P = 0.10).

Variable Measured	Bradenton, FL		Tifton, GA	
	Irrigated	Non-Irrigated	Irrigated	Non-Irrigated
Water Distribution	15.7 B a	14.0 B a	16.1 B a	13.3 B b
Nutsedge Control	25.7 A a	26.9 A a	27.1 A a	27.8 A a