Do Prowl and Treflan Cause Cotton Injury?

Jody Moffett, William B. McCloskey, Stephen H. Husman and Gary L. Dixon

Abstract

Two dinitroaniline herbicides, Prowl and Treflan, were tested in field experiments with cotton to determine their differences, if any, in terms of weed control and crop injury potential. Plots treated with the lowest rate of Treflan (0.125 lb a.i./A at one location and 0.25 lb a.i./A at a second location) exhibited reduced weed control in comparison to the other herbicide treatments. Although root inhibition was slight, lateral root growth of cotton was inhibited more by the higher rates of Treflan (0.75 and 1.0 lb a.i./A) than by the higher rates of Prowl (1.0 and 1.25 lb a.i./A). However, differences in weed control and crop injury were not reflected in differences in cotton stand counts, height measurements and yield as there were no significant differences in these parameters between treatments.

Introduction

Dinitroaniline herbicides have been used since the 1960's to control both grass and small seeded broadleaf weeds in a variety of crops. These herbicides disrupt plant cell division and their primary symptom of injury is the inhibition of root development. Cotton, partly due to its large seed size, is tolerant of dinitroaniline herbicides, and for this reason, these herbicides are used extensively in cotton production. However, under some conditions, cotton plants can exhibit root injury in response to the use of these herbicides. Dinitroaniline herbicides at high rates, particularly in greenhouse studies where rooting volume is restricted, can affect cotton seedling root development (Hamilton and Arle 1976, Murray et. al. 1979). This study was aimed at determining if two extensively used dinitroaniline herbicides, Prowl and Treflan, differed in their potential to cause crop injury and control weeds in the field. Field plots were established and treated with various rates of each herbicide and data on weed control, cotton stand establishment, height, lateral root development, and yield were collected.

Materials and Methods

Plots were established at three locations for this experiment; Goodyear, Buckeye, and the Maricopa Agricultural Center (MAC). The Goodyear and Buckeye locations are on a Gilman Loam (sand 52.6%, clay 10.6%, and silt 36.8%) and the MAC location is on Casa Grande Sandy Clay Loam (sand 50%, clay 25%, and 25% silt). The experiment included six rates each of Prowl 3.3 EC and Treflan 5 EC (see Tables 1, 2, and 3 for rates), a hand weeded weed free check that was not treated with herbicides, and a weedy check that received no weed control measures. Herbicides were applied on the flat, incorporated into the soil through discing and listing and then the cotton was either dry planted (in Goodyear and Buckeye) or planted to moisture (at MAC). The cotton variety used was Delta Pine 5415 and was planted on April 2 at the Goodyear location, April 6 at the Buckeye location, and April 27 at MAC. A randomized complete block design with four blocks was used for these experiments. The plots were six rows by 30 ft. in Goodyear and Buckeye, and four rows by 40 feet at MAC.

Once the cotton had emerged, two 9.84 ft. (3 m) subplots were staked out in each plot. Stand counts and cotton

heights were measured within these subplots. Stand counts were done on May 17 and 28 at the Goodyear location, May 10 and 28 at the Buckeye location and May 24 and June 8 at MAC. Cotton height measurements were done at the same time as the second stand count. At the MAC location on June 15, when the cotton was about a foot tall, cotton plants from selected plots were dug up with a post-hole digger, their roots carefully washed from the soil and dried, and then visually rated for root development. Four representative plants were taken from plots receiving the three highest Prowl and Treflan rates, and the weed free checks. Visual ratings were made by two observers who compared each group of four samples to roots from the non-herbicide treated weed free check. Visual weed control ratings were made on July 8 at the Goodyear location. In general, few weeds were found in the plots at the Buckeye location so no weed control data was collected. At MAC, counts of the number of pigweed (*Amaranthus retroflexus*) and Wright groundcherry (*Physalis wrightii*) in each plot were made on July 26 and used as a measure of weed control. Cotton yield data was collected at the Goodyear location by hand picking 10 ft. in each of the center two rows of selected plots on October 10. Cotton yield data was collected at MAC on October 20 by machine harvesting the center two rows of each plot with a two row picker.

Results and Discussion

Analysis of variance was used to determine if there were significant differences between the two herbicides, or between the herbicides and the controls, with respect to weed control, cotton stand establishment, height, root growth, and yield. The stand count and cotton height data collected at the Buckeye and Goodyear locations revealed no significant differences between any of the treatments (Tables 1 and 2). Analysis of weed control in the Goodyear experiment indicated that significantly more weeds were found in the plots with the lowest rate of Treflan, however, at use rates in Arizona (0.5 lb a.i./A or greater for both Prowl and Treflan) both herbicides provided excellent weed control. The weedy check received a lower weed control rating than any of the herbicide treated plots. A reduction in grass weed control by the lowest rate of Treflan was not significant enough to reduce yields in these plots as cotton yields were similar for all herbicide treated plots. However, weed pressure in the plots receiving no weed control measures was sufficient to cause a reduction in yield (Table 2).

Data from the Maricopa location again indicated no difference between any of the treatments in terms of stand count numbers and height measurements (Table 3). While the highest rate of Treflan appears to exhibit a lower stand count, this value is not significantly different from the other high rates of Treflan or Prowl. Also, this difference is not correlated with a decrease in height or yield, and finally, this reduction is not found at any of the other locations. Overall, pigweed and groundcherry counts at this location were very low but did reveal a greater groundcherry infestation in the plots treated with the lowest rate of Treflan and greater numbers of pigweed in the weedy check as compared to the other treatments (data not shown). Both herbicides inhibited lateral root development compared to the non-herbicide treated check (Table 3). Plants from plots receiving the two highest rates of Treflan exhibited more root injury compared to plants in the Prowl plots (Table 3). But again, the similarity in yield data for all treated plots indicates that differences in root growth inhibition between Prowl and Treflan treated plots were not correlated with yield.

Similarities in stand counts, height measurements and yield found at each location across all treatments indicates that differences in weed control or root injury between Prowl and Treflan are not significant. Despite reduced weed control by the low rate of Treflan, suppression was sufficient to allow for normal yield. The level of root damage under high rates of Treflan was not severe enough to cause any long term damage to the plant. Thus, while differences may exist between Prowl and Treflan, these differences have no measurable effect on cotton establishment and yield under the conditions that these experiments were conducted.

References

Hamilton, K.C. and H.F. Arle. 1976. Preplanting applications of dinitroanilines in cotton. Weed Sci. 24:51-53.

Murray, D.S., J.E. Street, J.K. Soteres and G.A. Buchanan. 1979. Growth inhibition of cotton *(Gossypium hirsutum)* and soybean *(Glycine max)* roots and shoots by three dinitroaniline herbicides. Weed Sci. 27:336-342.

Table 1. Cotton Establishment Data from the Buckeye Location.

Treatments			
Herbicide	Rate	Stand Count (May 28)	Cotton Height
	(lb a.i./A)		(in)
Prowl	0.5	69 a[1]	5.02 abc
	0.625	79 a	5.14 ab
	0.75	67 a	4.93 abc
	0.875	74 a	4.60 bc
	1.0	80 a	5.38 a
	1.25	74 a	4.86 abc
Treflan	0.25	72 a	5.15 ab
	0.375	75 a	4.88 abc
	0.5	75 a	5.16 ab
	0.625	68 a	4.65 bc
	0.75	70 a	4.77 abc
	1.0	66 a	4.39 c
Weed Free Check		69 a	4.88 abc
Weedy Check		79 a	4.97 abc

[1] Values followed by the same letter are not different at the p=.05 probability level using Duncan's Multiple Range Test.

Table 2. Weed Control, Cotton Establishment, and Yield Data from the Goodyear Location.

Treatments					
Herbicide	Rate	Stand Count (May 28)	Cotton Height	Weed Control[1]	Seed Cotton Yield
	(lb a.i./A)		(in)	(%)	(lb/A)
Prowl	0.375	77 ab[2]	3.90 ab	85 ab	4670 a
	0.5	83 ab	3.63 b	89 ab	4564 a
	0.625	79 ab	3.72 b	96 a	
	0.75	74 ab	3.71 b	95 a	4138 a
	0.875	86 ab	3.89 ab	92 a	
	1.0	85 ab	3.78 b	95 a	4137 a
Treflan	0.125	77 ab	4.04 ab	41 c	4164 a
	0.25	83 ab	3.90 ab	76 b	4329 a
	0.375	76 ab	3.93 ab	93 a	
	0.5	84 ab	3.87 ab	94 a	4297 a
	0.625	93 a	3.78 b	97 a	
	0.75	77 ab	3.70 b	97 a	4209 a
Weed free Check		70 b	4.32 a		
Weedy Check		71 b	3.73 b	3 d	2605 b

[1] 100% Control indicates no weeds. Primary weed species were barnyard grass (*Echinochloa crus-galli*), and jungle rice (*Echinochloa colona*), with some yellow foxtail (*Setaria glauca*).

[2] Values followed by the same letter are not different at the p=.05 probability level using Duncan's Multiple Range Test.

Table 3. Cotton Establishment, Root Injury, and Yield Data from MAC

Treatments					
Herbicide	Rate	Stand Count (June 8)	Cotton Height	Lateral Root Growth[1]	Seed Cotton Yield
	(lb a.i./A)		(in)		(lb/A)
Prowl	0.5	132 abc[2]	7.94 ab		2442 abc
	0.625	143 a	7.31 b		2891 a
	0.75	135 ab	7.97 ab		2463 abc
	0.875	122 abc	9.16 a	7.21 ab	2232 abc
	1.0	128 abc	7.31 b	5.87 bc	2535 abc
	1.25	119 abc	7.71 ab	6.79 ab	2684 ab
Treflan	0.25	138 ab	7.55 ab		2541 abc
	0.375	130 abc	7.99 ab		2665 ab
	0.5	131 abc	8.95 ab		2106 abc
	0.625	121 abc	8.19 ab	5.71 bc	2415 abc
	0.75	115 bc	7.48 ab	4.25 c	2023 abc
	1.0	108 c	7.65 ab	3.83 c	2203 abc
Weed free Check		136 ab	7.86 ab	8.46 a	2546 abc
Weedy Check		133 abc	8.41 ab		1621 c

[1] Growth is rated on a scale from 1 to 10, a rating of 10 indicates no growth inhibition.

[2] Values followed by the same letter are not different at the p=.05 probability level using Duncan's Multiple Range Test.