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Comparison of Methods for Spot Treating Johnsongrass in Cotton

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Introduction

Treatments with selective over-the-top herbicides have improved rhizome johnsongrass control in cotton. Cotton production techniques stress "clean" culture, and johnsongrass is usually confined to small areas or isolated plants in Mississippi cotton fields.

The application of over-the-top grass herbicides as spot treatments in cotton is currently a major method of johnsongrass control. Production costs are often reduced by spot spraying over those of broadcast application because less herbicide is usually required. The objective of the experiment reported in this bulletin was to measure the effectiveness of over-the-top grass herbicides for control of johnsongrass using several spot treatment methods, with and without prior use of preplant incorporated trifluralin ((Treflan 4E®).

Materials and Methods

A study was conducted on a silt loam soil (37% sand, 53% silt, 10% clay, 0.9% organic matter, pH 5.6) at the Delta Branch of the Mississippi Agricultural and Forestry Experiment Station, Stoneville, during 1985-1987. Cotton (DES '422' or DES '119') was planted in late April each year on an area which contained a natural infestation of johnsongrass. Treflan was applied at 1.0 lb ai/A (pound of active ingredient per acre) in 1985 or 0.75 lb ai/A in 1986 and 1987 to half the total number of plots, soil incorporated 3 to 4 inches deep by disking twice, operating a field cultivator, and hipping rows in March each year. The beds were re-hipped and then reduced to a final planting height of 3 inches with a row conditioner just prior to planting. Conventional production practices were used as recommended by the Mississippi Cooperative Extension Service.

The entire experimental site received fluometuron (Cotoran 4L®) applied preemergence at 1.25 lb ai/A each year, plus directed postemergence herbicides applied to a 14-inch band. Broadcast rates and application dates of directed sprays were Cotoran 4L + MSMA at 1 + 1.6 lb ai/A on May 21, 1985, Bladex 4L® + surfactant at 0.6 lb ai/A + 0.25% on June 17, 1985; Cotton-Pro 4L® + surfactant at 0.5 lb ai/A + 0.25% on May 16, 1986, Cotoran 4L + MSMA 0.8 + 1.5 lb ai/A on June 4, 1986, Bladex 4L + MSMA at 0.6 + 2 lb ai/A on June 19, 1986; Caparol 4L® + surfactant at 0.5 lb ai/A + 0.5% on May 20, 1987, and Cobra 2E® + Agri-Dex® crop oil concentrate at 0.25 lb ai/A + 0.25% on June 1, 1987. Row middles were cultivated and broadleaf weeds were removed by selective hand hoeing.

Johnsongrass control treatments were arranged factorially (preplant and no preplant Treflan, spot treatments) using a randomized complete block design with three replications. Each plot was four 40-inch rows and 40 feet long. Spot treatments and Treflan were applied to the same plots each year. The herbicides used for spot treatments were SC 1084 (an experimental discontinued after 1985) in 1985 and clethodim (Select 2E®) in 1986 and 1987. Agri-Dex crop oil concentrate was added to all in-season treatments at 1.25% v/v.

Individual spot treatments were made with a 2-gallon hand-held "Spray-Doc® " sprayer (concentrations of 0.12 and 0.24 % v/v), a hand-held "Spot Gun® " (Figure 1) applicator (concentrations of 0.06, 0.12, and 0.24 % v/v), and an electrically weed-activated tractor-mounted spot applicator

Figure 1. Hand spot treatments were made with the "Spot Gun" sprayer shown here or with a 2-gallon "Spray Doc" sprayer.

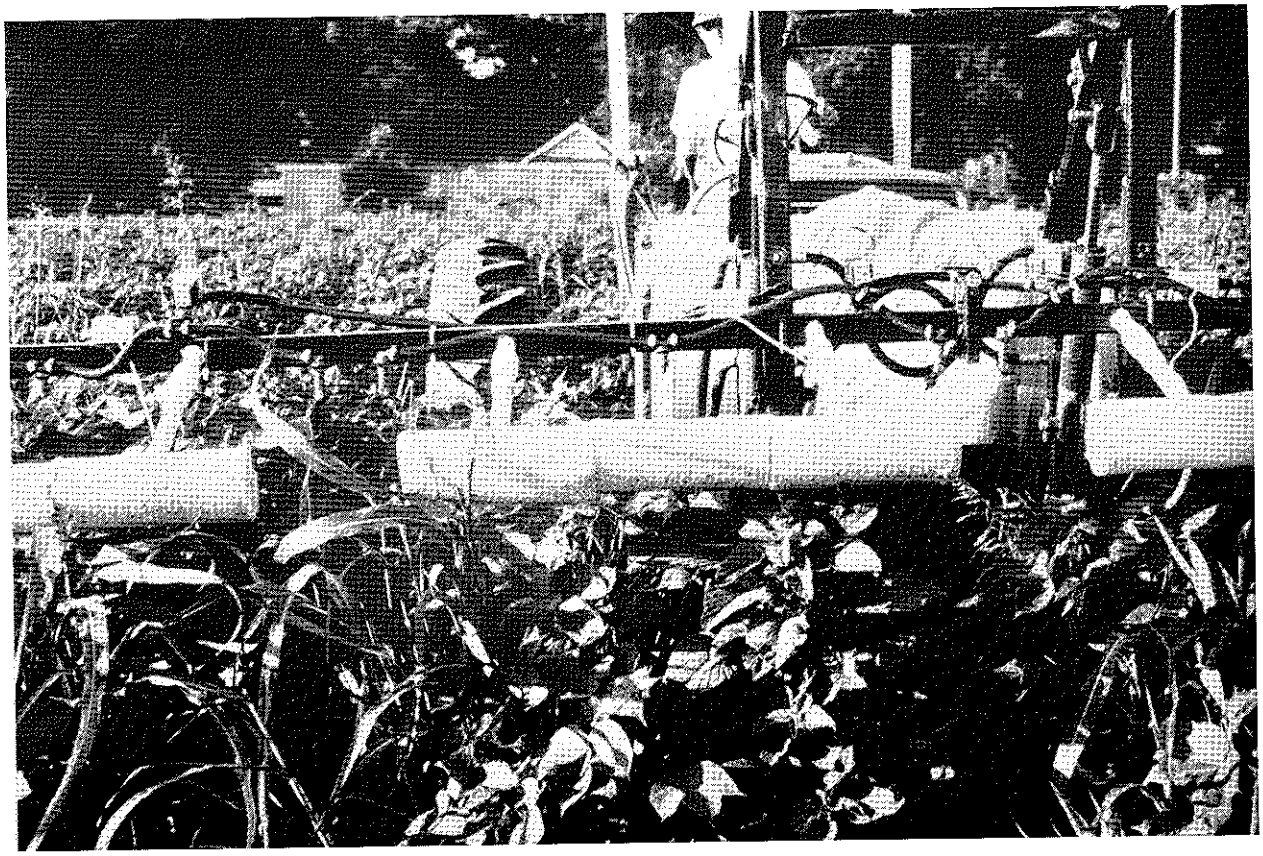
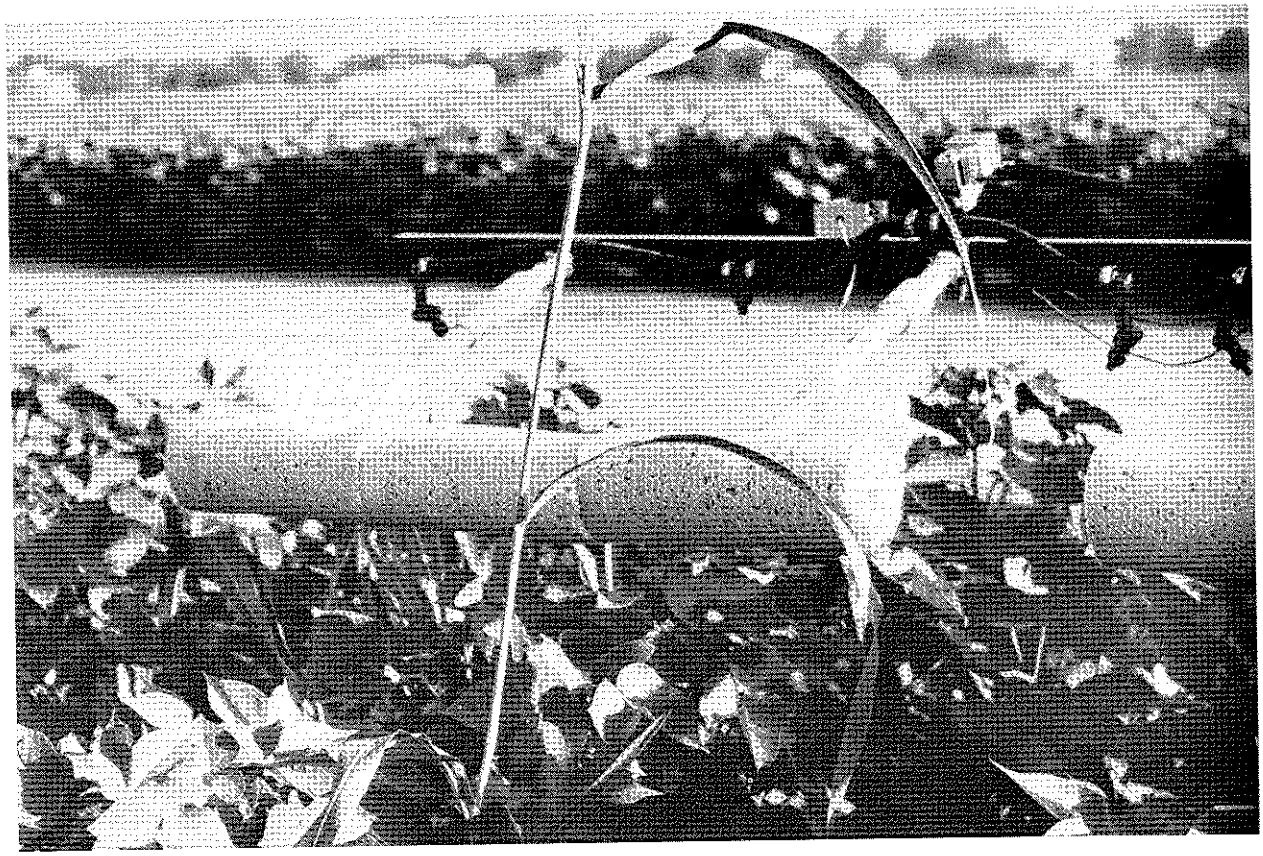


Figure 2. Spot treatments were applied with a tractor-mounted applicator (above) that was electrically activated when sensor contacted a johnsongrass plant (below). Note the three-nozzle spray arrangement.



(Figure 2) applying 0.0625 and 0.125 lb ai/A calibrated to deliver 10 gal/A broadcast volume when activated.

A control treatment of 0.125 lb ai/A of SC 1084 or Select was applied with a conventional boom sprayer using one nozzle per row calibrated to deliver a broadcast volume of 10 gal/A. Treatments applied by hand were made once each season, usually in mid-June. With each pass, two crop rows were sprayed to "cover" johnsongrass foliage. The "Spot Gun" device was calibrated to deliver a measured volume of 5, 10, or 20 ml/squeeze in a straight stream, which was directed toward the main culm(s) of the johnsongrass plants that were at or above the height of cotton plants.

The tractor-mounted spot sprayer consisted of a conventional spray system with three cone tip nozzles per row arranged with one nozzle centered over the row and one on each side directed at a 45-degree angle to the row (Figure 2). A solenoid valve was added to each row to activate the spray nozzles and a sensor that activated the solenoid valve was located about 20 inches ahead of the nozzles. When vegetation (e.g. johnsongrass) contacted the sensor, it activated the spray system for a predetermined time interval. The sensors, solenoids, and spray nozzles were mounted on a frame attached to the front of the tractor. The height of the system was controlled by the tractor's hydraulic system to operate about 4 inches above the cotton plants.

Tractor-mounted spot treatments were applied three times in 1985 and 1986 and two times in 1987. Application time was determined by visually estimating the amount of johnsongrass foliage extending above cotton plants. Conventional boom treatments were applied three times in 1985, once in 1986, and twice in 1987, at or near the time of application with the tractor-mounted spot-sprayer. The volume of spray required for the 2-gallon hand and 'Spot Gun' treatments was measured for each plot.

Control of johnsongrass was determined by counting johnsongrass plants at various times during the year. Seedling johnsongrass plants (separated from rhizome plants based on a height difference) were counted in May each year from an area 1 foot wide by 10 feet long on a preselected row in each plot. Rhizome johnsongrass plants were counted in late season from an area 1 foot wide by 40 feet long on a preselected row in each plot. An additional johnsongrass control evaluation was made by visually estimating the percent control (0 = no control, 100 = complete kill) at mid-or late-season each year on the two center rows of each plot.

Cotton stand was determined by counting plants from one row in each plot. Seed cotton was mechanically harvested once each year from the two center rows in each plot.

Data were subjected to an analysis of variance. Means were separated using Duncan's multiple range test for significance at the 5% level of probability.

Results

Seedling johnsongrass

Treflan use in 1985 resulted in an average increase in johnsongrass control of 39.7% over the no Treflan plots (average 7.3 and 4.4 plants/row foot), based on plant counts made May 14 (Table 1). The respective values for 1986 and 1987 were 86.5% and 90.0% (average 11.1 and 1.5 plants/row foot in 1986, 11.1 and 1.1 plants/row foot in 1987). The average seedling

Table 1. The effect of SC 1084 or Select applied as spot treatments on seedling and rhizome johnsongrass populations. Delta Branch, Mississippi Agricultural and Forestry Experiment Station, Stoneville, MS.

Application [1]		Average johnsongrass plants/row foot[5]											
		Seedling Plants						Rhizome Plants					
		May 14, 1985		May 15, 1986		May 13, 1987		Oct. 4, 1985		Aug. 21, 1986		Aug. 6, 1987	
	Herbicide rate (lb) or concentration	Treflan		Treflan		Treflan		Treflan		Treflan		Treflan	
Method	(%)	−	+	−	+	−	+	−	+	−	+	−	+
		(No.)											
1 nozzle per row [2]	0.125 lb	13.6 a	2.9 bc	19.5 a	3.3 d	7.4 bcd	0.7 d	5.5 a	1.1 ab	0.7 c	0.1 c	0.3 e	0.0 e
2-gallon hand [3]	0.24%	9.8 ab	3.2 bc	8.0 bcd	1.6 d	16.4 ab	1.8 cd	5.6 a	2.7 ab	2.8 bc	0.3 c	4.8 c	0.6 e
2-gallon hand [3]	0.12%	7.6 abc	4.8 bc	17.2 ab	2.7 d	16.4 ab	1.9 cd	4.3 ab	2.7 ab	6.0 a	1.4 bc	7.8 b	2.3 de
Spotgun, 5 ml/squeeze [3]	0.24%	6.7 abc	4.4 bc	7.1 bcd	0.2 d	12.7 abc	1.4 cd	1.1 ab	2.9 ab	2.8 bc	0.5 c	4.4 cd	0.4 e
Spotgun, 10 ml/squeeze [3]	0.12%	3.0 bc	4.4 bc	7.7 bcd	0.3 d	10.3 a-d	0.4 d	0.8 b	1.6 ab	3.8 ab	0.1 c	10.5 a	0.9 e
Spotgun, 20 ml/squeeze [3]	0.06%	6.3 bc	2.4 c	15.5 abc	0.1 d	20.5 a	0.5 d	4.0 ab	1.1 ab	6.7 a	0.4 c	10.5 a	1.8 e
Tractor spot applicator [4]	0.125 lb	3.3 bc	8.9 abc	5.4 cd	3.5 d	2.1 cd	1.5 cd	1.0 ab	5.1 ab	0.7 c	0.3 c	0.0 e	0.0 e
Tractor spot applicator [4]	0.0625 lb	8.2 abc	3.8 bc	8.0 bcd	0.4 d	2.9 cd	0.7 d	1.8 ab	1.9 ab	1.0 c	0.2 c	0.3 e	0.0 e
Standard Error of Mean		2.1		3.2		3.5		1.3		1.0		1.1	
C.V (%)		63.2		89.2		98.6		86.3		79.8		69.6	

[1] Used SC 1084 4E in 1985, Select 2E in 1986 and 1987.

[2] Applied in 10 gallons/acre broadcast volume. Applied June 10, June 25, July 8, 1985; May 21, 1986; and May 22 and June 23, 1987.

[3] Applied June 10, 1985; June 17, 1986; and June 17, 1987.

[4] Applied in 10 gallons/acre broadcast volume when activated. Applied June 10, June 25, July 9, 1985; June 4, June 24, and July 21; and May 28 and June 23, 1987.

[5] Treflan 4E PPI 1.0 lb ai/A in 1985, and 0.75 lb ai/A in 1986 and 1987. Values within each date with the same letter are not different according to DMRT (P=0.05).

johnsongrass population in plots without Treflan increased 34% from 1985 to 1986 and remained stable from 1986 to 1987. The average johnsongrass population in Treflan-treated plots decreased 65% from 1985 to 1986 and further decreased 26% from 1986 to 1987.

Seedling johnsongrass control with multiple application treatments of Select in 1986 and 1987 differed only with the one nozzle per row treatment in 1986 when applied following Treflan compared with plots not receiving Treflan (Table 1). Seedling control in 1985 can only be compared between Treflan and no Treflan because other treatments were not applied until after May 14. On May 15, 1986, seedling johnsongrass control was greater in plots with Treflan with single application treatments of SC 1084 in 1985 using the 2-gallon hand treatment at 0.12% v/v and the "Spot Gun" at 0.06% v/v. Single application treatments made in 1986 resulted in less seedling johnsongrass on May 13, 1987 with Treflan with all treatments except with Select when applied in the "Spot Gun" at 0.12% and 0.24% v/v.

Rhizome johnsongrass

In early October 1985, the average increase in rhizome johnsongrass control with SC 1084 treatments following Treflan was 20% (average 3.0 and 2.4 plants/row foot) (Table 1). Respective values for increased johnsongrass control with Select in 1986 and 1987 were 87% and 83% (average plants per row foot were 3.1 and 0.4 in 1986, and 4.8 and 0.8 in 1987). The average rhizome johnsongrass population increase in treatments without Treflan from 1985 to 1986 was 3%, and from 1986 to 1987 was 55%. With treatments following Treflan, average rhizome johnsongrass populations decreased 83% from 1985 to 1986 but increased 50% from 1986 to 1987.

Johnsongrass control in all treatments with SC 1084 in 1985 following Treflan did not differ from those without Treflan (Table 1). Without Treflan, the number of rhizome johnsongrass plants was less with SC 1084 at 0.12% in the 'Spot Gun' than at 0.24% with the 2-gallon hand or the one-nozzle-per-row treatments. Multiple application treatments with Select in 1986 and 1987 without Treflan provided equal rhizome johnsongrass control to comparable treatments with Treflan. In 1986, single applications of Select with the 2-gallon hand treatment at 0.12% and the "Spot Gun" treatment at 0.12% resulted in more rhizome johnsongrass plants in late August without Treflan than with those treatments applied following Treflan. All single application spot treatments of Select in 1987 following Treflan had fewer rhizome johnsongrass plants in early August than those without Treflan.

Visual rhizome johnsongrass control in July or September with spot treatments of SC 1084 or Select following Treflan averaged 22%, 40%, and 16% greater than the same treatments without Treflan for 1985, 1986, and 1987, respectively (Table 2). SC 1084 or Select treatments that did not show visual control differences from Treflan were (1) one-nozzle-per-row in all years, (2) the 2-gallon hand treatments with Select at 0.12 and 0.24% v/v in 1987, (3) "Spot Gun" treatments at 0.24% v/v 5 ml/squeeze in 1985 with SC 1084 and in 1987 with Select, (4) "Spot Gun" treatments with SC 1084 at 0.12% v/v 10 ml/squeeze and at 0.06% v/v 20 ml/squeeze in 1985, and (5) the tractor-mounted device with SC 1084 or Select at 0.0625 and 0.125 lb ai/A in all years.

Spray volume

The spray volume required to spot treat johnsongrass plants by hand

Table 2. The effect of SC 1084 or Select applied as spot treatments on visual rhizome johnsongrass control. Delta Branch, Mississippi Agricultural and Forestry Experiment Station, Stoneville, MS.

Application [1]		Estimated Visual Johnsongrass Control [5]					
	Herbicide rate (lb) or concentration (%)	July 16, 1985		September 3, 1986		July 24, 1987	
Method		− Treflan	+ Treflan	− Treflan	+ Treflan	− Treflan	+ Treflan
		(%)					
1 nozzle per row [2]	0.125 lb	58 ab	82 a	82 a	95 a	90 abc	97 a
2-gallon hand [3]	0.24%	45 bc	82 a	40 bc	87 a	73 cd	90 abc
2-gallon hand [3]	0.12%	13 c	70 ab	13 cd	70 ab	60 d	60 d
Spotgun, 5 ml/squeeze [3]	0.24%	68 ab	80 ab	38 bc	90 a	68 cd	82 bcd
Spotgun, 10 ml/squeeze [3]	0.12%	72 ab	82 a	30 cd	88 a	30 e	72 cd
Spotgun, 20 ml/squeeze [3]	0.06%	53 ab	90 a	7 d	87 a	30 e	72 cd
Tractor spot applicator [4]	0.125 lb	87 a	87 a	93 a	95 a	94 ab	95 ab
Tractor spot applicator [4]	0.0625 lb	90 a	92 a	79 a	97 a	93 ab	97 a
Standard Error of Mean		10.3		9.9		7.1	
C.V. (%)		24.9		25.2		16.4	

[1] Used SC 1084 4E in 1985, Select 2E in 1986 and 1987.

[2] Applied in 10 gallons/acre broadcast volume. Applied June 10, June 25, July 8, 1985; May 21, 1986; and May 22 and June 23, 1987.

[3] Applied June 10, 1985; June 17, 1986; and June 16, 1987.

[4] Applied in 10 gallons/acre broadcast volume when activated. Applied June 10, June 25, July 9, 1985; June 4, June 24, and July 21, 1986; and May 28 and June 23, 1987.

[5] Treflan 4E PPI 1.0 lb ai/A in 1985, and 0.75 lb ai/A in 1986 and 1987. Values within each date with the same letter are not different according to DMRT (P=0.05).

Figure 3. Both plots shown here had SC 1084 applications in 1985. The plot above was treated with Treflan PPI, the plot below was not treated with Treflan PPI. Plots were photographed May 21, 1986.

averaged 1.8, 4.3, and 2.3 times more without Treflan than with the same treatments applied after the use of Treflan for 1985, 1986, and 1987, respectively (Table 3). Volume ranged from a low of 6.9 gal/A in 1985 with the 2-gallon hand application of SC 1084 at 0.24% v/v with Treflan to a high of 208.8 gal/A in 1986 with the 2-gallon hand application of Select at 0.12% v/v without Treflan.

Cotton response

Cotton stand was not affected by any treatment during the course of this study (data not presented). In 1985, seed cotton yields in plots treated with the 2-gallon hand treatment at 0.12% v/v SC 1084 without Treflan were lower than those treated with the 2-gallon hand treatment at 0.24% v/v with Treflan, the "Spot Gun" treatment at 0.12% with Treflan, and the tractor-mounted spot treatment of 0.0625 lb ai/A with Treflan (Table 4). The yields were lower in the SC 1084 treatment applied with one nozzle per row without Treflan than the treatment with the 2-gallon hand sprayer at 0.24% v/v with Treflan.

In 1986, cotton yields from Select treatments using the tractor-mounted spot sprayer were not compared to the other treatments because the spray mix-

Table 3. Spray volume used in spot treating johnsongrass by hand. Delta Branch, Mississippi Agricultural and Forestry Experiment Station, Stoneville, MS.

Application [1]		Spray Volume Used [2]					
		June 10, 1985		June 17, 1986		June 16, 1987	
Method	Herbicide concentration	− Treflan	+ Treflan	− Treflan	+ Treflan	− Treflan	+ Treflan
	(%)	(Gallons/Acre)					
2-gallon hand	0.24	29.5 bcd	6.9 d	115.3 bc	22.5 d	64.6 a	20.5 b
2-gallon hand	0.12	20.8 cd	14.0 cd	208.8 a	63.1 cd	64.6 a	27.5 b
Spotgun, 5 ml/squeeze	0.24	54.2 ab	35.5 bcd	90.3 bc	30.4 d	34.6 b	27.8 b
Spotgun, 10 ml/squeeze	0.12	28.7 bcd	37.5 bc	100.1 bc	22.8 d	38.1 b	16.0 b
Spotgun, 20 ml/squeeze	0.06	79.7 a	22.8 cd	135.9 b	13.0 d	59.9 a	22.9 b
Standard Error of Mean		8.7		17.1		7.3	
C.V. (%)		45.5		36.9		33.6	

[1] Used SC 1084 4E in 1985, Select 2E in 1986 and 1987. Applied June 10, 1985; June 17, 1986; and June 16, 1987.

[2] Treflan 4E PPI 1.0 lb ai/A in 1985, and 0.75 lb ai/A in 1986 and 1987. Values within each date with the same letter are not different according to DMRT (P=0.05).

Table 4. The effect of johnsongrass control with SC 1084 or Select applied as spot treatments on seed cotton yield. Delta Branch, Mississippi Agricultural and Forestry Experiment Station, Stoneville, MS.

Application		Seed Cotton Yield[5]					
		1985		1986		1987	
Method	Herbicide rate (lb) or concentration (%)	− Treflan	+ Treflan	− Treflan	+ Treflan	− Treflan	+ Treflan
		(Pounds/Acre)					
1 nozzle per row [1]	0.125 lb	1,606 bc	2,167 abc	1,605 ab	1,350 abcd	2,432 ab	2,736 a
2-gallon hand [3]	0.24%	2,195 abc	2,494 a	1,539 abc	1,725 a	331 c	2,464 ab
2-gallon hand [3]	0.12%	1,590 c	2,069 abc	536 d	1,319 abcd	201 c	1,720 b
Spotgun, 5 ml/squeeze [3]	0.24%	2,391 abc	2,396 abc	1,067 abcd	1,717 a	518 c	2,137 ab
Spotgun, 10 ml/squeeze [3]	0.12%	2,238 abc	2,418 ab	780 bcd	1,519 abc	416 c	2,230 ab
Spotgun, 20 ml/squeeze [3]	0.06%	2,140 abc	2,347 abc	682 cd	1,462 abc	58 c	2,308 ab
Tractor spot applicator [4]	0.125 lb	2,352 abc	2,347 abc	927 abcd[6]	1,125 abcd [6]	2.781 a	2,779 a
Tractor spot applicator [4]	0.0625 lb	1,944 abc	2,418 ab	723 abcd[6]	994 abcd[6]	2.161 ab	2,494 ab
Standard Error of Mean		237.9		269.9		295.8	
C.V. (%)		18.8		39.2		29.5	

[1] Used SC 1084 4E in 1985, Select 2E in 1986 and 1987.

[2] Applied in 10 gallons/acre broadcast volume. Applied June 10, June 25, July 5, 1985; May 21, 1986; and May 22 and June 23, 1987.

[3] Applied June 10, 1985; June 17, 1986; and June 16, 1987.

[4] Applied in 10 gallons/acre broadcast volume when activated. Applied June 10, June 25, July 9, 1985; June 4, June 24, July 21, 1986; and May 28 and June 23, 1987.

[5] Treflan 4E PPI 1.0 lb ai/A in 1985, and 0.75 lb ai/A in 1986 and 1987. Values within each date with the same letter are not different according to DMRT (P=0.05).

[6] Yields reduced by cotton injury on July 21 from accidental spray contamination.

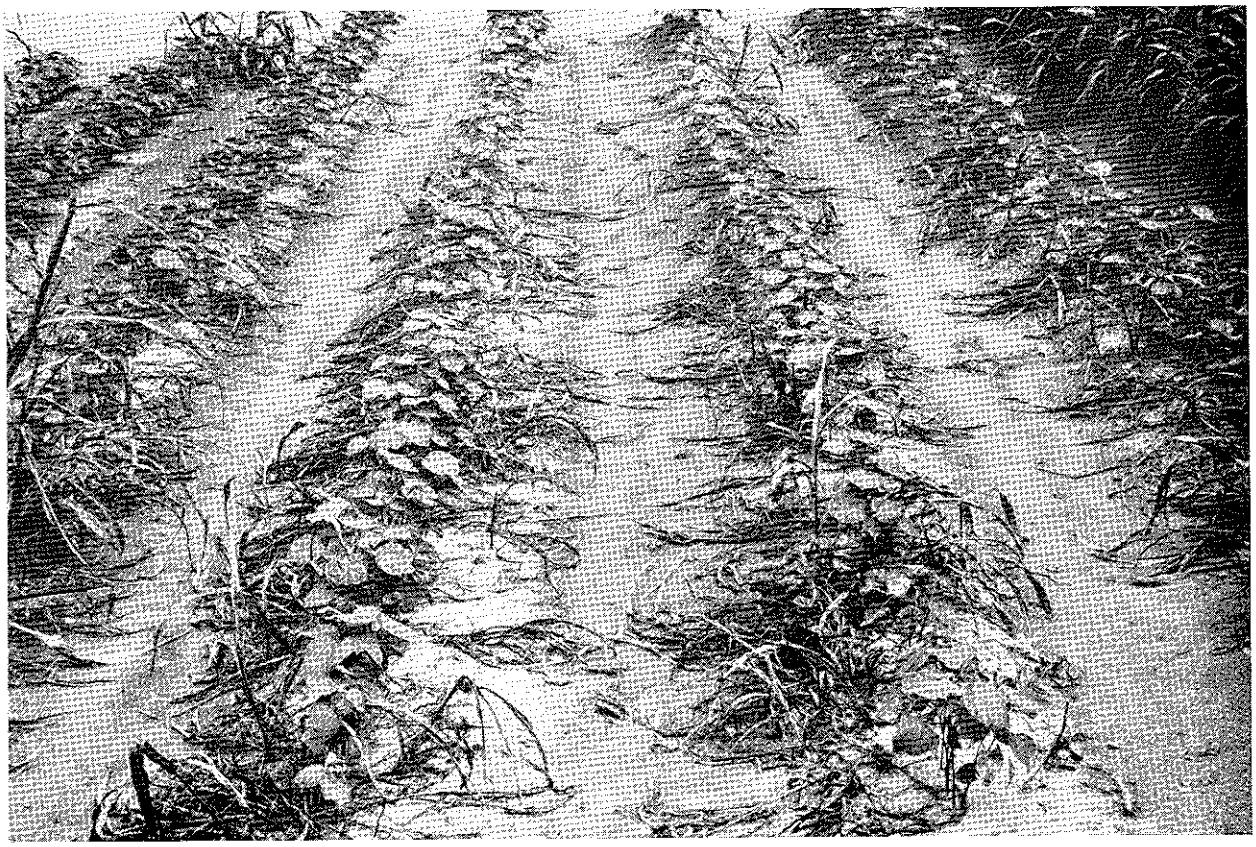
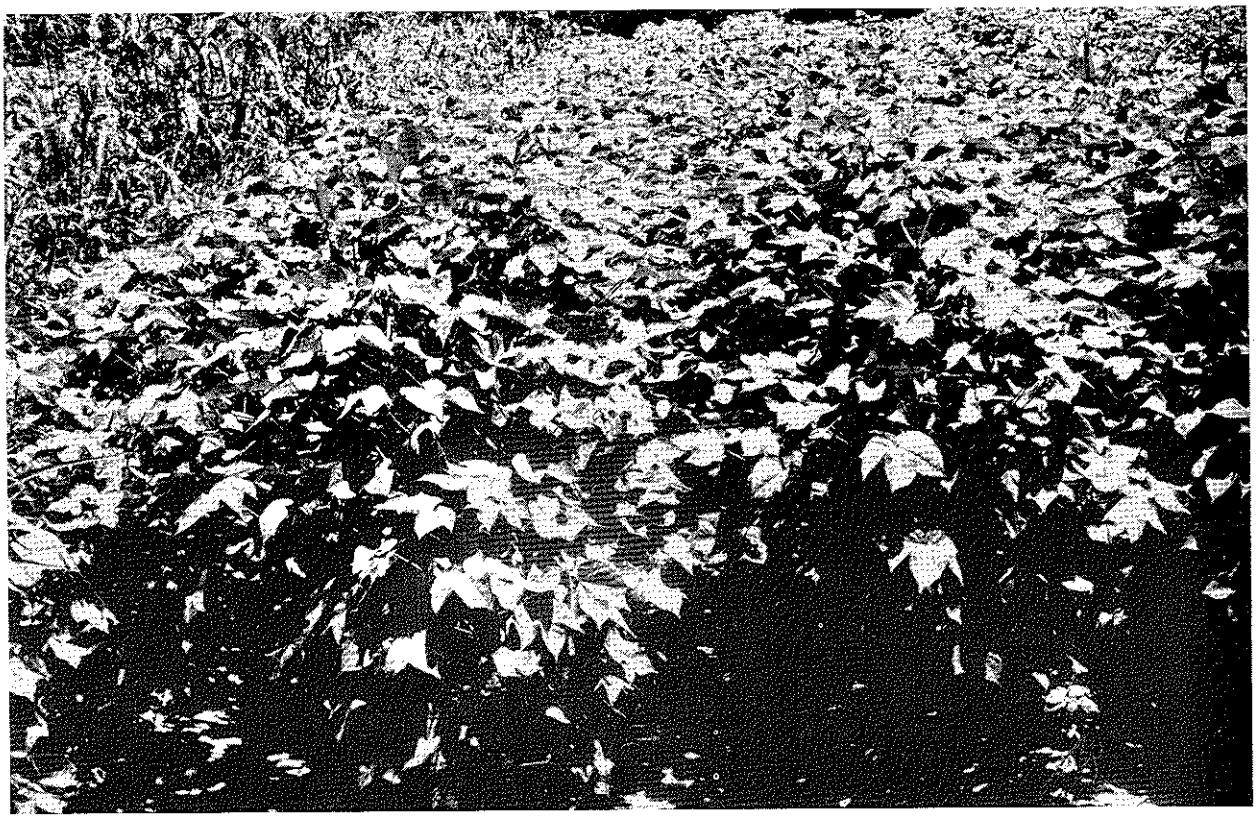


Figure 4. Both plots pictured here were treated with SC 1084 in 1985, and with Select in 1986 and 1987 using one nozzle per row. Photograph above taken June 1, 1987, shows effect on johnsongrass. Photograph below taken July 16, 1987 shows very little regrowth of treated johnsongrass plants.



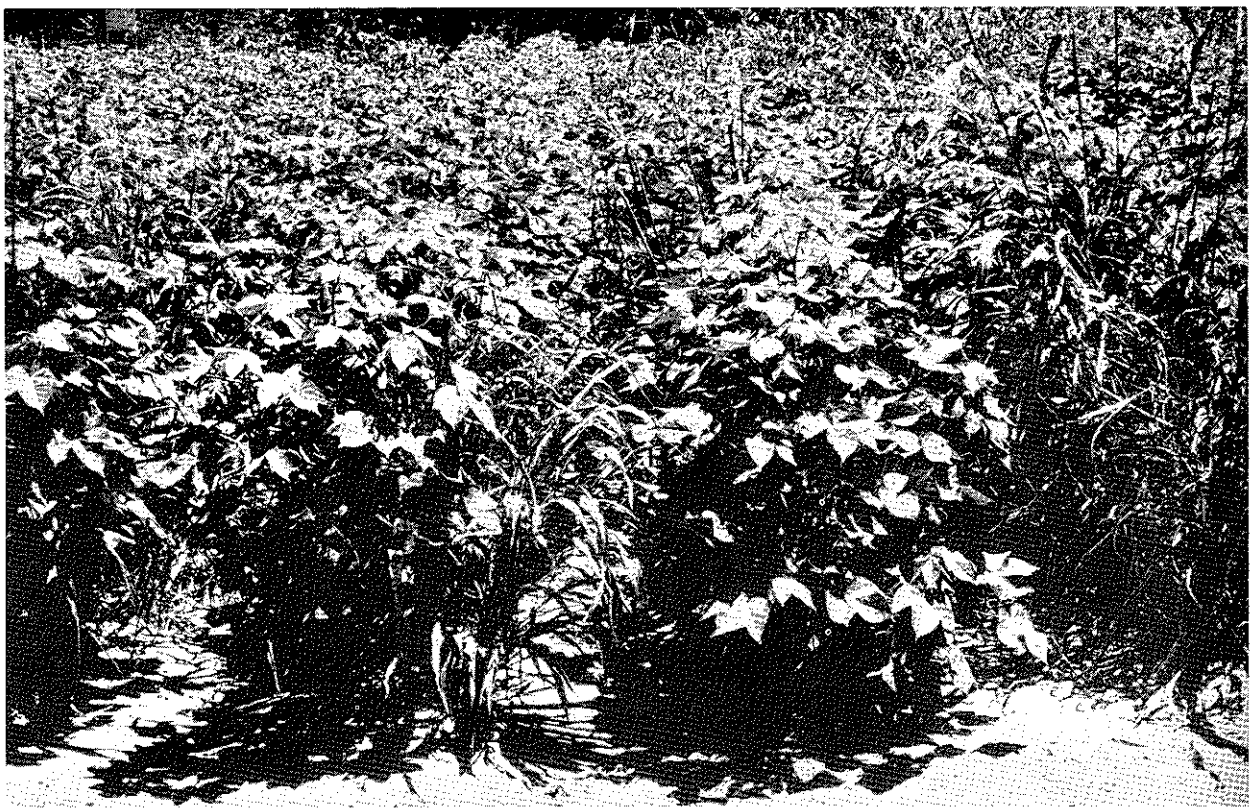


Figure 5. The plot above was treated with Treflan PPI plus a single "Spot Gun" application of SC 1084 or Select 1985-1987. The plot below was spot treated with multiple applications of SC 1084 or Select with the tractor-mounted sprayer 1985-1987. The photographs were taken in late July 1987.

ture at the second application date was accidentally contaminated with imazaquin resulting in cotton injury.

Cotton yields were less with Select applied with the 2-gallon hand treatment at 0.12% v/v without Treflan when compared with all of the "Spot Gun" and the 2-gallon hand treatment at 0.24% v/v with Treflan. With the "Spot Gun" treatment at 0.06% v/v without Treflan, cotton yields were less than the "Spot Gun" at 0.24% v/v and 2-gallon hand at 0.24% v/v treatments with Treflan. The cotton yields in 1987 were less when Select was applied without Treflan when compared with spot treatments with Select following Treflan, except for those applied with the tractor-mounted spot sprayer (Table 4). The one-nozzle per-row treatment with Select without Treflan produced similar yields to those obtained with Treflan.

The performance of the tractor mounted spot sprayer was satisfactory during each year. The efficiency of the system was $\geq$ 95% in detecting the presence of johnsongrass that was taller than the cotton. When activated, the three nozzle arrangement provided adequate coverage of the johnsongrass plants.

Summary

The conventional boom and tractor-mounted spot sprayer provided excellent johnsongrass control. Initial control was maintained through the season with repeated applications. Hand-held application techniques using one treatment each season resulted in the need for preplant incorporated applications of Treflan for effective johnsongrass control and acceptable cotton yields. The use of Select in 1986 and 1987 was very effective for control of johnsongrass, especially with multiple applications —and multiple application treatments did not require prior use of Treflan. Single application spot treatments following Treflan, which gave excellent control (<0.6 plant/foot) of johnsongrass at late-season, were Select at 0.24% v/v applied with a 2-gallon hand sprayer and all "Spot Gun" treatments in 1986 and at 0.24% v/v (5 ml) with a "Spot Gun" in 1987.

Literature References

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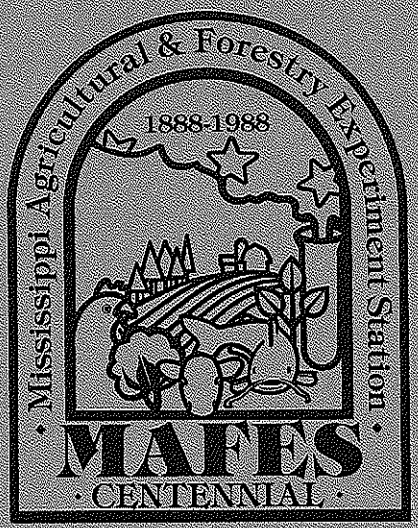

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