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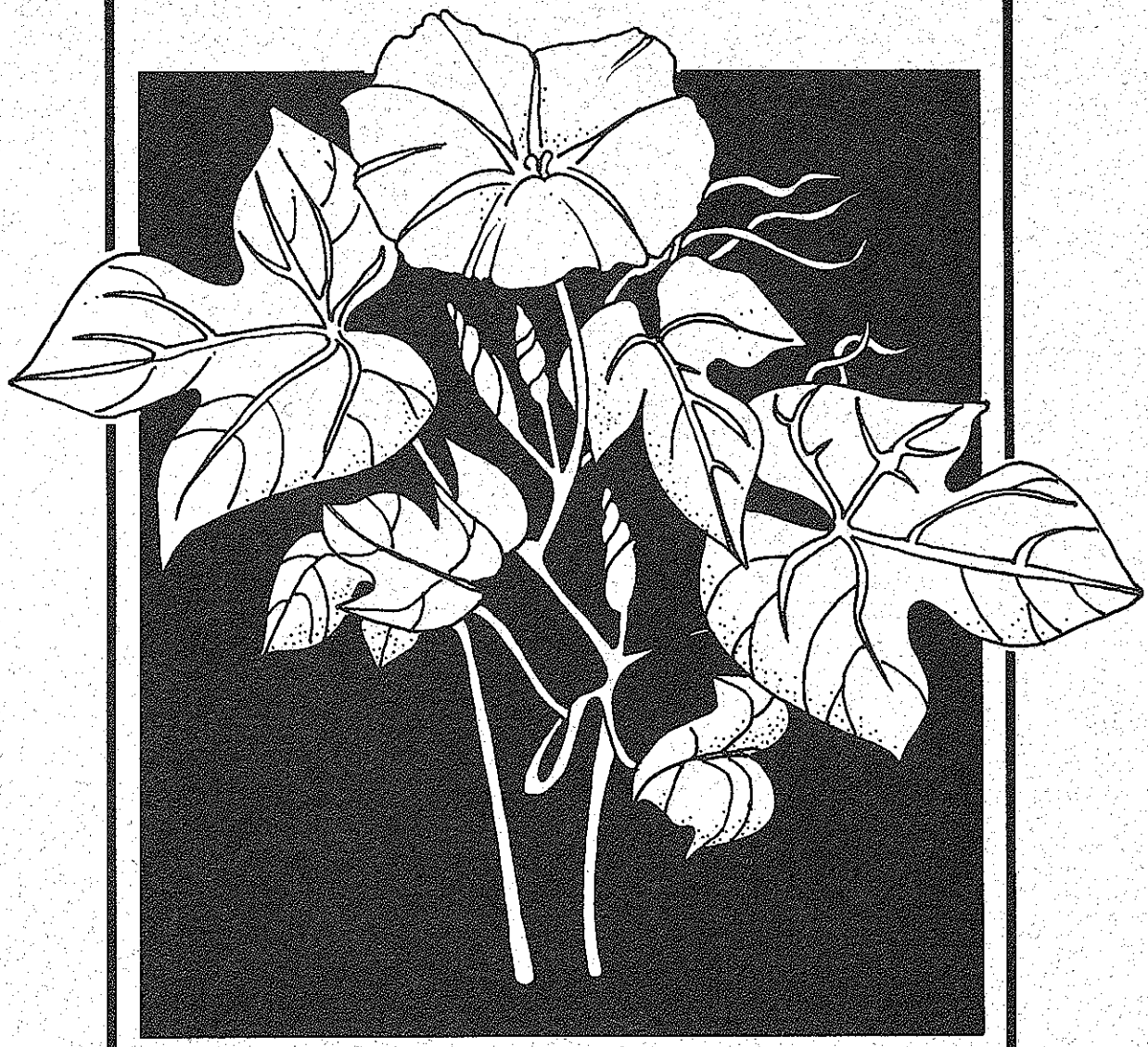

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Ivyleaf Morningglory Control in Soybeans with Serial Herbicide Applications

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Introduction

The presence of morningglories in soybean fields is very troublesome. Morningglory plants not only compete with soybeans for the available moisture and nutrients, but are a nuisance at harvest. Also, discounts for foreign material are often attached to the harvested soybeans at the first point of sale.

The weed survey committee of the Southern Weed Science Society began surveys of the most common and most troublesome weeds in crop fields in 1973. Morningglories were among the most common, most troublesome, and mostly costly weed species in Mississippi soybean fields in 1973 (1) (5th in all categories).

In subsequent surveys in 1976 (2), morningglories were 3rd, 4th, and 5th in the respective categories; in 1979 (3), 4th and 2nd (no category for most costly in field crops); in 1982 (4), 2nd in both categories; in 1983 (5), 2nd and 4th; and in 1988 (6), 4th and 1st. Morningglories were identified as the number 2 weed increasing in economic importance in the 1979 (3) and 1982 (4) reports. From these surveys, it is apparent that morningglories continue to be a major weed problem for soybean farmers in Mississippi.

Mathis and Oliver (7) reported that ivyleaf morningglory (*Ipomoea hederacea* (L.) Jacq.) is more difficult to control with postemergence herbicides than other morningglory species. This is commonly thought to result from the inhibition of herbicide uptake in pubescent species (8).

This study was conducted to evaluate the application of selected sequential applications of preplant soil incorporated (PPI) and/or preemergence (PRE) followed by over-the-top (OT) herbicides when compared with a standard treatment of Treflan® (trifluralin) PPI followed by Sencor® (metribuzin) PRE followed by Scepter® (imazaquin) OT.

Materials and Methods

A nonirrigated experiment was conducted on a silt loam soil (30% sand, 53% silt, 17% clay, 0.8% organic matter, pH 6.1) in an area infested with ivyleaf morningglory at the Delta Branch Experiment Station, Stoneville, Mississippi. The treatments were arranged in a randomized complete block design with four replications. Individual plots were four 40-inch rows 40 feet long. Treatments were applied to the same plot areas during 1986-1990 in 10 or 20 gallons per acre spray volume using a tractor-mounted boom sprayer.

Herbicide treatments were:

1) Turbo® 8E (metribuzin + metolachlor) at 2.0 lb ai/A applied PRE followed by Blazer® 2L (acifluorfen) at 0.125 lb ai/A OT;
2) Reflex® (fomesafen) at 0.25 lb ai/A PRE in 1986-1988 or Treflan at 0.75 lb ai/A PPI in 1989, 1990 followed by Reflex® at 0.125 lb ai/A + surfactant at 0.25% v/v OT;
3) Scepter 2AS (imazaquin) at 0.125 lb ai/A PRE in 1986-1988 or Squadron® 2.33E (pendimethalin + imazaquin) at 0.87 lb ai/A in 1989-90 followed by Scepter at 0.125 lb ai/A + surfactant at 0.25% v/v OT;
4) Canopy® 75DF (metribuzin ¢ chlorimuron) at 0.375 lb ai/A PRE followed by Classic® 25DF (chlorimuron) at 0.008 lb ai/A + surfactant at 0.25% v/v OT; and
5) Treflan 4E at 0.75 lb ai/A PPI followed by Sencor 75DF at 0.375 lb ai/A PRE followed by Scepter at 0.125 lb ai/A + surfactant at 0.25% v/v OT (standard treatment).

The OT herbicides were applied to ivyleaf morningglory plants that ranged from cotyledon to 3 inches tall with three true leaves.

Soybeans ('Forrest,' 1986; 'Leflore,' 1987; 'Centennial,' 1988-90) were planted in a prepared seedbed mid- to late May each year (except delayed to mid-July 1988 due to inadequate rainfall). Excessive rainfall prevented stand establishment in 1986 and 1990, so seeds of the indicated cultivars were replanted after 8 and 17 days, respectively, without additional preplant tillage. Preplant herbicides were applied 47, 35, 55, 38, and 34 days before planting in 1986, 1987, 1988, 1989, and 1990, respectively. Soil incorporation was performed with a tandem disk harrow operated two times, the final pass at 30° to the row direction. Additional mechanical soil disturbance of the seedbed between the application of PPI herbicides and planting ranged from two operations in 1987, 1989 and 1990 to five in 1986 and 1988. Devices used were the tandem disk harrow and/or a shallow shovel-plow harrow. Surface preemergence applications were made immediately after the original planting. Over-the-top herbicide applications were made one time each year 14 to 18 days after the original planting date.

Cultivation of the row middles leaving an undisturbed 12-inch band centered on the row was performed two times in 1986 (June 26 and July 11) and one time each in subsequent years (June 19, 1987; August 17, 1988; June 19, 1989; and July 5, 1990).

Broadleaf weeds other than morningglory and grass weeds were removed by hand. Late emerging grasses were controlled with Select® 2E (clethodim) at 0.125 lb ai/A + surfactant at 0.5% v/v OT on August 25, 1988 and Poast® 1.5E (sethoxydim) at 0.5 lb ai/A + surfactant at 0.5% v/v OT on August 8, 1990.

Ivyleaf morningglory control was determined by counting the number of plants on an area 3.3 feet by 40 feet when determined before cultivation and on an area 1 foot by 40 feet when determined after cultivation. Morningglory plants were separated into two categories in 1987-90, plants less than 2 inches tall and those taller than 2 inches, to evaluate the residual effectiveness of the OT herbicides. The counts of morningglory plants were converted to plants per square foot for presentation in Tables 1-4.

Soybean stand was determined in 1986-89 by counting one row in each plot 7 to 14 days after the final planting. Observations were made on the progress of soybean plant development and visual injury ratings (0 = no effect, 100 = complete plant kill) were made in 1987 and 1989. Soybean yield was obtained from the two center rows of each plot with a plot combine. Samples of approximately 900 grams were randomly removed from each harvested plot for subsequent hand removal of foreign material in the laboratory. The percent foreign material values were used to calculate the net soybean yield from each plot. Yield values are presented as bushels per acre of net weight at 13% moisture.

Data were subjected to an analysis of variance. Means were separated using Duncan's New Multiple Range Test (NMRT) and are reported at the 5% level of probability.

Results

In 1986 and 1989 (Table 1), ivyleaf morningglory counts 54 days after Treflan PPI resulted in no dif-

Table 1. The effect of preplant herbicide applications on control of ivyleaf morningglory at Stoneville, Mississippi, 1986, 1988, 1989.

Trt. no.	Herbicide, application method, and broadcast rate: Preplant soil incorporated	(lb ai/A)	Ivyleaf morningglory[a]: 1986 4/29	1988 5/24	1988 7/6	1989 5/11
			(Plants/sq ft)			
1.	None		0.25	0.069 ab	0.065 ab	1.20
2.	None (1986-88)					
	Treflan (1989-90)	0.75	0.20	0.065 ab	0.046 ab	1.07
3.	None	–	0.20	0.092 ab	0.104 a	1.82
4.	None	–	0.28	0.099 a	0.023 b	1.03
5.	Treflan	0.75	0.25	0.030 b	0.069 ab	1.41

[a]Values in the same column without letters or with a common letter are not different (P = .05) according to Duncan's NMRT.

Table 2. The effect of preplant and/or preemergence herbicide applications on control of ivyleaf morningglory at Stoneville, Mississippi, 1986-1990.

Trt. no.	Herbicide, application method, and broadcast rate: Preplant soil incorporated	(lh ai/A)	Surface Preemergence	(lb ai/A)	Ivyleaf morningglory[a]: 1986 6/9	1987 6/1 >1 inches tall	1987 6/1 <1 inches tall	1988 7/28	1989 6/12	1990 6/8
					(Plants/sq ft)					
1.	None		Turbo	0.375/1.65	0.14	0.63 ab	0.23 b	0.38 a	0.74 a	0.23 a
2.	None (1986-88)		Reflex (1986-88)	0.25						
	Treflan (1989-90)	0.75	None (1989-90)	–	0.20	0.42 b	0.04 c	0.13 b	0.68 a	0.10 b
3.	None	–	Scepter (1986-88)	0.125						
			Squadron (1989-90)	0.75/0.125	0.27	0.92 a	0.35 ab	0.32 ab	0.50 a	0.09 b
4.	None	–	Canopy	0.32/0.054	0.16	0.33 b	0.40 a	0.12 b	0.23 b	0.05 b
5.	Treflan	0.75	Sencor	0.375	0.30	0.58 b	0.32 ab	0.25 ab	0.61 a	0.13 b

[a]Values in the same column without letters or with a common letter are not different (P = .05) according to Duncan's NMRT.

ference between its use and no use. In 1988, at 34 days after Treflan PPI application (5/24), this treatment resulted in the least number of ivyleaf morningglory plants. A subsequent count 13 days later did not confirm the earlier result, thus this was probably due to counting error or some unknown factor. Results in 1988 could also have been affected by a residual influence from applications made after planting in 1987.

The results of ivyleaf morningglory plant counts made 10-19 days after PRE applications (Table 2) indicate there were no differences in 1986 between treatments. Treatments resulting in improved control when compared with the Treflan followed by Sencor standard were Reflex in 1987 (only with plants <1 inch), and Canopy in 1989. Treatments resulting in more ivyleaf morningglory plants than the standard treatment were Scepter in 1987 (only with plants >1 inch) and Turbo in 1990.

Table 3 presents count data that illustrate the ivyleaf morningglory control resulting from plant counts made 9 to 23 days after the OT application (before plots were cultivated except 16 days after in 1989). There were no differences between treatments in 1986, 1987 (plants <1 inch) 1988, and 1989 (plants <2 inches). In 1987, counts of ivyleaf morningglory plants >1 inch in plots treated with Canopy followed by Classic had the fewest number. This treatment was better than the standard treatment of Treflan followed by Sencor followed by Scepter. The standard was better than Scepter followed by Scepter and Turbo followed by Blazer as was Reflex followed by Reflex. The least number of ivyleaf morningglory plants >2 inches in 1989 resulted from plots treated with Canopy followed by Classic. This treatment and Squadron followed by Scepter were better than the standard treatment of Treflan followed by Sencor followed by Scepter. Plots treated with Turbo followed by Blazer resulted in the greatest number of ivyleaf morningglory plants >2 inches in 1989. Similar results were recorded among treatments in 1990 with both >2-inch and <2-inch ivyleaf morningglory plants. The only exception was that Canopy followed by Classic had fewer plants >2 inches than the standard treatment; whereas plants <2 inches were not different from the standard. The largest number of ivyleaf morningglory plants resulted with plots treated with Turbo followed by Blazer.

Ivyleaf morningglory plant populations were determined 41 to 51 days after applying the OT herbicides in 1987, 1989, and 1990 to evaluate residual control (Table 4). There were no differences between treatments in 1987 with plants <6 inches and in 1989. In 1987, with plants >6 inches Canopy followed by Classic provided better control than the standard treatment of Treflan followed by Sencor followed by Scepter. The standard treatment and Reflex PRE

Table 3. Ivyleaf morningglory population as influenced by serial applications of herbicides applied preplanting, preemergence and over-the-top at Stoneville, Mississippi, 1986-1990.

Trt.	Herbicide, application method, and broadcast rate				Ivyleaf morningglory[b]									
					1986	1987		1988		1989		1990		
					6/26	6/11		8/11		7/5		6/22		
								inches tall						
no.	Preplant soil incorporated		Surface preemergence		Over-the-top[a]	>1	<1	>2	<2	>2	<2	>2	<2	
	(lb ai/A)		(lb ai/A)		(lb ai/A)	(Plants/sq ft)								
1.	None		Turbo	0.375/1.65	Blazer 0.125	0.173	1.046 a	0.034	0.100	0.149	0.333 a	0.175	0.242 a	0.578 a
2.	None (1986-88)		Reflex (1986-88)	0.25										
	Treflan (1989-90)	0.75	None (1989-90)	–	Reflex 0.125	0.167	0.276 bc	0.006	0.010	0.045	0.108 bc	0.150	0.135 b	0.124 b
3.	None	–	Scepter (1986-88)	0.125										
			Squadron (1989-90)	0.75/0.125	Scepter 0.125	0.227	0.938 a	0.041	0.041	0.137	0.070 c	0.250	0.032 b	0.179 b
4.	None	–	Canopy	0.32/0.054	Classic 0.008	0.210	0.045 c	0.053	0.011	0.055	0.025 c	0.095	0.003 c	0.075 b
5.	Treflan	0.75	Sencor	0.375	Scepter 0.125	0.221	0.536 b	0.055	0.098	0.171	0.170 b	0.120	0.137 b	0.197 b

[a]Added nonionic surfactant to each at 0.25% by volume, applied 14-18 days after planting.
[b]Values in the same column without letters or with a common letter are not different (P = .05) according to Duncan's NMRT.

followed by Reflex OT provided better control than Scepter followed by Scepter and Turbo followed by Blazer, but Reflex followed by Reflex was no better than the standard treatment. In 1990, no treatment was different from the standard Treflan followed by Sencor followed by Scepter treatment 41 days after applying OT herbicides. Treatments of Canopy followed by Classic and Treflan followed by Reflex provided better control than Turbo followed by Blazer.

Soybean stand (data not included) was adequate for maximum production in all years. No significant stand differences occurred in 1986-88 or 1990. In 1989, the standard treatment of Treflan followed by Sencor followed by Scepter had significantly greater stand than treatments of Turbo followed by Blazer, Treflan followed by Reflex, and Squadron followed by Scepter. Canopy followed by Classic was intermediate and was not different from other treatments. Stand differences did not affect soybean yields (Table 6).

Phytotoxicity to soybeans did not occur with PPI and PRE treatments in 1986, 1988, or 1990. Visual soybean injury at 13 and 18 days after PRE herbicide applications in 1987 and 1989 resulted in greatest phytotoxicity from Turbo (data not included). This treatment was significantly more injurious (7%) than the treatment of Canopy in 1987. The standard treatment of Treflan followed by Sencor was not different from the above treatments. Treatment with Reflex or Scepter in 1987 or Treflan followed by Sencor or Squadron in 1989 did not injure soybeans. Subsequent OT applications of Blazer, Reflex, Scepter, and Classic resulted in added phytotoxicity of 0 to 15% by 15 days after application (data not included), but foliage injury was not considered sufficient to adversely affect yields.

The average percent foreign material was not different between treatments in 1986 or 1989. Values ranged from 0.85% to 1.84% in 1986, and from 0.46%

Table 4. The residual effect of serial applications of herbicides applied preplanting, preemergence and over-the-top on ivyleaf morningglory at Stoneville, Mississippi, 1987, 1989, 1990.

	Herbicide, application method, and broadcast rate						Ivyleaf Morningglory[b]			
							1987 7/20		1989 7/26	1990 7/26
Trt. no.	Preplant soil incorporated		Surface preemergence		Over-the-top[a]		-- inches tall -- >6	<6		
		(lb ai/A)		(lb ai/A)		(lb ai/A)	---------- (Plants/sq ft) ----------			
1.	None		Turbo	0.375/1.65	Blazer	0.125	0.795 a	0.137	0.359	2.608 a
2.	None (1986-88)		Reflex (1986-88)	0.25						
	Treflan (1989-90)	0.75	None (1989-90)	–	Reflex	0.125	0.300 bc	0.096	0.261	0.888 b
3.	None	–	Scepter (1986-88)	0.125						
			Squadron (1989-90)	0.75/0.125	Scepter	0.125	0.745 a	0.098	0.231	1.558 ab
4.	None	–	Canopy	0.32/0.054	Classic	0.008	0.130 c	0.122	0.242	0.713 b
5.	Treflan	0.75	Sencor	0.375	Scepter	0.125	0.390 b	0.146	0.269	1.608 ab

[a]Added non-ionic surfactant to each at 0.25% by volume, applied 14-18 days after planting.
[b]Values in the same column without letters or with a common letter are not different (P = .05) according to Duncan's NMRT.

Table 5. The effect of serial applications of herbicides applied preplanting and over-the-top on foreign material in combine-harvested soybeans at Stoneville, Mississippi, 1986-1990.

	Application, herbicide, and broadcast rate						Foreign Material[b]				
Trt. no.	Preplant soil incorporated		Surface preemergence		Over-the-top[a]		1986	1987	1988	1989	1990
		(lb ai/A)		(lb ai/A)		(lb ai/A)	---------- (%) ----------				
1.	None		Turbo	0.375/1.65	Blazer	0.125	1.84	2.42 ab	4.71 ab	1.31	8.56 a
2.	None (1986-88)		Reflex (1986-88)	0.25							
	Treflan (1989-90)	0.75	None (1989-90)	–	Reflex	0.125	1.45	2.57 ab	2.81 b	0.47	6.65 ab
3.	None	–	Scepter (1986-88)	0.125							
			Squadron (1989-90)	0.75/0.125	Scepter	0.125	0.85	2.84 a	6.62 a	0.68	1.77 c
4.	None	–	Canopy	0.32/0.06	Classic	0.008	1.11	1.80 b	3.39 b	0.46	3.51 bc
5.	Treflan	0.75	Sencor	0.375	Scepter	0.125	1.53	2.39 ab	4.10 ab	0.54	6.29 ab

[a]Added nonionic surfactant to each at 0.25% by volume, applied 14-18 days after planting.
[b]Values in the same column without letters or with a common letter are not different (P = .05) according to Duncan's NMRT.

Table 6. The effect of serial applications of herbicides applied preplanting, preemergence, and over-the-top on net soybean yield at Stoneville, Mississippi, 1986-1990.

Trt. no.	Herbicide, application method, and broadcast rate: Preplant soil incorporated	(lb ai/A)	Surface preemergence	(lb ai/A)	Over-the-top[a]	(lb ai/A)	Net Soybean Yield[b] 1986	1987	1988	1989	1990
							(bu/A)				
1.	None		Turbo	0.375/1.65	Blazer	0.125	6.8 ab	7.6 b	24.2 ab	41.2	19.2
2.	None (1986-88)		Reflex (1986-88)	0.25							
	Treflan (1989-90)	0.75	None (1989-90)	–	Reflex	0.125	5.7 b	7.7 b	26.3 a	45.0	21.3
3.	None	–	Scepter (1986-88)	0.125							
			Squadron (1989-90)	0.75/0.125	Scepter	0.125	8.8 a	7.3 b	21.1 b	40.3	26.3
4.	None	–	Canopy	0.32/0.054	Classic	0.008	6.3 ab	11.4 a	27.2 a	44.3	19.8
5.	Treflan	0.75	Sencor	0.375	Scepter	0.125	8.3 ab	8.7 ab	25.8 a	46.3	22.9

[a]Added non-ionic surfactant to each at 0.25% by volume, applied 14-18 days after planting.
[b]Values in the same column without letters or with a common letter are not different (P = .05) according to Duncan's NMRT.

to 1.31% in 1989 (Table 5). Foreign material with the standard treatment of Treflan followed by Sencor followed by Scepter was not different from other treatments in 1987 and 1988, but was greater than the Squadron followed by Scepter treatment in 1990. Foreign material with the Turbo followed by Blazer treatment in 1990 was greater than with treatments of Squadron followed by Scepter and Canopy followed by Classic; however, in 1987 and 1988 this treatment was not different from other treatments (Table 5).

Soybean net yield with the standard treatment was not different from other treatments except in 1988 when it was greater than the Scepter followed by Scepter treatment (Table 6). Adequate vegetative soybean growth was obtained in 1986 and 1987, but dry conditions in mid- and late season severely limited yield (Table 6). Net yield of soybeans in 1986 was numerically greatest with Scepter followed by Scepter but was only statistically greater than treatment with Reflex followed by Reflex. In 1987, the greatest numerical yield was obtained from plots treated with Canopy followed by Classic, which was statistically greater than all other treatments except the standard. The Scepter followed by Scepter treatment resulted in the lowest numerical yield in 1987. In 1988, when wet soil conditions delayed planting until mid-July, the least numerical net yield resulted with the Scepter followed by Scepter treatment. This treatment was statistically lower than all other treatments except the Turbo followed by Blazer treatment. There were no significant differences in net yield among treatments in 1989 or 1990.

Conclusion

Ivyleaf morningglory control was not enhanced by Treflan PPI.

At the morningglory plant populations in this study (Table 3), no treatment consistently performed better than the standard treatment of Treflan followed by Sencor followed by Scepter. Canopy followed by Classic, however resulted in more consistent late-season ivyleaf morningglory control than other treatments.

Soybean yield was greatly affected by the growing conditions of each year. The standard treatment of Treflan followed by Sencor followed by Scepter provided ivyleaf morningglory control that resulted in yield no different from the other treatments.

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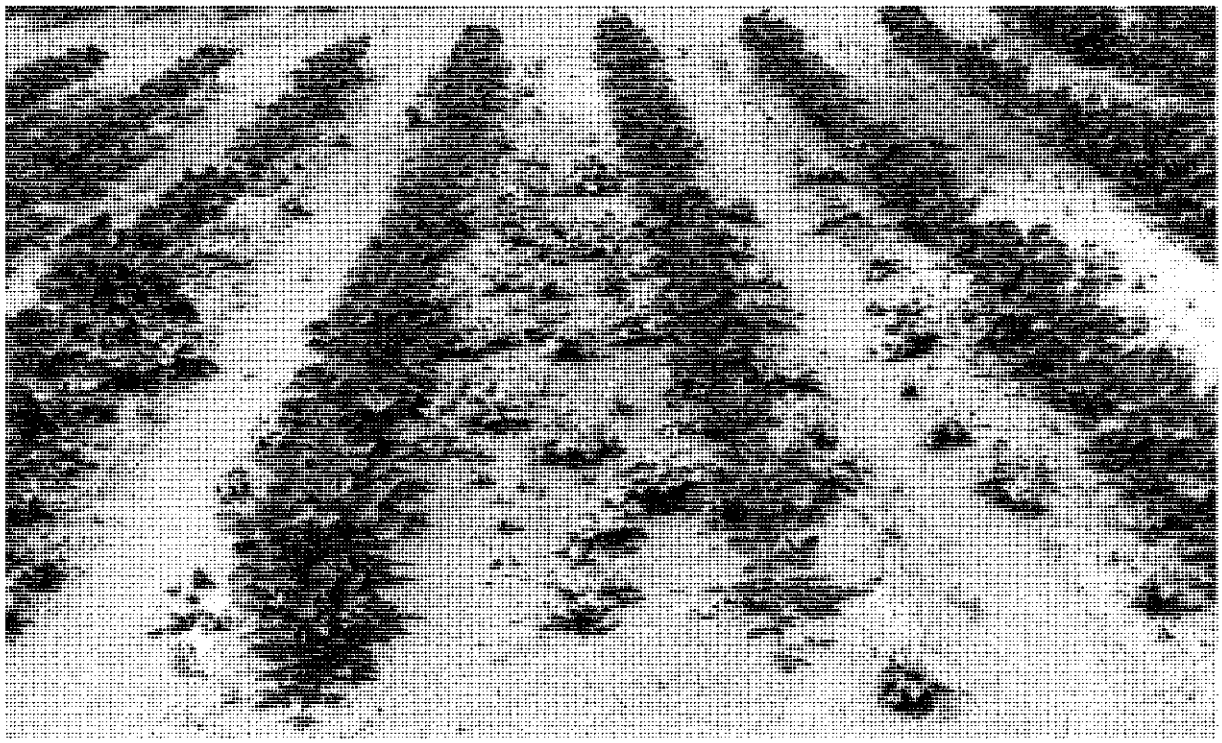

Figure 1. Ivyleaf morningglory in plots 13 days after application of OT herbicides, which were applied 14 days after planting in 1987. Treatment on these plots was Turbo® at 2.0 lb ai/A applied PRE followed by Blazer® at 0.125 lb ai/A + Triton AG-98® OT.

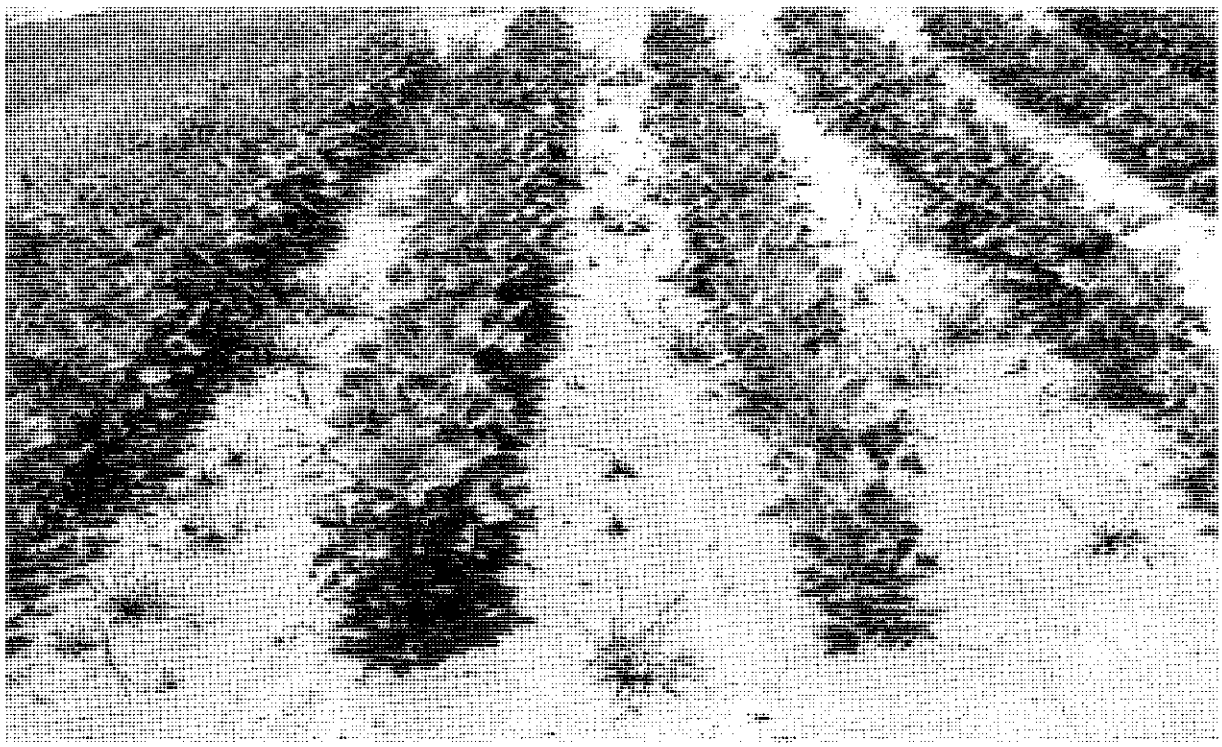

Figure 2. Ivyleaf morningglory in plots 13 days after application of OT herbicides, which were applied 14 days after planting in 1987. Treatment on these plots was Reflex® at 0.25 lb ai/A PRE followed by Reflex® at 0.125 lb ai/A + Activate® OT.

Figure 3. Ivyleaf morningglory in plots 13 days after application of OT herbicides, which were applied 14 days after planting in 1987. Treatment on these plots was Scepter® at 0.125 lb ai/A PRE followed by Scepter at 0.125 lb ai/A + Triton AG-09 OT.

Figure 4. Ivyleaf morninglory in plots 13 days after application of OT herbicides, which were applied 14 days after planting in 1987. Treatment on these plots was Canopy® at 0.375 lb ai/A PRE followed by Classic® at 0.078 lb ai/A + Surfactant MK® OT.

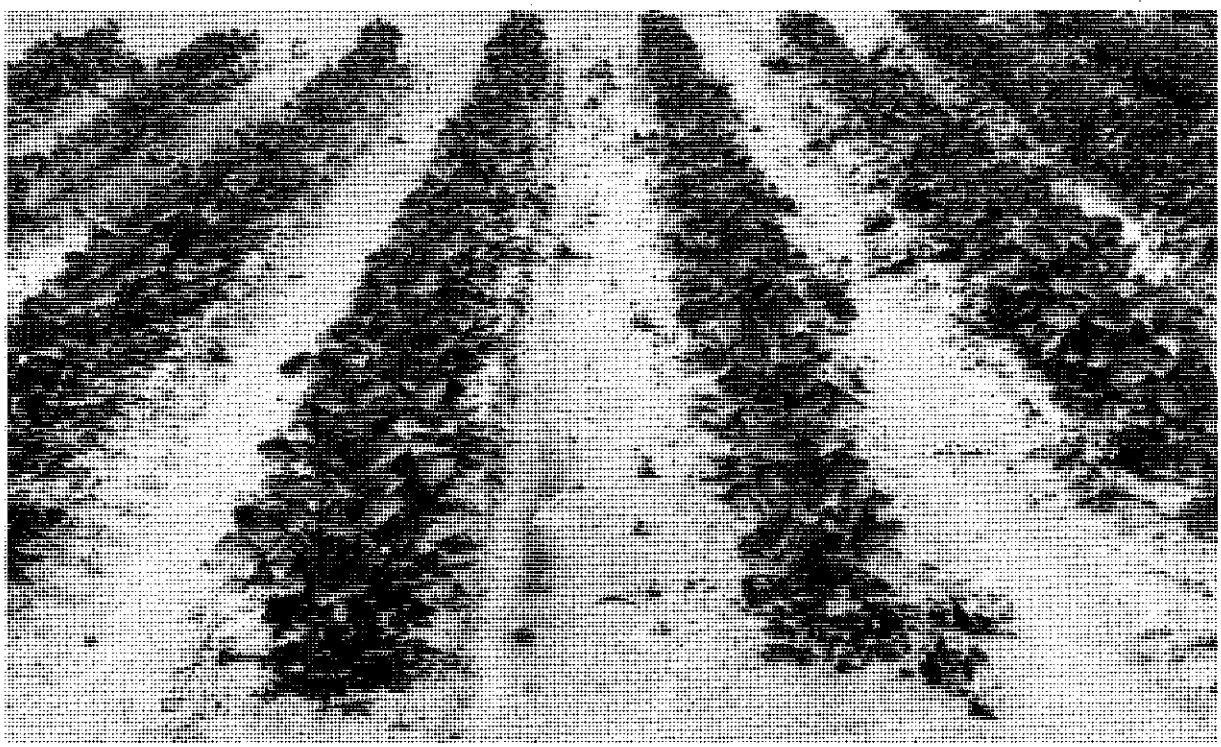

Figure 5. Ivyleaf morninglory in plots 13 days after application of OT herbicides, which were applied 14 days after planting in 1987. Treatment on these plots was the standard: Treflan 0.75 lb ai/A PPI followed by Sencor® at 0.375 lb ai/A PRE followed by Scepter at 0.25 lb ai/A + Triton AG-98 OT.

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