Vol. 22, No. 11 Research Report May 2000

Ivyleaf Morningglory and Slender Amaranth Control in BXN Cotton

Harold R. Hurst

INTRODUCTION

Cotton farmers in Mississippi consider morningglory to be one of the weeds most troublesome to control. Webster and Coble *(5)* found from surveys of the South that morningglories were the fourth most troublesome weed in cotton in 1983 but had advanced to the top of the list by 1995. When present in large numbers, morningglory plants compete with cotton for light, water, and nutrients, and they greatly interfere with harvest operations when left partially or totally uncontrolled. Low early- to mid-season populations of morningglory plants may also increase to interfere with harvest when late-season rainfall or irrigation allows plants to grow and develop. Rodgers, et al. *(4)* in Oklahoma recorded cotton lint yield reductions of 3.9% to 5.9% for each additional ivyleaf morningglory plant up to 8.7 plants per 33 feet of row from full-season interference. Mechanical harvest was not possible at densities greater than 16 plants per 33 row feet for irrigated cotton and eight plants per 33 row feet for dryland production. Under irrigated production, lint yield was reduced 11.2% for each week up to 11 weeks of interference. For dryland cotton, the reduction was 7.8% for each week of interference. Morningglory leaves are easily removed with defoliants or desiccants, but stems are tough and wiry causing them to be more resistant to drying.

In a comprehensive review of the morningglory family *(2)*, several factors are identified from prior research studies that detail plant characteristics relating to the competitiveness of morningglory. Among these factors are large seed size, hard seed coat, ability to emerge from up to three inches deep in the soil, and rapid seedling growth under warm temperature. Culpepper and York *(1)* found that bromoxynil effectively substituted for fluometuron plus MSMA only in systems that included fluometuron preemergence (PRE) and cyanazine plus MSMA late post directed (PODIR).

Slender amaranth emerges primarily in early- to mid-season under lower temperature. This weed does not grow tall (only to about 30 inches) and matures in mid-season. Thus, its competitiveness with cotton is not severe unless control is not obtained early and large numbers of plants are present. Slender amaranth plants are similar to other *Amaranthus* sp. such as smooth pigweed and Palmer amaranth in response to control with over-the-top (OT) cotton herbicides. Slender amaranth is not widely distributed in Mississippi cotton fields.

The objective of this study was to compare the response from OT applications of bromoxynil (Buctril®) alone and with applications of selected preplant incorporated (PPI), PRE, and OT herbicides to BXN cotton in a naturally occurring population of ivyleaf morningglory [*Ipomoea hederacea* (L.) Jacq.] and slender amaranth (*Amaranthus viridus* L.).

Harold Hurst is a plant physiologist with the Delta Research and Extension Center in Stoneville, Mississippi. For more information, contact Dr. Hurst at (662) 686-9311. This research report was published by the Office of Agricultural Communications, a unit of the Mississippi State University Division of Agriculture, Forestry, and Veterinary Medicine. It was edited and designed by Robert A. Hearn, publications editor.

Experiment Station
Vance H. Watson, Director
Mississippi Agricultural & Forestry Experiment Station
Malcolm A. Portera, President • Mississippi State University • J. Charles Lee, Vice President

MATERIALS AND METHODS

The experiment was conducted from 1995 to 1998 on a silt loam soil with 0.97% organic matter and pH 6.3. No supplemental irrigation or post-plant cultivation were used. The experiment was designed as a randomized complete block with four replications. Individual treatments were applied to four rows, which were 40 inches wide and 40 feet long. Treatments consisted of combinations of selected PPI, PRE, and OT herbicide applications. Each treatment was repeated on the same area each year. Data were obtained from the center two rows of each plot.

Table 1. Dates of preplant tillage in an experiment on ivyleaf morningglory and slender amaranth control in BXN cotton.

Year	Tillage operation (date performed)			
	Subsoil	Disk harrow	Disk hipper	Bed conditioner
1995	2/3	–	3/20[1], 4/19	3/20, 4/3[2], 4/19
1996	10/10/95	3/11[1]	3/11	3/14, 4/3[2]
1997	–	3/12[1]	3/12	3/12, 4/3[2]
1998	10/17/97	3/23[1]	3/24	3/24, 3/30[2]

[1]Treatments 7, 9 applied prior to this operation.
[2]Treatments 2, 5 applied prior to this operation.

BXN 57 cotton was planted April 27, 1995, and April 18, 1996 (replanted May 10). BXN 47 was planted May 1, 1997 (replanted May 14), and May 6, 1998. The replanting was necessary in 1996 and 1997 due to stand failure from adverse weather conditions. In both years, the original cotton planting was killed with paraquat (Gramoxone Extra®). The second planting was made without additional seedbed preparation, and additional disulfoton (Di-Syston®) was applied in-furrow to prevent cotton injury from the clomazone (Command®) treatments.

Cotton stand was determined by counting the plants in one or both of the center rows in each plot. The counts were converted to plants per acre and are presented in Table 3. Seed cotton yield was determined by harvesting the two center rows of each plot with a mechanical picker adapted for plot harvesting. Plot weights were converted to pounds of seed cotton per acre (Table 4).

Weed counts by species were made on a 40-inch by 40-foot area between the two center rows of each plot (133 square feet). Visual control was estimated for each weed species using a 0-100 scale (0 = no control, 100 = complete kill). Weed control evaluations are presented in Tables 5-10. Table 1 lists the preplant tillage dates for each operation. Table 2 lists the herbicides, rates, and application dates for each treatment. All data were subjected to an analysis of variance and means were separated using Duncan's Multiple Range Test at a 0.5% probability level.

Table 2. Application information for herbicides to control ivyleaf morningglory and slender amaranth in BXN cotton.[1]

Treatment	Preplant incorporated (PPI)				Preemergence (PRE)		Over-the-top (OT)					
	Herbicide	Rate per acre (ai)	Dates	Before/after hipping	Herbicide	Rate per acre (ai)	Herbicide[4]	Rate per acre (ai)	1995	1996	1997	1998
		lb				*lb*		*lb*				
Trt. 1	None	–	–	–	None	–	Buctril 4E	0.5	5/19, 6/5, 6/27	5/10, 5/24, 6/14	6/2, 6/23	5/27, 6/17
Trt. 2	Command 3ME	0.5	4/3/95, 4/3/96, 4/3/97, 3/30/98	After[2]	Cotoran 85DF + Command 3ME	1.25 + 0.25	Buctril 4E	0.5	6/27	5/24, 6/14	–	5/27, 6/17
Trt. 3	None	–	–	–	Command 3ME	0.75	Buctril 4E	0.5	6/5, 6/27	5/24, 6/14	6/2, 6/23	5/27, 6/17
Trt. 4	None	–	–	–	Cotoran 85DF + Command 3ME	1.0 + 0.75	Buctril 4E	0.5	6/13	5/24, 6/14	6/2, 6/23	5/27, 6/17
Trt. 5	Command 3ME	0.75	4/3/95, 4/3/96, 4/3/97, 3/30/98	After[2]	Cotoran 85DF	1.25	Buctril 4E	0.5	–	5/24, 6/14	6/2, 6/23	6/17
Trt. 6	None	–	–	–	Cotoran 85DF	1.25	Buctril 4E	0.5	6/13	5/10, 5/24, 6/14	6/2, 6/23	5/27, 6/17
Trt. 7	Treflan 4E	0.75	3/20/95, 3/11/96, 3/12/97, 3/23/98	Before[3]	Staple 85SP	0.032	Staple 85SP	0.032	6/5	5/24, 6/14	6/2, 6/23	5/27, 6/17
Trt. 8	None	–	–	–	Command 3ME	0.75	Staple 85SP	0.063	6/5	5/24, 6/14	6/2, 6/23	5/27, 6/17
Trt. 9	Treflan 4E	0.75	3/20/95, 3/11/96, 3/12/97, 3/23/98	Before[3]	Command 3ME	0.75	Buctril 4E	0.5	6/13, 6/27	5/10, 6/14	6/2, 6/23	5/27, 6/17

[1]Entire Area:
- Planted BXN 57 on 4/27/95, 4/18/96, and 5/10/96; and BXN 47 on 5/1/97, 5/14/97, and 5/6/98;
- Preplant burn-down – Roundup D-Pak 0.75 lb ai/A on 2/18/97; Gramoxone Extra 0.75 lb ai/A on 4/24/97 and 0.94 lb ai/A on 5/15/97, 3/3/98, and 5/6/98;
- Escaped annual grasses – Bugle 0.67E OT 0.1 lb ai/A on 6/15/95; Select 2E OT 0.094 lb ai/A on 6/27/96 and 0.125 lb ai/A on 7/3/97 (Treatment 1 only); Poast Plus OT 0.19 lb ai/A on 6/1/98;
- Nutsedge – Bueno 6 1 lb ai/A OT 5/30/96;
- Lay-by – Riverside diuron 4L 1 lb ai/A + Goal 2XL 0.3 lb ai/A on 7/25/97.

[2]Hipped beds, reduced to 50% height with bed conditioner, applied herbicide, followed with bed conditioner one time.
[3]Disk tilled one time in row direction after application followed by hipping.
[4]Used Buctril Gel 4E or Buctril 2E in 1995 for Treatments 1-4, 6, 9.

RESULTS

Cotton

The cotton stand was not affected by any herbicide treatment (Table 3). In 1995 and 1998, Treatment 3 had fewer cotton plants than Treatment 7 (Table 2 has descriptions of each treatment). Field observation in Treatment 3 plots indicated a large purple nutsedge population, which increased in density over the years. The nutsedge suppressed cotton growth and contributed to the reduced stand. In 1996, there were no cotton stand differences among treatments. In 1997, the overall stand was less than optimal. Minor influences from counting error or other factors are considered responsible for the stand variation, especially since the determination for stand was made late (July 11).

Seed cotton yield was not different among treatments in 1995 (Table 4). In 1996, seed cotton yield was least with Treatment 9. With this treatment, field observations indicate that purple nutsedge was responsible for influencing yield. In 1997, Treatment 9 again had the lowest yield due to the negative influence from purple nutsedge. The yield trend from Treatment 3 also was lower. After the high rainfall in 1997 followed by the dry conditions of 1998, purple nutsedge greatly influenced yield results in treatments with high populations of this weed (Treatments 3 and 9). On July 30, 1998, a visual assessment of cotton stunting in Treatment 3 plots revealed that 35% of total harvest row length was stunted because of purple nutsedge. Other cotton plant stunting values included 31% for Treatment 9, 12% for Treatment 2, 7% for Treatment 8, and 3% for Treatment 1. The very low yield with Treatment 3 was also a result of the very poor stand.

Ivyleaf Morningglory

The population of ivyleaf morningglory increased from 1995 to 1998 based on plant counts made in late April 1995, 1997, and 1998 (Table 5). PPI treatments applied before bed formation (Treatments 2, 5) appeared to have been more effective in reducing morningglory numbers than the PPI treatments applied after beds were formed (Treatments 7, 9). In 1998, this finding was less apparent because of the high rainfall in 1997 that caused morningglory plants to produce more seed late in the growing season.

When compared with Treatment 1 (no PPI or PRE), ivyleaf morningglory plant counts after both PPI and PRE treatments were applied (Table 6) resulted in good to excellent control with Treatment 2 for all years. Control with Treatment 5 was excellent in all years but 1997 when excess rainfall occurred.

Compared with Treatment 1, Treatment 2 continued to result in good to excellent ivyleaf morningglory control from 12 to 20 days after single OT applications were made in 1995 and 1997 (Table 7). At the time of the first OT application in those two years, field observation indicated that the morningglory population was insufficient to justify OT treatment with Treatment 2. A similar situation existed for Treatment 5 in 1995 and 1998. Except for Treatment 1, ivyleaf morningglory plants were small (1 to 2 inches) when the OT treatment was made. With Treatment 1, Buctril at 0.5 pound of active ingredient per acre was very effective on ivyleaf morningglory plants 1 to 8 inches tall.

After all herbicides were applied, visual control of ivyleaf morningglory was estimated in late June or July (Table 8). In 1995, 91% control was obtained with three OT 0.5-pound Buctril applications. Greatest morningglory control (95%) was obtained with Treatment 2 in 1995. Control was 91% or greater in 1996 and 1997 with all treatments, except Treatment 1 in 1997. In 1998, control was 94% or more with all treatments, except Treatment 3 (78%), Treatment 1 (88%), and Treatment 5 (89%).

Table 3. Effect of herbicide treatments on cotton stand.

Treatment	Cotton plants per acre (thousands)[1]			
	5/16/95	5/27/96	7/11/97	6/9/98
Treatment 1	48.1 ab	48.7 a	32.0 ab	41.4 ab
Treatment 2	48.8 ab	45.3 a	30.8 abc	52.4 a
Treatment 3	43.0 b	45.0 a	25.9 d	26.5 b
Treatment 4	44.6 ab	41.6 a	28.5 bcd	44.9 ab
Treatment 5	46.0 ab	50.2 a	31.0 abc	49.2 a
Treatment 6	48.9 ab	49.4 a	33.0 a	47.8 a
Treatment 7	51.0 a	45.6 a	28.8 bcd	50.0 a
Treatment 8	44.3 ab	41.9 a	27.3 cd	40.5 ab
Treatment 9	44.8 ab	47.1 a	26.5 d	40.9 ab

[1]Means within the same column with the same letter are not different using a significance level of 0.05 according to DMRT.

Table 4. Effect of herbicide treatments on seed cotton yield.

Treatment	Seed cotton yield[1]			
	1995	1996	1997	1998
	lb/A	*lb/A*	*lb/A*	*lb/A*
Treatment 1	2,030 a	2,127 ab	3,125 a	2,020 b
Treatment 2	2,068 a	2,333 a	3,278 a	1,897 bc
Treatment 3	2,004 a	2,218 ab	2,815 ab	1,255 c
Treatment 4	2,215 a	2,307 a	3,327 a	2,564 ab
Treatment 5	2,110 a	2,468 a	3,380 a	2,636 ab
Treatment 6	2,122 a	2,347 a	3,096 a	2,883 a
Treatment 7	2,313 a	2,379 a	3,243 a	2,605 ab
Treatment 8	1,931 a	2,066 ab	3,168 a	2,343 ab
Treatment 9	2,056 a	1,834 b	2,176 b	1,976 b

[1]Means within the same column with the same letter are not different using a significance level of 0.05 according to DMRT.

Table 5. Effect of PPI herbicide applications on numbers of ivyleaf morningglory plants.[1]

Treatment	Plants per 133 square feet [2]		
	4/28/95	4/23/97	4/30/98
	no.	*no.*	*no.*
Treatment 1 [3]	12.5 ab	48.5 a	202.3 a
Treatment 2	4.0 c	13.8 b	83.8 a
Treatment 3 [3]	7.0 bc	25.4 ab	195.4 a
Treatment 4 [3]	8.0 abc	32.3 ab	153.1 a
Treatment 5	2.0 c	18.0 b	91.5 a
Treatment 6 [3]	8.5 abc	25.4 ab	136.1 a
Treatment 7	11.5 ab	30.8 ab	103.1 a
Treatment 8 [3]	5.8 bc	16.2 b	126.1 a
Treatment 9	14.8 a	26.9 ab	153.1 a
(DA – 2, 5) [4]	(25)	(20)	(31)
(DA – 7, 9) [5]	(36)	(42)	(38)

[1]No count made before PRE application in 1996.
[2]Means within the same column with the same letter are not different using a significance level of 0.05 according to DMRT.
[3]No PPI applied.
[4]Days after PPI application in Treatments 2 and 5.
[5]Days after PPI application in Treatments 7 and 9.

Table 6. Effect of PPI and/or PRE herbicide applications on numbers of ivyleaf morningglory plants.

Treatment	Plants per 133 square feet [1]			
	5/18/95	5/8/96	5/29/97	5/22/98
	no.	*no.*	*no.*	*no.*
Treatment 1 [2]	26.3 a	35.5 a	110.0 ab	19.5 a
Treatment 2	0.5 d	2.5 c	5.4 b	6.3 ab
Treatment 3	12.5 bc	22.5 ab	124.6 a	13.5 ab
Treatment 4	1.3 d	4.5 bc	61.5 ab	8.3 ab
Treatment 5	1.5 d	2.5 c	26.2 ab	0.3 b
Treatment 6	3.8 d	5.0 bc	38.5 ab	7.0 ab
Treatment 7	12.0 bc	6.5 bc	69.2 ab	5.5 ab
Treatment 8	7.3 cd	17.0 bc	71.3 ab	6.3 ab
Treatment 9	16.0 b	16.5 bc	132.3 a	11.0 ab
(Days after first planting)	(21)	(20)	(28)	(16)

[1]Means within the same column with the same letter are not different using a significance level of 0.05 according to DMRT.
[2]No PPI or PRE herbicides applied.

Table 7. Effect of PPI and/or PRE herbicide applications and/or one OT application on numbers of ivyleaf morningglory plants.

Treatment	Plants per 133 square feet [1]			
	6/27/95	6/13/96	6/18/97	6/8/98
	no.	*no.*	*no.*	*no.*
Treatment 1	133.5 a	167.0 ab	39.8 ab	69.0 a
Treatment 2	36.8 c [2]	64.0 b	2.8 b [2]	24.0 b
Treatment 3	117.5 ab	183.0 a	27.3 ab	35.0 b
Treatment 4	136.0 a	138.5 ab	26.5 ab	31.3 b
Treatment 5	45.0 c [2]	67.3 ab	7.3 b	10.8 b [2]
Treatment 6	94.0 abc	121.3 ab	17.8 ab	25.8 b
Treatment 7	64.0 bc	93.8 ab	52.0 a	23.5 b
Treatment 8	65.3 bc	88.3 ab	34.0 ab	11.3 b
Treatment 9	131.8 a	167.3 ab	41.8 ab	42.3 ab
(Days after first OT treatment)	(14)	(20)	(16)	(12)

[1]Means within the same column with the same letter are not different using a significance level of 0.05 according to DMRT.
[2]First OT herbicide determined not to be needed at time of application.

Table 8. Effect of PPI, PRE, and OT herbicide applications on control of ivyleaf morningglory.

Treatment	Visual control [1,2]			
	7/10/95	6/26/96	7/15/97	6/25/98
	%	%	%	%
Treatment 1	91 ab (3)	100 a (3)	63 c (2)	88 bc (2)
Treatment 2	95 a (1)	100 a (2)	91 b (0)	96 ab (2)
Treatment 3	74 cd (2)	95 c (2)	97 ab (2)	78 d (2)
Treatment 4	81 bcd (1)	99 ab (2)	98 ab (2)	95 abc (2)
Treatment 5	85 a-d (0)	100 a (2)	100 a (2)	89 bc (1)
Treatment 6	81 bcd (1)	99 ab (3)	100 a (2)	96 ab (2)
Treatment 7	71 d (1)	100 a (2)	99 a (2)	98 a (2)
Treatment 8	80 bcd (1)	99 ab (2)	98 ab (2)	99 a (2)
Treatment 9	90 abc (2)	97 bc (2)	98 ab (2)	94 abc (2)
(Days after last OT treatment)	(13)	(14)	(13)	(8)

[1]Means within the same column with the same letter are not different using a significance level of 0.05 according to DMRT.
[2]Numbers in parentheses after the visual control ratings are the total OT treatments applied.

Table 9. Effect of PPI and/or PRE herbicide applications on numbers of slender amaranth plants.

Treatment	Plants per 133 square feet [1]			
	5/18/95	5/27/96	5/14/97	5/22/98
	no.	*no.*	*no.*	*no.*
Treatment 1	62.8 ab	29.5 a [2]	146.1 a	17.5 a
Treatment 2	0.0 b	0.0 b	0.0 b	1.8 bc
Treatment 3	0.3 b	1.0 b	0.0 b	1.5 bc
Treatment 4	1.3 b	1.0 b	18.5 b	6.5 bc
Treatment 5	0.0 b	3.5 ab	0.0 b	0.0 c
Treatment 6	0.3 b	8.0 ab [2]	0.0 b	3.8 bc
Treatment 7	120.8 a	4.5 ab	1.5 b	0.0 c
Treatment 8	7.8 b	30.8 a	13.8 b	8.0 b
Treatment 9	0.3 b	0.0 b	2.3 b	0.0 c
(Days after first planting)	(21)	(17)	(13)	(16)

[1]Means within the same column with the same letter are not different using a significance level of 0.05 according to DMRT.
[2]One OT application applied.

Table 10. Effect of PPI, PRE, and OT herbicide applications on control of slender amaranth.

Treatment	Plants per 133 square feet [1,2]			Visual control [1,2]
	6/27/95	6/26/96	6/18/97	6/25/98
	no.	*no.*	*no.*	%
Treatment 1	25.8 b (2)	35.3 a (3)	14.5 a (1)	10 e (2)
Treatment 2	0.0 b (0)	1.8 b (2)	0.0 b (0)	84 ab (2)
Treatment 3	0.3 b (1)	5.3 b (2)	0.5 b (1)	55 cd (2)
Treatment 4	2.8 b (1)	5.8 b (2)	0.3 b (1)	44 d (2)
Treatment 5	0.0 b (0)	1.0 b (2)	0.0 b (1)	81 bc (1)
Treatment 6	2.8 b (1)	5.8 b (3)	0.0 b (1)	56 cd (2)
Treatment 7	74.0 a (1)	6.3 b (2)	0.5 b (1)	99 a (2)
Treatment 8	20.3 b (1)	39.8 a (2)	0.0 b (1)	91 ab (2)
Treatment 9	23.3 b (1)	3.3 b (2)	0.0 b (1)	96 ab (2)

[1]Means within the same column with the same letter are not different using a significance level of 0.05 according to DMRT.
[2]Numbers in parentheses after the plant counts and control ratings are the total OT treatments applied.

Slender Amaranth

May plant count data for slender amaranth were variable across years (Table 9). Before OT treatments were applied, large numbers of this weed were present in Treatment 1 in 1995 and 1997. Compared with Treatment 1, slender amaranth plants were effectively controlled with all PPI and/or PRE treatments in all four years of the study. Exceptions to this finding were Treatment 7 in 1995 and Treatment 8 in 1996.

Plant counts in June 1995-1997 after OT treatments were made demonstrated results similar to those obtained in May (Table 10). An exception was with Treatment 7 in 1995, when one OT application of Staple at 0.032 pound of active ingredient per acre did not control slender amaranth, but two treatments that included single applications of Buctril were effective. In 1996, Treatment 1 was much less effective than all other treatments except for Treatment 8. In 1997, all treatments outperformed Treatment 1. In 1998, control was determined in late June with a visual rating. Treatments 7-9 provided 91% or greater control, while Treatments 2 and 5 were intermediate with 84% and 81% control, respectively. These results tend to indicate that slender amaranth is somewhat more difficult to control with Staple. However, this may not be an accurate assessment since the population of slender amaranth was inconsistent and plots treated with Staple were infested with larger populations of purple nutsedge, which may have suppressed the emergence and/or interfered with spray coverage on slender amaranth.

SUMMARY

Cotton stand was not affected by selected PPI, PRE, and OT herbicide applications for controlling ivyleaf morningglory and slender amaranth. Seed cotton yield was not affected by the mixed population of ivyleaf morningglory and slender amaranth in 1995-1998, though ivyleaf morningglory plants were present in large numbers and slender amaranth plants were present in low to moderate numbers. PPI and PRE herbicides provided early control, and OT herbicide applications were made to small, newly emerged weed plants, which prevented undue competition on the cotton. Seed cotton yield was reduced with certain treatments where large infestations of nutsedge plants were present and were not effectively controlled.

Ivyleaf morningglory plants were effectively controlled with Buctril alone and with serial applications of PPI, PRE, and OT herbicides.

Slender amaranth plants were not effectively controlled with Buctril alone. Control with serial herbicide treatments was generally satisfactory with a few exceptions that were not consistent over the years.

REFERENCES

(1) Culpepper, A.S., and A.C. York. 1997. Weed management in no-tillage bromoxynil-tolerant cotton (*Gossypium hirsutum*). Weed Technology 11:335-345.

(2) Elmore, C.D., H.R. Hurst, and D.F. Austin. 1990. Biology and control of morningglories (*Ipomoea* sp.). Rev. Weed Sci. 5:83-114.

(3) Hurst, H.R. 1998. Ivyleaf morningglory [*Ipomoea hederacea* (L.) Jacq.] and slender amaranth (*Amaranthus viridus* L.) control in BXN cotton. Proc. Beltwide Cotton Conferences, 22nd Weed Sci. Conf., San Diego, CA, pp. 852-854.

(4) Rodgers, J.B., D.S. Murray, L.M. Verhalen, and P.L. Claypool. 1996. Ivyleaf morningglory (*Ipomoea hederacea*) interference with cotton (*Gossypium hirsutum*). Weed Technology 10:107-114.

(5) Webster, T.M., and H.D. Coble. 1997. Changes in the weed species composition of the Southern United States: 1974 to 1995. Weed Technology 11:308-317.

Mississippi State
UNIVERSITY

Printed on Recycled Paper

Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the Mississippi Agricultural and Forestry Experiment Station and does not imply its approval to the exclusion of other products that also may be suitable.

http://www.mafes.msstate.edu **16097/950**