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Herbicides in Narrow-row Cotton Culture[1]

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ABSTRACT

On loamy sand soil application of several pre-emergence herbicides followed by sprinkle irrigation or rainfall resulted in good control of a mixture of several *Amaranthus* (pigweed) species in narrow-row (18 to 25 cm) cotton (*Gossypium hirsutum* L.) without causing crop injury. On fine sandy loam soil preplant herbicide applications, followed by incorporation with a spike-toothed harrow, gave good weed control without cotton injury. Deep incorporation of preplant herbicides on fine sandy loam caused cotton injury. On loam soil, shallow incorporation with a grain drill during the planting operation or deeper incorporation with a tandem disk gave good pigweed control without cotton injury. Herbicide rates required for control of pigweed in narrow-row cotton were comparable to those required for weed control in conventional cultivated cotton on the same soil types.

Additional index words: **Pigweed (*Amaranthus* sp.) control, DCPA, Trifluralin, Diuron, Norea, Prometryne, Nitralin, Alachlor, Fluometuron, Herbicide incorporation.**

RECENTLY, herbicides have made it possible to grow many crops with reduced cultivation and hand weeding (12). Crop production without cultivation has eliminated the necessity of growing crops in rows wide enough for cultivation equipment. With optimum growing conditions yields of corn (*Zea mays* L.) (4), grain sorghum [*Sorghum bicolor* (L.) Moench] (5), and soybeans [*Glycine max* (L.) Merill] (1, 3) were increased by narrow spacings and high plant populations.

The feasibility of cotton production in narrow rows has been demonstrated (6, 8). Cotton planted in 18- to 25-cm rows produced higher yields, at a 27% reduction in production costs, than did cotton planted in 1-m rows. In addition, fruit production was more uniform, bolls matured earlier, and fiber quality was improved when short-season cotton varieties were grown in narrow rows. A harvester has been perfected to strip narrow-row cotton faster and more economically than conventional row-oriented equipment (2).

Full utilization of the agronomic, economic, and mechanical advantages of closely spaced cotton is dependent upon complete chemical weed control (9). Although rapid development of a crop canopy in narrow rows may minimize weed development, rapid establishment of the crop is partially dependent upon a weed-free environment following planting. Since weed control is poor with herbicides that can be applied over the top of emerged cotton in West Texas, emphasis was placed upon the use of preplant or preemergence herbicides. Recent studies have shown that incorporation enhanced effectiveness of preplant and some preemergence herbicides in this area, which has erratic rainfall and high winds (10, 11).

This research was conducted to determine the feasibility of controlling weeds in narrow-row cotton on three soil types with various preplant and preemer-

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gence herbicides applied in conjunction with several incorporation methods.

METHODS

Weed control in narrow-row cotton was investigated in eight experiments. Studies were conducted on loamy sand soil in 1964, fine sandy loam in 1964 and 1965, and loam soil in 1965 and 1969. The approximate percentages of sand, silt, clay, and organic matter for the loamy sand soil were 83, 12, 5 and 0.5; for fine sandy loam: 75, 13, 12, and 0.5; and for the loam: 50, 25, 24, and 1.0.

Herbicides were applied in water at 120 and 300 liters/ha with tractor-mounted sprayers or at 400 liters/ha with hand-held booms. Plot size varied from 8 × 30 m to 4 × 15 m for treatments applied with tractor sprayers and were 5 × 5 m when hand-held booms were used. In 1964 identical studies were applied with one replication at each of two locations; otherwise, all studies were in randomized block or split-plot design with three replications. Herbicides used were alachlor (2-chloro-2',6'-diethyl-N (methoxymethyl)acetanilide), DCPA (dimethyl tetrachloroterephthalate), diuron [3-(3, 4-dichlorophenyl)-1,1-dimethyl-urea], fluometuron [1,1-dimethyl-3-(a,a,a,-trifluoro-m-tolyl)urea] nitralin [4-(methysulfonyl)-3,6-dinitro-N,N-dipropylaniline], norea [3-(hexahydro-4,7-methanoindan-5-yl)-1,1-dimethylurea], prometryne [2,4-bis(isopropylamino)-6-(methylthio)-s-triazine], and trifluralin (a,a,a,-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine). Details as to herbicide rates, incorporation, rainfall, and planting dates are shown in the tables. Weeds were a mixture of *Amaranthus* species — primarily *Amaranthus palmeri* S. Wats., *A. retroflexus* L., *A. hybridus* L. — and will be referred to as pigweed. Percentage of pigweed control was visually estimated, or weeds were counted in 2.4 m² per plot to estimate percentage of control.

Cotton was planted in 25-cm rows with a single disk grain drill at 45 to 67 kg/ha of seed, which gave from 170,000 to 220,000 plants per ha. Crop injury was estimated visually, and stand was estimated by counting seedlings in 2.4 m².

RESULTS

Loamy Sand Soil

On loamy sand soil cotton is frequently planted in dry soil and sprinkle-irrigated for emergence. Five cm of irrigation water or 3.8 cm rainfall the day following cotton planting and application of DCPA, diuron, norea, or prometryne on loamy sand soil resulted in 99 or more percent control of pigweed at rates that did not result in cotton injury (Table 1). Trifluralin applied at rates up to 0.6 kg/ha did not cause adequate weed control at the location receiving rainfall only, but as little as 0.3 kg/ha gave control when 5 cm of irrigation water was applied. The reason for this difference is unknown.

Table 1. Pigweed control in narrow-row cotton on loamy sand with preemergence herbicides.

Herbicide	kg/ha	% control on July 10	
		Location I*	Location II†
DCPA	2.2	100	70
	4.5	100	70
	6.7	100	99
Diuron	0.3	80	20
	0.4	85	100
	0.6	99	100
	1.1	100	90
Norea	0.6	99	99
	1.1	99	98
	1.7	100	100‡
Prometryne	0.3	80	90
	0.6	85	99
	1.1	99	99
Trifluralin	0.3	95	0
	0.4	98	55
	0.6	98	80

* Planted and treated on April 28; sprinkle irrigated with 5 cm of water. One replication. † Planted and treated on May 26; 3.8 cm of rain on May 26 and 5 cm on May 29. One replication. ‡ About 10% cotton stunting.

Fine Sandy Loam Soil

Preplant and preemergence applications of DCPA, diuron, prometryne, norea, and trifluralin were made in 1964 and 1965 (Table 2). In 1964 the preplant applications were incorporated to about 2.5 cm with a spike-toothed harrow about 1 month before planting. If one considers an average of all herbicides, this type of incorporation increased weed control. However, closer observation of the data shows that prometryne gave equally as good weed control with or without incorporation with a harrow. No herbicide injury to the crop occurred in the study.

In 1965 preplant herbicides were applied about 3 weeks ahead of planting and incorporated 5 to 10 cm with a tandem disk. Average pigweed control was markedly increased by the preplant applications that were incorporated, but severe cotton injury (chlorosis, necrosis, and stunting) occurred with all herbicide treatments except 0.6 kg/ha of diuron. Preemergence application of trifluralin, prometryne, and norea gave good weed control without cotton injury. Good control with trifluralin applied preemergence indicates that heavy rainfall probably occurred shortly after application. Daily rainfall records were not available.

Loam Soil

In 1965 preplant herbicide applications incorporated with a tandem disk were compared to preemergence applications that were not incorporated (Table 3). Pigweed control was improved with preplant application and incorporation of all herbicides except prometryne.

In 1969 three studies were conducted on loam soil to compare methods of incorporating herbicides used in narrow-row cotton plantings. In one study a preplant application of nitralin and trifluralin that was incorporated with a tandem disk was compared to preemergence applications at two times after planting and followed by different amounts of natural rainfall. Preplant application of the two herbicides and a pre-

Table 2. Pigweed control in narrow-row cotton on fine sandy loam soil after preplant and preemergence applications of herbicides.

Herbicide	kg/ha	% control					
		1964†			1965‡		
		Preplant	Preemergence	Avg	Preplant	Preemergence	Avg
DCPA	4.5	98	81	90 abcde	90§	59	75 f
	6.7	92	79	86 abcde	98§	64	81 def
	9.0	100	85	92 abc	--	--	--
Diuron	0.6	92	88	90 abcde	87	86	87 cde
	0.8	100	89	94 ab	87§	70	78 ef
	1.1	94	96	85 a	--	--	--
Prometryne	1.1	89	97	93 abc	97§	86	92 abc
	1.7	97	99	98 a	99§	99	99 a
	2.2	100	100	100 a	--	--	--
Norea	1.1	98	53	76 e	86§	91	88 bcd
	1.7	93	80	77 e	98§	98	98 a
	2.2	87	72	79 cde	--	--	--
Trifluralin	0.6	98	87	92 abc	98§	91	94 abc
	0.8	97	97	98 a	--	--	--
	1.1	98	73	86 abcde	--	--	--
Avg		96 A	85 B		93 A	83 B	

* Means followed by the same letter of the same case are not significantly different ($P < 0.05$) † Preplant herbicides applied and incorporated with a spike-toothed harrow on April 22; cotton planted on all plots and preemergence herbicides applied on May 19. Entire area was sprinkle irrigated on May 20 to insure emergence. Data were obtained on June 5. ‡ Preplant herbicides applied on April 28 and incorporated with one tandem disking. Cotton planted and preemergence herbicides applied on May 19. June rainfall was 16 cm and a 10 cm flood irrigation was applied on July 9. Data were obtained on July 19. § Cotton seedlings were injured from 20 to 30%. (Chlorosis, necrosis and stunting).

Table 3. Pigweed control in narrow-row cotton on loam soil atfer herbicide application in 1965.

Herbicide	kg/ha	% control†		
		Preplant	Preemergence	Avg
DCPA	4.5	100	32	66 abc
	6.7	94	33	64 bc
Diuron	0.6	69	66	67 abc
	0.8	100	70	85 ab
Prometryne	1.1	87	89	88 ab
	1.7	100	94	97 a
Norea	1.1	57	32	45 c
	1.7	82	32	57 bc
Trifluralin	0.4	80	68	74 abc
	0.6	100	82	91 ab
Avg		87 A	60 B	

* Preplant herbicides applied and spike-toothed harrowed March 25 and tandem disked once on March 31. Cotton was planted and preemergence herbicides were applied on May 5. May rainfall was 2 cm. Data were obtained on June 3. † Means followed by the same letter of the same ease are not signifieantly different (P < 0.05).

Table 4. Percentage control of pigweed in narrow-row cotton grown on loam soil following incorporation or surface application of herbicides, 1969.

Herbicide	kg/ha	Incorporation†	
		Planter	None
Nitralline	0.6	76 a	--
Trifluralin	0.6	72 a	--
Trifluralin	0.8	85 a	--
Prometryne	1.7	94 a	93 a
Alachlor	1.7	93 a	90 a
Diuron	0.8	77 a	30 b
Fluometuron	1.7	--	90 a
Untreated control	-	--	0 b

* Means followed by the same letter are not significantly different (P < 0.05). † For planter incorporation, herbicides were applied on April 29 just before planting with a single disk drill. Herbicides were applied the same day after planting for comparison. Wind blown sand destroyed cotton stand and the whole study was rotary hoed on May 12 and replanted on May 15. Data were obtained on July 1. Rainfall April 29 to July 1 was 14.8 cm.

emergence application of nitralin followed by 22.5 mm of rain one day later eliminated the pigweed. No weed control occurred when nitralin and trifluralin were applied to the same field 2 days after the 22.5 mm of rain, and only 2.5 mm of rain fell 4 days later. A possible explanation is that the pigweed had started to germinate after the 22.5 mm rain and the 2.5 mm rain did not leach the herbicides deeply enough to kill the seedlings.

In a second study several herbicides were applied just ahead of cotton planting on April 29 and incorporated with the single disks on the grain drill used for planting. This type of incorporation was compared to preemergence applications made just after planting (Table 4). Windblown sand destroyed the cotton before weeds emerged and the entire study area was rotary hoed and replanted on May 13. Weed control in July from applications of trifluralin, nitralin, prometryne, alachlor, and diuron, which had been incorporated with disks on the drill, was comparable to that obtained with unincorporated prometryne, fluometuron, and alachlor. If diuron was not incorporated at planting, weed control was reduced. In a third study nitralin and trifluralin were either applied 3 weeks before planting and incorporated with a tandem disk or applied the day of planting and incorporated with the disks on the drill. All treatments eliminated the weeds.

Cotton injury observations and stand counts showed that cotton was not injured by any treatments in loam soil.

DISCUSSION

These studies indicate that herbicides and application procedures that will give good enough pigweed control in narrow-row cotton so that very little hoeing will be necessary are available. Sprinkle irrigation immediately after application of several herbicides applied preemergence resulted in good weed control on loamy sand soil. Preplant application of diuron, trifluralin, DCPA, norea, and prometryne followed by incorporation with a spike-toothed harrow resulted in good weed control without cotton injury on fine sandy loam soil. Deep incorporation of several herbicides with a tandem disk caused cotton injury on this soil and would not be advisable. On loam soil shallow incorporation with a tandem disk gave adequate weed control for narrow-row cotton. Rates of herbicides that resulted in adequate pigweed control in these trials were the same on the various soil types as presently recommended for row-planted cotton (7).

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