CHEMICAL CONTROL OF WILD CANE, *SORGHUM BICOLOR*, IN SOYBEANS, *GLYCINE MAX*

by 6508

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INTRODUCTION

Wild cane (Sorghum bicolor (L.) Moench) has become a serious problem in the grain sorghum (S. bicolor (L.) Moench) producing areas of the Midwest. This ancient, mid- to tall-growing, wild type grain sorghum has been used by sorghum breeders to develop modern hybrid grain sorghum varieties. Because wild cane can readily cross with other grain sorghum varieties, a diverse gene pool has been created, not only in wild cane, but also in hybrid sorghums. Therefore, wild cane infestations have become most serious where a continuous sorghum cropping system is used.

Wild cane seems best adapted to the sub-humid, temperate regions of the United States. Because of its diverse gene pool and probable increased range of adaptability, wild cane is becoming a serious weed in the western regions of the corn belt. The reduction of yields by wild cane in corn (Zea mays L.), grain sorghum and soybeans (Glycine max (L.) Merr.) can be attributed to competition and the increased difficulty in, and losses due to, harvesting operations. Because of early maturity and shattering, most wild cane seed falls to the ground before grain sorghum or corn can be harvested. This shattering results in an increase of wild cane seed in the soil. Wild cane seed can remain viable in the soil for several years and wild cane plants can emerge from depths greater than those of normal tillage. It can germinate and emerge at any time throughout the growing season. Therefore, mechanical control measures aside from hand weeding have not proved successful in controlling wild cane.

Herbicides which are effective in controlling wild cane in grain sorghum or corn may also injure these crops. However, within the past six years several herbicides which have been labeled for use in soybeans give acceptable control of grassy weeds. Since soybeans are adapted to the same general areas as wild cane, it may be feasible to use these herbicides with soybeans to reduce and eventually control infestations of wild cane.

The purpose of this study was four-fold: (1) To determine which of those herbicides that are labeled or may be labeled for use in soybeans might provide acceptable control of wild cane; (2) to study the site of uptake of those herbicides which caused injury to wild cane; (3) to determine at which stage of growth soybeans can compete with wild cane; and (4) to find how much wild cane is necessary to cause significant reduction in soybean yield.

All common names of herbicides used in this manuscript with the exception of those bearing experimental labels are approved by the Terminology Committee of the Weed Science Society of America.

REVIEW OF LITERATURE

Effects of Weeds on Soybean Production

Scott and Aldrich (31) state that, in the early stages of development, soybeans are poor competitors with established weed stands or weeds that germinate at the same time as the soybeans. Hinson (16) found that soybeans can successfully compete with weeds 4 to 6 weeks after soybeans emerge. He reported that soybeans may lose one pound of dry matter for each pound of weed dry matter produced.

In corn and sorghum producing areas of the Great Plains, johnsongrass (*Sorghum halepense* L.), wild cane, and volunteer corn have become serious problems. Norman (27) reported 15 bu/A (bushels per acre) reduction in soybean yields due to johnsongrass.

Staniforth and Weber (33), and Weber and Staniforth (36) found that some weeds compete only for moisture. Foxtail (*Setaria spp*. L.), smartweed (*Polygonum spp*. L.), and annual morningglory (*Ipomoea purpurea* (L.) Roth.) usually are unable to surpass soybean growth to compete for light. Norman (27) and Kottman (22) reported that soybean yields can be reduced as much as 50% by pigweed (*Amaranthus spp*. L.) and 40% by annual morningglory competition.

Until the early 1960's cultivation and rotary hoeing were the best methods of weed control. Dunham (7), and Lovely *et al*. (23) found that the timely use of the rotary hoe effectively reduced weed infestations with no more than 10% reduction of soybean stands. Mader *et al*. (24) and Staniforth and Weber (34) reported that pure seed and weed-free seedbeds were essential in reducing weed populations in soybeans.

Characteristics of Wild Cane

Schilling (30) did an intensive review of the origin, introduction, and characteristics of wild cane. A continuation into the review of seed and plant characteristics is in order at this time.

The persistence and seriousness of a weed in a cropping system depends largely on the dormancy, viability, and germination of the weed seed in the soil. Plants arising from seeds that have short periods of dormancy or low viability are easier to control or may be controlled in a shorter period of time than those having high viability and long periods of dormancy. Gritton and Atkins (10) reported that the genotypes in grain sorghum express differences in seed dormancy. Cold temperature treatments and scarification increased germination 2 to 3 weeks after harvest, but untreated seed germinated as well after a 3-month period.

Goodsell (9) found that pre-chilling, slow drying, and scarification could break seed dormancy of grain sorghum. Robbins and Porter (29) reported that wild cane seed exposed to 20 F for 12 hours had little effect on germination, but when the seed was exposed for the same length of time at -20 F germination dropped from 87 to 7%.

Kersting _et al_. (19) found that sorghum seed could germinate 12 to 15 days after pollination, but germination was highest when the seed was harvested 20 days after pollination.

Burnside (4) reported that wild cane could produce viable seed 10 days after anthesis. He reported that 16% of the wild cane seed remained dormant after one month and 4% after 32 months. It was noted that 97% of the seed was viable after one month and 94% was viable after 32 months. Three days after harvest germination of wild cane seed was 53%. After five months the germination of wild cane seed increased to 84% and 90% after 21 months.

Karper and Jones (17) reported 88% germination after seven years from sorghums such as Blackhull Kafir.

Weeds that can germinate and emerge from considerable soil depths are difficult to control with normal tillage operations. Burnside (4) found up to 42% wild cane emergence from seed planted six inches deep. Condray (6) found no significant differences in emergence of wild cane planted at one-, two-, four-, six- or eight-inch depths.

Many variations exist among the wild type grain sorghums. Wild cane may grow from 3 to 12 feet tall; glume color may be reddish brown to black; glumes may enclose the seed completely or only partially; and the panicle may be open or compact.

Early maturity and seed shattering are other characteristics which make wild cane a problem. Wild cane seed could be harvested with grain sorghum, but its early maturing seed shatters before normal harvest of grain sorghum. Burnside (4) stated that wild cane may germinate, emerge, and produce viable seed within 65 to 75 days. Most hybrid grain sorghums require from 90 to 120 days to reach maturity.

The shattering mechanism of sorghum seed was investigated by Karper and Quinby (18). They reported that the formation of a callus layer just below the seed where abcission takes place is responsible for shattering. Since formation of this callus layer is controlled by two dominant genes, the breeding of non-shattering lines is relatively easy.

Activity and Site of Uptake of Herbicides

With careful calibration of spray equipment and immediate incorporation as recommended on the label, variations in weed control have occurred. Fields that have a large number of weed seeds on the soil surface, or that are exposed to minor flooding, may have inconsistent weed control. Such variations are often difficult and sometimes impossible to explain. Several investigators (1, 6, 8, 11, 26) reported that the chemical nature of the herbicide, soil type, organic matter content, climatic conditions, and site of uptake of the herbicide by the plant should be studied.

Because of the high volatility and susceptibility to photodegradation of most herbicides labeled for use in soybeans, it is necessary that these herbicides be incorporated into the soil. The carbamates; S-propyl dipropylthiocarbamate (vernolate), S-(2,3-dichloroallyl) diisopropylthiocarbamate (diallate), and S-(2,3,3-trichloroallyl) diisopropylthiocarbamate (triallate); are highly volatile and must be incorporated into a fairly dry soil to minimize volatilization. Trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), 4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline (nitralin) and related compounds are sensitive to ultraviolet light and must be incorporated to minimize photodegradation. Schilling (30) reported on the incorporation and decomposition of these herbicides in the soil.

Talbert (35) stated that preemergence herbicides may appear selective under field conditions due to physiological tolerance by the crop species, differential depth of root growth in the soil between the crop and weeds (depth protection), or a combination of these two mechanisms. He reported that the amount of herbicide required to control weeds satisfactorily may depend on the nature of the soil. Soils low in organic matter will absorb smaller amounts of trifluralin, nitralin, and vernolate. Therefore lower rates of herbicide may be required to control weeds and avoid crop injury. Soils high in organic matter may require slightly more herbicide to accomplish the same results.

Hicks (15) warned that certain herbicides may give adequate weed control in field crops, but after several years of continued use, weed species that are not controlled may increase and become a serious problem.

Placement of preemergence herbicides with respect to weed seed is an important factor for effective weed control. Appleby et al. (2) state that the site of uptake and lethal action are important when deciding where the herbicides should be placed for optimum results. Knake et al. (20) found that the most advantageous placement of a soil applied herbicide depends on the chemical and physical properties of the herbicide, soil characteristics, climatic factors and site of uptake for the plant species.

Burnside (5) found that trifluralin and vernolate gave more effective control of wild cane when these chemicals were incorporated above the seed. Condray (6) reported similar results, but also noted that vernolate was absorbed through the roots of wild cane and velvetleaf (Abutilon theophrasti Medic.).

Increased control of yellow nutsedge (Cyperus escultus L.), sickle pod (Cassia tora L.) and Texas millet (Panicum texanum Bukl.) was reported by Hauser and Marchant (13) with vernolate (PPTC) when subsurfaced at a depth of 3.81 cm.

Nitralin was found by Negi et al. (25) to decrease mitochondrial activity in corn. Oxygen uptake and oxidative phosphorylation were inhibited with nitralin solutions.

Banting (3) investigated the effects of diallate and triallate on wheat (*Tricticum aestivum* L.) and wild oats (*Avena fatua* L.). He found that diallate and triallate affected the shoot cells more than the root cells. In his studies he also noted a slightly greater activity with diallate. Nishimoto *et al*. (26) found that S-ethyl dipropylthiocarbamate (EPTC) and several other carbamates were most effective when absorbed through the shoots of oats. Gummeson (12) found that the control of wild oats was most successful when diallate and triallate were applied before or shortly after germination. As the coleoptile length increased, injury by these two herbicides decreased. While most herbicides are limited either to shoot or root uptake, some herbicides may be absorbed by both. Such herbicides as trifluralin are absorbed by the shoot of grasses but may be absorbed by roots of broadleaf plants as shown by Oliver and Frans (28) in soybeans and cotton (*Gossypium hirsutum* L.).

Sloane *et al*. (32) reported that vernolate and trifluralin as preplant incorporated treatments have possibilities for weed control in soybeans. They found that vernolate at high rates of application injured soybeans.

METHODS AND MATERIALS

Field Research

The field research reported in this paper was conducted at two locations during 1969 and 1970. In 1969, Location 1 was east of Manhattan, Kansas, on river bottom land. The soil was a sandy loam. Location 2 was south of Manhattan. The soil type here was a silt loam. In 1970 the experiments were conducted at Location 1 and at a new location (Location 3) which was a silt loam soil. Location 3 was on Unit 3 of the Ashland Agronomy Farm near Manhattan. Locations 1 and 2 were naturally infested with wild cane, and Location 3 was over seeded with wild cane. The soil pH for Locations 1, 2, and 3 was 7.4, 7.6, and 6.9, respectively. The organic matter content was 1.8, 3.0, and 3.4%, respectively.

Thirty-two treatments were evaluated at each location in 1969. These included duplicate treatments of trifluralin at 1.12 and 2.24 kilograms active ingredient per hectare (hereafter kg/ha); vernolate at 3.36 kg/ha; diallate and triallate each at 2.24 and 3.36 kg/ha; nitralin at 1.40 and 1.68 kg/ha; combinations of nitralin-vernolate at 1.40 plus 2.24 kg/ha; trifluralin-vernolate, trifluralin-diallate, and trifluralin-triallate at 1.12 plus 2.24 kg/ha. Of these 13 duplicated treatments, one of each treatment received, in addition to herbicide, a supplemental cultivation later in the season. Of the remaining 6 treatments without herbicide, one was used as an untreated check, another as a cultivated check, and the remaining 4 plots were maintained weed free by hand weeding for 4, 6, and 8 weeks and full season, respectively.

Twenty-eight treatments were investigated in 1970. Cultivated and uncultivated treatments of trifluralin, vernolate, and nitralin were the same as in 1969. Diallate, triallate, combinations of these with trifluralin, and the nitralin-vernolate combination were deleted. Those treatments were replaced by cultivated and uncultivated treatments of Torpedo, SD 30187, and BAS 3870 at 1.68 kg/ha, 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) at 3.36 kg/ha and a trifluralin-nitralin combination at 1.12 plus 1.40 kg/ha.

Plots at Locations 1 and 2 were 3.05 x 9.14 m with 4.57-m alleys between tiers. Plots at Location 3 were 3.05 x 6.10 m with 4.57-m alleys. All treatments were replicated three times in a randomized complete block design.

Herbicides were applied on June 10, 1969, at Location 1; June 30, 1969, at Location 2; June 16, 1970, at Location 1; and June 22, 1970, at Location 3. A tractor-mounted, compressed air sprayer calibrated to deliver approximately 187.0 l/ha from tips spaced 50.8 cm apart was used to spray the plots. After the plots were sprayed, they were double disked in the same direction as they were sprayed. Where necessary, wild cane seed was applied by a broadcast seeder. The plots were tine tooth harrowed perpendicular to the direction of disking. Soybeans were planted immediately after harrowing with the exception of Location 1, 1969. There the soybeans were planted on June 16. The soybeans were planted in 76.2-cm rows with a 2-row surface planter.

Two and one-half cm or more of rain fell during the night following planting of all plots except Location 3 in 1970.

All plots to receive a cultivated treatment were cultivated during the fourth week after planting. Injury ratings were recorded on the fourth week and wild cane control ratings were recorded on the sixth week after planting. Stand counts of soybeans were taken early in the season. Wild cane was hand harvested when the seed started to shatter. A 1.52-m wide band of wild cane was removed from the length of the plots and weighed to obtain a green weight. A random sample of wild cane was dried to obtain the percent dry matter.

The soybeans were harvested at maturity. In 1969 the soybeans were cut with a plot cutter and later threshed. In 1970 the soybeans were combined directly. After threshing, the soybean samples were weighed and 100 soybeans were taken from each sample to obtain an average seed weight.

Data on wild cane control, wild cane yield, soybean injury, stand counts, soybean yields, and weight per 100 soybeans were statistically analyzed.

Site of Uptake Experiment

Site of uptake studies were conducted during the winter of 1970 in the growth chamber. An alluvial-colluvial silty clay loam soil was obtained from the North Agronomy Farm at Kansas State University. Wild cane and Kansas orange sorgo (*S. bicolor* (L.) Monech) were used for bioassay.

Sixteen treatments were included in the site of uptake studies. Trifluralin at 1.12 kg/ha, nitralin at 1.68 kg/ha, vernolate, diallate, and triallate at 3.36 kg/ha were used to treat the soil. The sixteenth treatment was the control.

Each of five flats with a 0.93 sq m area were filled with soil sifted through a 0.635 cm screen. Proper alloquats of each stock herbicide solution were applied with 500 ml of water. The soils were then mixed to obtain uniform incorporation of the herbicide.

Each treatment was prepared in a manner similar to that used by Knake and Wax (21) (Figure 1). Three treatments were used for each herbicide: A 2.54 cm band of treated soil above the seed; a 2.54 cm band of treated soil with the seed; and a 2.54 cm band of treated soil placed below the seed. Metal cans 17 cm in height and 15 cm in diameter were used. Layers of untreated or treated soil were placed in the cans according to the placement of the herbicides. Twenty-five wild cane or Kansas orange seeds were planted 3.81 cm deep. To minimize movement of the herbicides each soil layer was wetted to field capacity as it was placed into the cans. A 0.64 cm layer of sand was placed over the soil in each can to reduce evaporation and soil cracking. Each treatment was replicated three times and the cans were placed in a growth chamber in a completely randomized block design. A 12-hour photoperiod was used in the growth chamber with temperatures near 31 C during the day and 25 C at night.

Visual observations and coleoptile measurements were recorded 7, 10, and 14 days after planting.

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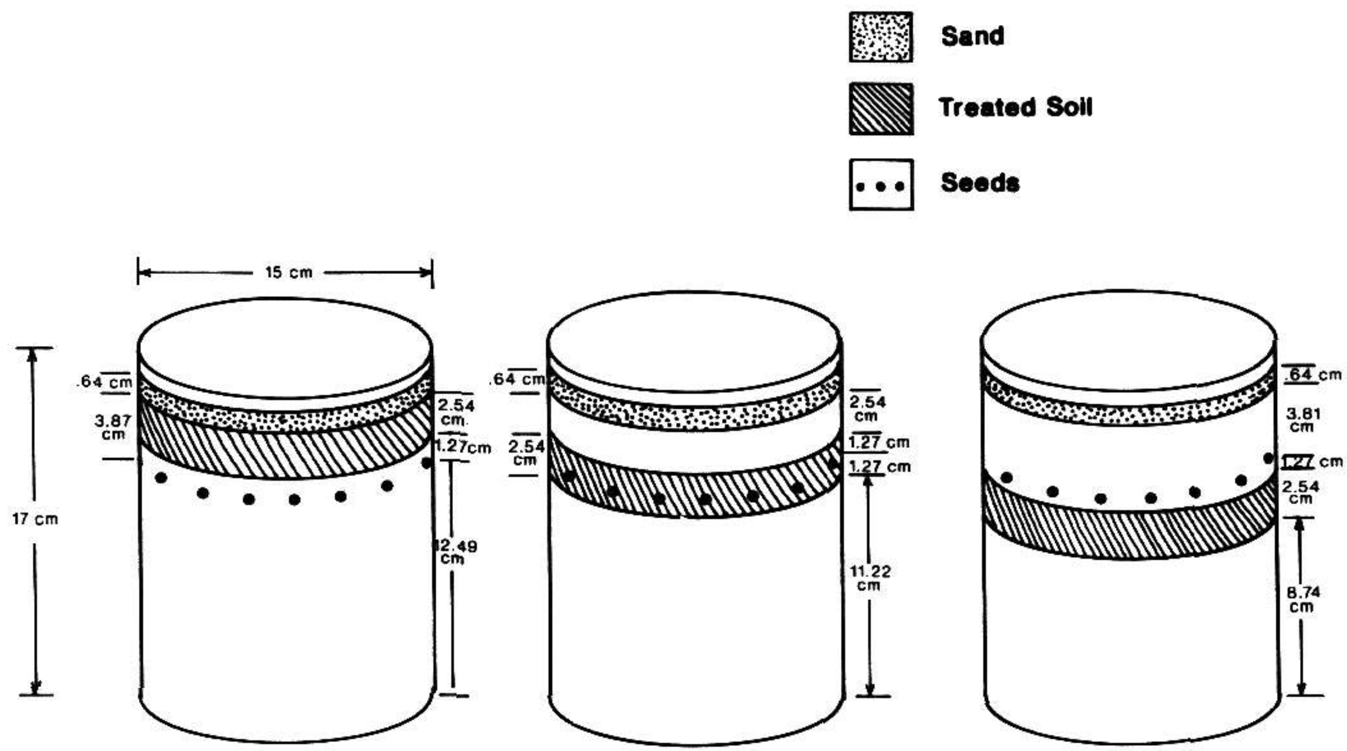

Fig. I. Placement of treated soil with respect to wild cane and Kansas orange sorgo seed.

EXPERIMENTAL RESULTS

Visual observations recorded during the first four weeks are summarized in Tables 1 and 2. Vernolate alone and in combination with trifluralin and nitralin injured soybeans. The injury appeared as a wrinkling of leaves and stunting of plants. There was some indication in 1969, that 2.24 kg/ha of trifluralin and the trifluralin-diallate combination injured soybeans. In 1970 the trifluralin-nitralin combination caused injury to the beans. Trifluralin and trifluralin-nitralin injury appeared as a slight stunting of the soybean plants. The injury symptoms of all herbicides disappeared by the sixth week, and injury was not reflected in soybean stand count, bean yields, or seed weight.

Soybean stand count data appear in Tables 3 and 4. Some significant differences were noted between the no treatment and weed-free plots at Location 1 in 1969 and 1970. Those plots did not receive herbicide treatments, nor had they been cultivated or hand weeded when the stand counts were taken. Since those differences in stand counts appeared in herbicide treated and untreated plots it was concluded that those differences could be attributed to factors other than herbicide injury.

Wild cane control ratings taken six weeks after the soybeans were planted (Tables 5 and 6) are highly correlated with the actual wild cane yields. Wild cane yield data and soybean yield data (Tables 7 through 10) (Figures 1 through 8 of the Appendix) were compared for each treatment. It was found that a high degree of correlation existed between wild cane control and soybean yields. Correlations appear in Table 9 of the Appendix.

At all locations trifluralin at 1.12 and 2.24 kg/ha gave excellent wild cane control. There were significant differences in wild cane yields

Table 1. Average per cent of soybean injury noted in 1969.

Treatment	Rate kg/ha	Location 1		Location 2	
		No Culti- vation	With Culti- vation	No Culti- vation	With Culti- vation
Trifluralin	1.12	3.3	3.3	11.6	5.0
Trifluralin	2.24	23.3	16.6	16.6	1.7
Nitralin	1.40	10.0	10.0	0	0
Nitralin	1.68	6.7	3.3	3.3	5.0
Vernolate	3.36	20.0	13.3	21.7	13.3
Diallate	2.24	0	6.6	8.3	1.6
Diallate	3.36	13.3	16.6	10.0	11.7
Triallate	2.24	6.6	0	3.3	0
Triallate	3.36	0	6.6	0	0
Nitralin + Vernolate	1.40 2.24	16.7	10.0	6.6	10.0
Trifluralin + Vernolate	1.12 2.24	13.3	23.3	30.0	26.7
Trifluralin + Diallate	1.12 2.24	13.3	20.0	13.3	5.0
Trifluralin + Triallate	1.12 2.24	10.0	3.3	3.3	6.7
No Treatment		0	0	0	0
Hand weed (four weeks)		0		0	
Hand weed (six weeks)		0		0	
Hand weed (eight weeks)		0		0	
Hand weed (full season)		0		0	
LSD .05		n.s.		12.4	

Table 2. Average per cent of soybean injury noted in 1970.

Treatment	Rate kg/ha	Location 1		Location 3	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	0	0	0	7.0
Trifluralin	2.24	7.0	0	10.0	3.3
Nitralin	1.40	3.3	0	0	0
Nitralin	1.68	0	3.0	0	0
Vernolate	3.36	10.0	10.0	3.3	0
Alachlor	3.36	3.3	0	0	0
Torpedo	1.68	0	0	0	0
SD 30187	1.68	0	0	0	0
BAS 3870	1.68	0	0	0	0
Trifluralin + Nitralin	1.12 1.40	20.0	17.0	10.0	17.0
Trifluralin + Vernolate	1.12 3.36	13.3	7.0	13.3	13.3
No Treatment		0	0	0	0
Hand weed (four weeks)		0		0	
Hand weed (six weeks)		0		0	
Hand weed (eight weeks)		0		0	
Hand weed (full season)		0		0	
LSD .05		9.0		8.0	

Table 3. Average number of plants per 30.48 cm of row in 1969.

Treatment	Rate kg/ha	Location 1		Location 2	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	5	5	5	5
Trifluralin	2.24	4	3	4	5
Nitralin	1.40	5	5	4	5
Nitralin	1.68	4	4	5	5
Vernolate	3.36	5	5	3	5
Diallate	2.24	5	5	4	4
Diallate	3.36	4	4	3	5
Triallate	2.24	6	7	5	5
Triallate	3.36	6	5	6	6
Nitralin + Vernolate	1.40 2.24	5	5	5	4
Trifluralin + Vernolate	1.12	5	5	3	5
Trifluralin + Diallate	1.12	5	5	4	5
Trifluralin + Triallate	1.12 2.24	5	5	5	4
No Treatment		4	4	3	5
Hand weed (four weeks)		5		5	
Hand weed (six weeks)		5		5	
Hand weed (eight weeks)		6		5	
Hand weed (full season)		5		5	
LSD .05		1.2		n.s.	

Table 4. Average number of plants per 30.48 cm of row in 1970.

Treatment	Rate kg/ha	Location 1		Location 3	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	9	9	6	5
Trifluralin	2.24	7	8	5	6
Nitralin	1.40	8	8	5	6
Nitralin	1.68	8	8	7	5
Vernolate	3.36	9	9	6	7
Alachlor	3.36	8	9	6	6
Torpedo	1.68	8	9	6	7
SD 30187	1.68	8	8	7	6
BAS 3870	1.68	9	9	6	7
Trifluralin + Nitralin	1.12 1.40	8	7	7	5
Trifluralin + Vernolate	1.12 3.36	7	8	6	5
No Treatment		9	9	6	7
Hand weed (four weeks)		9		7	
Hand weed (six weeks)		9		6	
Hand weed (eight weeks)		9		6	
Hand weed (full season)		9		7	
LSD .05		1.0		n.s.	

Table 5. Average percent of wild cane control in 1969.

Treatment	Rate kg/ha	Location 1		Location 2	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	90	90	76	93
Trifluralin	2.24	95	95	86	95
Nitralin	1.40	65	70	35	76
Nitralin	1.68	75	70	41	61
Vernolate	3.36	90	90	63	95
Diallate	2.24	70	70	76	95
Diallate	3.36	85	85	55	91
Triallate	2.24	65	65	68	91
Triallate	3.36	80	70	81	86
Nitralin + Vernolate	1.40 2.24	85	90	70	93
Trifluralin + Vernolate	1.12 2.24	95	95	83	95
Trifluralin + Diallate	1.12 2.24	95	90	88	95
Trifluralin + Triallate	1.12 2.24	95	95	93	95
No Treatment		0	65	0	58
Hand weed (four weeks)		100		95	
Hand weed (six weeks)		100		96	
Hand weed (eight weeks)		100		96	
Hand weed (full season)		100		96	

Table 6. Average percent of wild cane control in 1970.

Treatment	Rate kg/ha	Location 1		Location 3	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	95	97	85	90
Trifluralin	2.24	95	98	95	97
Nitralin	1.40	68	80	37	85
Nitralin	1.68	70	75	68	83
Vernolate	3.36	95	95	80	92
Alachlor	3.36	77	88	37	75
Torpedo	1.68	57	87	27	75
SD 30187	1.68	75	83	33	70
BAS 3870	1.68	90	92	55	78
Trifluralin + Nitralin	1.12 1.40	95	93	95	97
Trifluralin + Vernolate	1.12 3.36	93	98	95	92
No Treatment		0	60	0	53
Hand weed (four weeks)		100		98	
Hand weed (six weeks)		100		100	
Hand weed (eight weeks)		100		100	
Hand weed (full season)		100		100	

Table 7. The average yield of wild cane in kg/ha dry weight for 1969.

Treatment	Rate kg/ha	Location 1		Location 2	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	0	22	465	211
Trifluralin	2.24	0	0	224	107
Nitralin	1.40	1,100	585	2,480	540
Nitralin	1.68	755	172	1,590	1,910
Vernolate	3.36	356	130	1,640	152
Diallate	2.24	1,660	465	510	64
Diallate	3.36	1,330	562	2,060	258
Triallate	2.24	1,700	1,158	929	312
Triallate	3.36	1,290	920	224	498
Nitralin + Vernolate	1.40 2.24	107	107	935	172
Trifluralin + Vernolate	1.12 2.24	10	0	364	120
Trifluralin + Diallate	1.12 2.24	0	9	120	56
Trifluralin + Triallate	1.12 2.24	0	0	0	130
No Treatment		5,760	3,860	4,200	3,095
Hand weed (four weeks)		162		43	
Hand weed (six weeks)		0		0	
Hand weed (eight weeks)		0		0	
Hand weed (full season)		0		0	
LSD .05		655		1,356	

Table 8. The average yield of wild cane in kg/ha dry weight for 1970.

Treatment	Rate kg/ha	Location 1		Location 3	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	9	18	348	128
Trifluralin	2.24	31	0	61	73
Nitralin	1.40	722	560	1,400	1,200
Nitralin	1.68	1,320	1,040	845	780
Vernolate	3.36	22	137	408	415
Alachlor	3.36	500	700	2,105	1,390
Torpedo	1.68	1,210	304	2,160	975
SD 30187	1.68	785	605	1,180	1,120
BAS 3870	1.68	111	65	1,035	1,065
Trifluralin + Nitralin	1.12 1.40	91	50	102	0
Trifluralin + Vernolate	1.12 3.36	58	22	171	262
No Treatment		2,980	1,256	2,420	1,757
Hand weed (four weeks)		0		3	
Hand weed (six weeks)		0		0	
Hand weed (eight weeks)		0		0	
Hand weed (full season)		0		0	
LSD .05		626		830	

Table 9. Average yields from soybeans in kg/ha for 1969.

Treatment	Rate kg/ha	Location 1		Location 2	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	3,210	3,150	1,725	1,560
Trifluralin	2.24	2,920	2,620	1,590	1,920
Nitralin	1.40	2,570	2,880	804	1,358
Nitralin	1.68	2,325	2,580	998	1,200
Vernolate	3.36	2,725	3,195	1,730	1,700
Diallate	2.24	2,210	2,820	1,215	1,625
Diallate	3.36	2,020	2,780	1,260	1,610
Triallate	2.24	2,160	2,660	1,360	1,725
Triallate	3.36	2,640	2,725	1,640	1,715
Nitralin + Vernolate	1.40 2.24	2,820	2,985	1,535	1,570
Trifluralin + Vernolate	1.12 2.24	3,240	3,000	1,310	1,440
Trifluralin + Diallate	1.12 2.24	3,095	2,880	1,605	1,950
Trifluralin + Triallate	1.12 2.24	3,080	3,200	1,812	1,505
No Treatment		350	1,880	336	1,220
Hand weed (four weeks)		2,790		1,750	
Hand weed (six weeks)		3,395		1,920	
Hand weed (eight weeks)		3,280		1,760	
Hand weed (full season)		3,120		1,710	
LSD .05		495		470	

Table 10. Average yields from soybeans in kg/ha for 1970.

Treatment	Rate kg/ha	Location 1		Location 3	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	1,750	1,570	2,540	2,395
Trifluralin	2.24	1,355	1,450	2,100	2,725
Nitralin	1.40	1,215	1,375	1,590	2,020
Nitralin	1.68	1,220	1,215	2,080	2,305
Vernolate	3.36	1,480	1,535	2,225	2,580
Alachlor	3.36	1,305	1,400	1,740	1,835
Torpedo	1.68	1,515	1,700	1,305	2,400
SD 30187	1.68	1,215	1,275	1,805	1,920
BAS 3870	1.68	1,385	1,300	1,900	2,225
Trifluralin + Nitralin	1.12 1.40	1,390	1,200	2,540	2,120
Trifluralin + Vernolate	1.12 3.36	1,515	1,625	2,580	2,200
No Treatment		820	1,060	1,260	1,510
Hand weed (four weeks)		1,695		2,725	
Hand weed (six weeks)		1,435		2,625	
Hand weed (eight weeks)		1,570		2,780	
Hand weed (full season)		1,310		2,350	
LSD .05		415		435	

and soybean yields between the two rates of trifluralin. No significant differences were found due to supplemental cultivations of the trifluralin treated plots.

Vernolate at 3.36 kg/ha appeared less active than trifluralin. Vernolate significantly reduced wild cane yields at all locations. Only at Location 2 in 1969 did a supplemental cultivation significantly increase wild cane control, and in this case, the soybean yield remained the same. The only significant difference between trifluralin and vernolate performance was noted in wild cane control at Location 2. At this location trifluralin controlled significantly more wild cane than did vernolate.

The performance of nitralin, although acceptable, was inconsistent. Nitralin was less active than trifluralin or vernolate. There were no significant differences in wild cane yields between the 1.40 and 1.68 kg/ha rates of nitralin. A supplemental cultivation with nitralin at 1.40 kg/ha significantly reduced wild cane yields and increased soybean yields at Location 2. Cultivation with nitralin at 1.68 kg/ha caused significant increases in soybean yields at Location 3.

Significant reductions in wild cane yields were noted with diallate and triallate at 2.24 and 3.36 kg/ha in 1969, but wild cane control ratings were less than acceptable. The performance of diallate and triallate was nearly identical. Supplemental cultivations with the diallate treatments reduced wild cane yields, and significant soybean yield increases were noted at Location 1. At Location 2 wild cane yields were reduced by cultivation but soybean yields were not affected. Wild cane and soybean yields were not significantly changed when the rates of diallate or triallate were increased from 2.24 to 3.36 kg/ha.

The nitralin-vernolate combination in 1969 gave excellent wild cane control. Wild cane yields were significantly reduced with this combination as compared with nitralin at 1.40 kg/ha. Soybean yields were significantly higher following the nitralin-vernolate combination than with nitralin at 1.40 kg/ha at Location 2. No significant differences in performance were noted between the nitralin-vernolate combination and vernolate treatments.

The combinations of vernolate with trifluralin and nitralin in 1969 and 1970, diallate and triallate with trifluralin in 1969 gave excellent wild cane control. Significant reductions in wild cane yields and increased soybean yields were noted when trifluralin-diallate and trifluralin-triallate combinations were compared to diallate and triallate treatments at 2.24 kg/ha. No differences were noted when these combinations were compared to trifluralin at 1.12 or 2.24 kg/ha. When the trifluralin-vernolate combinations were compared to single trifluralin or vernolate treatments, no significant differences were noted.

The performance of the trifluralin-nitralin combinations in 1970 were similar to the performance of trifluralin alone. There were significant reductions in wild cane yields when the trifluralin-nitralin combinations were compared to nitralin treatments. A significant increase in soybean yields was noted at Location 3.

In 1970, three experimental herbicides were available for evaluation in soybeans. The diallate and triallate treatments were discontinued, and the three experimental herbicides plus alachlor were added.

BAS 3870 at 1.68 kg/ha showed some potential as an effective herbicide for controlling wild cane. The differences in wild cane control between

BAS 3870 and trifluralin at 1.12 kg/ha were not significant, but soybean yields were significantly lower with BAS 3870.

The performance of SD 30187 at 1.68 kg/ha was similar to that of nitralin at both locations in 1970.

Torpedo at 1.68 kg/ha failed to reduce wild cane yield significantly or to increase soybean yields at Location 3. Supplemental cultivations on the Torpedo treated plots reduced wild cane yields significantly at both locations. An increase in soybean yield was noted at Location 2.

The performance of alachlor was similar to the performance of nitralin at 1.40 kg/ha in 1970.

The cultivated check plots showed significant reductions in wild cane yields at Location 1 in 1969 and 1970, but not at Location 2 in 1969 or Location 3 in 1970. Soybean yields were significantly increased at both locations in 1969, but at neither location in 1970.

After the soybean yields were calculated, 100 seeds from each treatment were selected at random and weighed. These data appear in Tables 11 and 12. It was found that a low degree of correlation existed between seed size and herbicide injury. A higher degree of correlation existed between soybean yields, wild cane yields and seed size. This trend showed a direct relationship between seed size and wild cane yield and an inverse relationship between soybean yield and seed size.

In the plots which had been kept weed free for four weeks after planting, wild cane was able to emerge and grow. The amount of wild cane present was not significant. Plots maintained weed free for six weeks or longer were weed free at harvest. It was found that 448 to 672 kg/ha (dry weight) of wild cane were required to cause significant reductions in

Table 11. Average weight in grams per 100 soybeans seeds for 1969.

Treatment	Rate kg/ha	Location 1		Location 2	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	17.6	17.6	17.8	17.5
Trifluralin	2.24	17.3	17.2	18.5	17.7
Nitralin	1.40	17.9	17.8	16.8	17.4
Nitralin	1.68	17.5	17.8	18.0	17.2
Vernolate	3.36	17.8	17.9	17.9	18.0
Diallate	2.24	17.7	18.7	17.8	18.1
Diallate	3.36	16.3	18.3	17.9	17.9
Triallate	2.24	18.3	18.5	17.0	17.8
Triallate	3.36	19.5	17.8	18.1	17.4
Nitralin + Vernolate	1.40 2.24	17.9	17.6	17.4	17.6
Trifluralin + Vernolate	1.12 2.24	17.5	17.2	18.5	18.5
Trifluralin + Diallate	1.12 2.24	17.4	17.3	18.4	18.0
Trifluralin + Triallate	1.12 2.24	17.7	17.4	17.6	17.7
No Treatment		18.6	19.2	16.5	17.1
Hand weed (four weeks)		17.4		17.5	
Hand weed (six weeks)		18.0		17.7	
Hand weed (eight weeks)		17.5		17.7	
Hand weed (full season)		17.8		17.2	
LSD .05		1.2		0.3	

Table 12. Average weight in grams per 100 soybeans seeds for 1970.

Treatment	Rate kg/ha	Location 1		Location 3	
		No Cultivation	With Cultivation	No Cultivation	With Cultivation
Trifluralin	1.12	16.8	16.9	17.4	16.7
Trifluralin	2.24	15.4	16.5	16.6	16.2
Nitralin	1.40	15.4	16.9	16.9	17.1
Nitralin	1.68	16.6	15.4	17.6	17.1
Vernolate	3.36	16.5	16.5	17.4	16.8
Alachlor	3.36	16.6	16.0	17.8	17.2
Torpedo	1.68	16.0	16.9	18.1	17.2
SD 30187	1.68	16.1	16.0	17.5	17.7
BAS 3870	1.68	16.1	16.1	17.9	17.5
Trifluralin + Nitralin	1.12 1.40	16.9	15.6	16.5	16.7
Trifluralin + Vernolate	1.12 3.36	17.2	16.1	16.8	17.5
No Treatment		16.1	15.2	17.9	17.4
Hand weed (four weeks)		17.2		16.7	
Hand weed (six weeks)		16.6		16.5	
Hand weed (eight weeks)		16.5		16.7	
Hand weed (full season		15.5		16.6	
LSD .05		1.7		1.0	

soybean yields compared to weed free plots.

Tables 1 to 8 (see Appendix) show the analysis of variance for wild cane and soybean yields at all locations for both years. With the exception of soybean yields at Location 1 in 1970, all treatment effects were found to be significant. Significant differences were noted between replications only at Location 2 in 1969.

Site of Uptake Results

Site of uptake experiments were conducted to help explain some differences in wild cane control with the same herbicide at different locations. Visual observations were taken 7, 10, and 14 days after planting of wild cane or Kansas orange sorgo. Plant height measurements appear in Figures 2 through 7. Trifluralin, nitralin, diallate, and triallate were absorbed through the shoots of wild cane and Kansas orange sorgo. Vernolate appeared most active when absorbed through the shoot of both species but severe reduction in growth was observed when vernolate was absorbed through the roots.

Although break-down or movement of the herbicides may have occurred in the field, it appears that the position of the wild cane seed with respect to the herbicide treated soil resulted in the variations that were noted in this study.

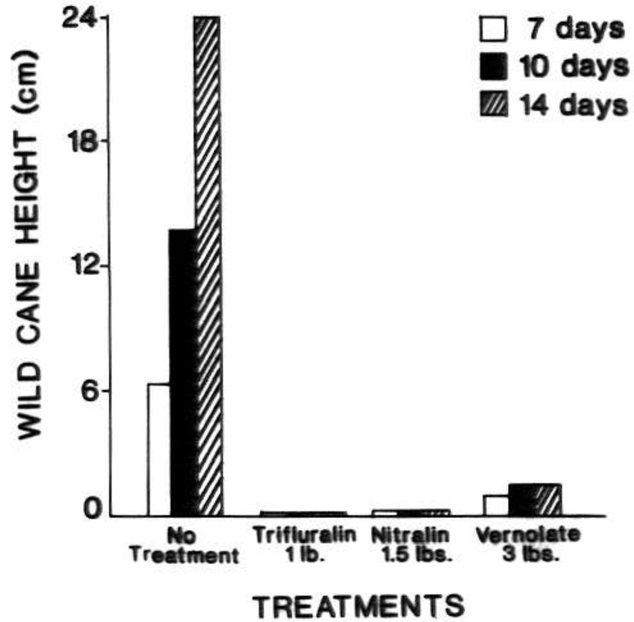

Fig. 2. Wild cane height at 7, 10, and 14 days with herbicides placed in a 2.54 cm band above the seed.

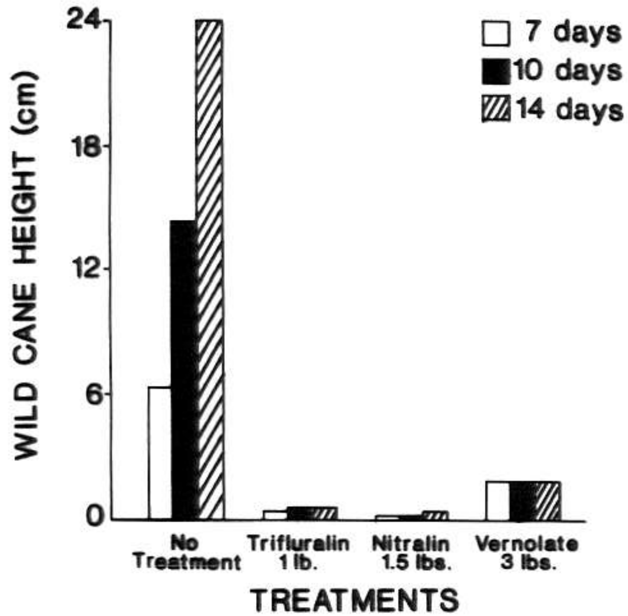

Fig. 3. Wild cane height at 7, 10, and 14 days with herbicides placed in a 2.54 cm band with the seed.

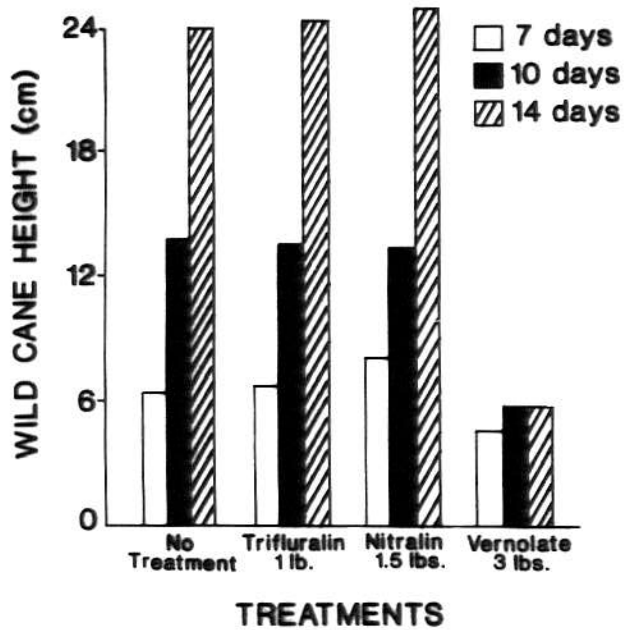

Fig. 4. Wild cane height at 7, 10, and 14 days with herbicides placed in a 2.54 cm band below the seed.

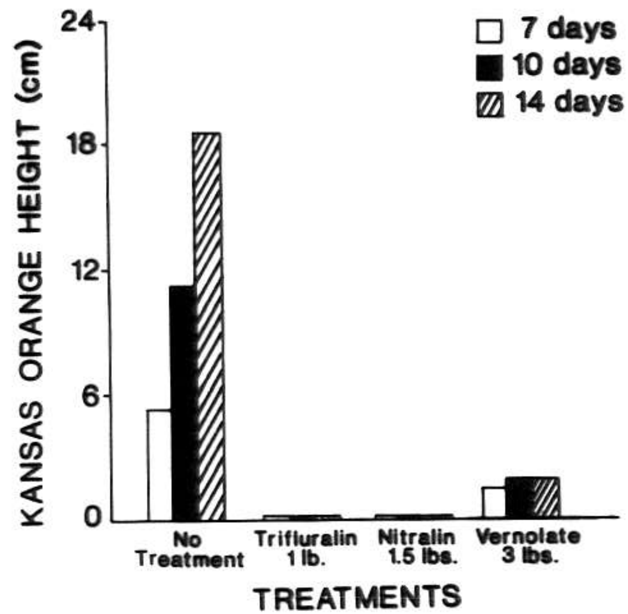

Fig. 5. Kansas orange height at 7, 10, and 14 days with herbicides placed in a 2.54 cm band above the seed.

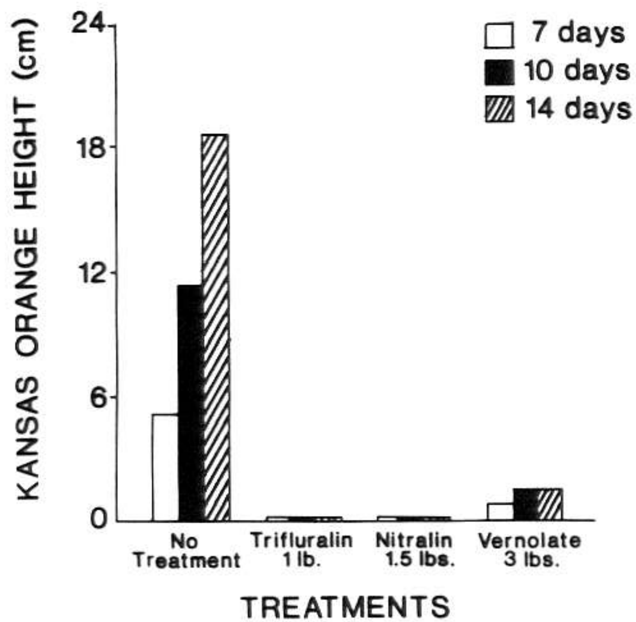

Fig. 6. Kansas orange height at 7, 10, and 14 days with herbicides placed in a 2.54 cm band with the seed.

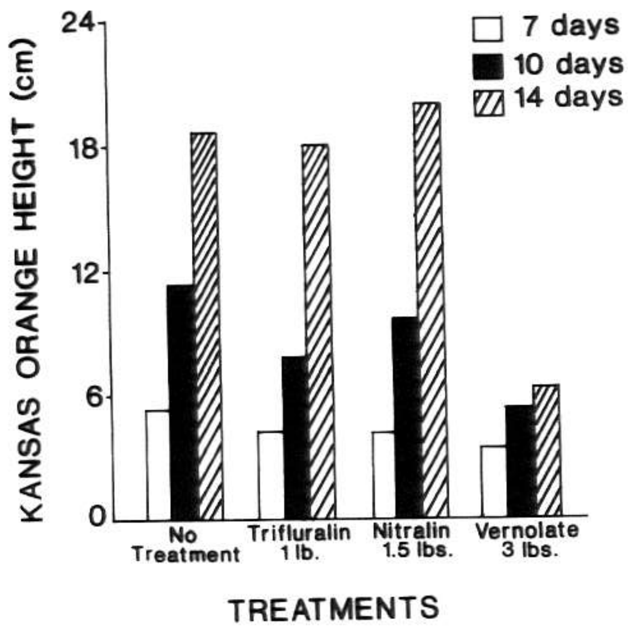

Fig. 7. Kansas orange height at 7, 10, and 14 days with herbicides placed in a 2.54 cm band below the seed.

EXPLANATION OF PLATE I

Wild cane infestation in an untreated plot.

EXPLANATION OF PLATE II

Wild cane infestation after cultivation of an untreated plot. Approximately 50% of the wild cane was controlled.

THIS BOOK CONTAINS NUMEROUS PICTURES THAT ARE ATTACHED TO DOCUMENTS CROOKED.

THIS IS AS RECEIVED FROM CUSTOMER.

PLATE I

PLATE II

EXPLANATION OF PLATE III

A trifluralin treated plot at 1.12 kg/ha. Wild cane control was 90%.

EXPLANATION OF PLATE IV

A vernolate treated plot at 3.36 kg/ha. Wild cane control was about 80%. Vernolate was slightly less active than trifluralin.

PLATE III

PLATE IV

EXPLANATION OF PLATE V

Nitralin at 1.40 kg/ha controlled about 70% of the wild cane. Nitralin was less active than trifluralin or vernolate, but its results were acceptable.

EXPLANATION OF PLATE VI

Hand weeding to four weeks resulted in 95% reduction of wild cane at harvest. One-hundred percent control was noted when plots were maintained weed free for six, eight weeks, or the entire season.

PLATE V

PLATE VI

EXPLANATION OF PLATE VII

Overall view of the growth chamber used for the site of uptake experiment.

EXPLANATION OF PLATE VIII

Site of uptake of trifluralin at 1.12 kg/ha by wild cane. Red bands show the placement of the herbicide with respect to the seed (black dots). It was apparent that trifluralin was absorbed through the shoot.

PLATE VII

PLATE VIII

EXPLANATION OF PLATE IX

Nitralin at 1.68 kg/ha was absorbed through the shoot of wild cane. Plants emerged from seed placed below or in treated soil but did not survive.

EXPLANATION OF PLATE X

Vernolate at 3.36 kg/ha was absorbed by both the shoot and roots of wild cane. Plants emerging from seed placed below or in treated soil did not survive. Plants emerging from seed placed above treated soil were dark green and growth was seriously retarded.

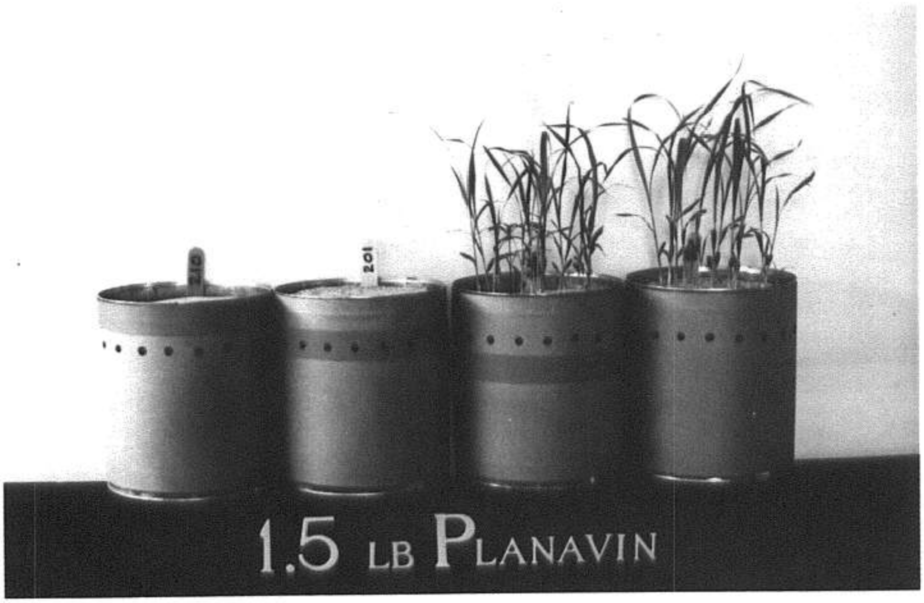

PLATE IX

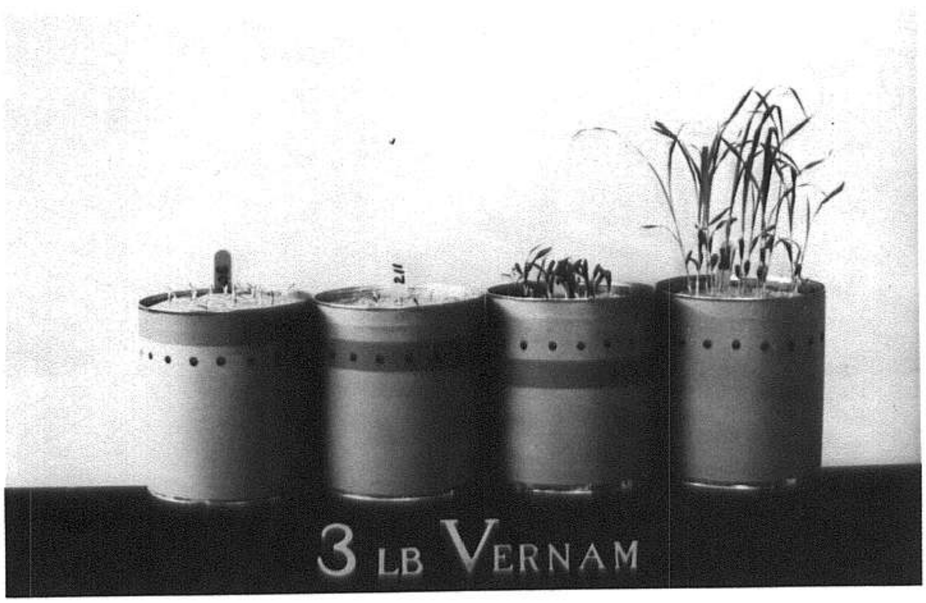

PLATE X

DISCUSSION

Trifluralin at 2.24 kg/ha, nitralin at 1.68 kg/ha, and all combinations in this study were not label registered. Their use at these rates or in combinations should be limited to research purposes only, until otherwise labeled. Herbicide combinations are used primarily to broaden the spectrum of weed control in the field. The purpose of this particular study was to find the most effective means of controlling one species of weeds, namely wild cane. Illegal residues, crop injury, or both may result when these herbicides are used at rates higher than those recommended or in combination. There was no significant difference in wild cane or soybean yields when the rates of trifluralin and nitralin were increased. The performance of the herbicide combination in this study was essentially equal to the performance of the more effective herbicide included in the combination. Therefore, where the control of wild cane is the major concern, the increased rates of these herbicides or combinations of these herbicides would only increase the cost of solving the problem.

In all cases, vernolate caused injury to the soybean plants. Vernolate injury appeared early in the growing season and injury symptoms disappeared after six weeks. Any reduction in soybean stand or yield could not be traced back to this early injury. It was concluded that soybean injury due to vernolate should be of little concern, that vernolate should be applied strictly in accordance to the label.

The variability in stand count that was noted at Location 1 could perhaps be attributed to soil type. This soil was a sandy silt loam and was fairly loose. It appeared that in certain areas of the field the planter was not maintaining a uniform planting depth. It was noted that where the bean stand was significantly lower, the depth of planting was 2.54 cm or more. It was further noted that stand reduction did not follow the herbicide injury or specific herbicide treatment. Although significant differences in stand count existed, there was no apparent difference in soybean yields. This can be attributed to the increased branching of the soybean plants in those areas where the plant population was reduced.

When wild cane control by the herbicide was less than 65% supplemental cultivations on herbicide-treated plots significantly reduced wild cane yields. Cultivation will remove only that cane between the soybean rows. Where the wild cane infestation is severe or the herbicide fails to give adequate wild cane control, the competition effects by wild cane in soybeans may be sufficient to reduce soybean yield. It was noted that cultivation of untreated plots could remove 50% of the wild cane and result in significant increases of the soybean yield. It appeared that if 35% or more of the wild cane remained from a severe infestation after chemical treatment, enough wild cane was present to compete with the soybeans and reduce soybean yields. In most cases where cultivation significantly reduced the yields of wild cane, soybean yields were increased.

As the infestation of wild cane increased in the plots, the yield of soybeans decreased. The soybean yield component most influenced by the wild cane competition was number of pods per plant; the number of beans per pod was not influenced, and individual bean seeds were heavier with than without cane competition. This difference was more apparent when seed weights from beans grown under drought were compared with those from beans grown with abundant moisture. In general the soybean yields were lower in 1970 than in 1969 due to the lack of moisture, but the average seed weight in 1970 was higher.

The performance of the herbicides used in this experiment was variable between and within locations. This experiment was conducted at sites having different soil types. The precipitation during the growing season of the first year was above normal. The temperatures were nearly optimum for the growth and development of wild cane and soybeans. The precipitation during the growing season of the second year was below normal with above optimum temperatures for soybean production. Those factors explained some of the variability that was encountered. More striking was the contrast in the performance of these herbicides at Location 2 in 1969. Shortly after emergence of soybeans and wild cane a heavy rain resulted in flooding of the plot area. As much as 3.87 cm of silt was deposited on the second replication. A heavy infestation of wild cane appeared in the silted area of the plots. Visual observations indicated that much of the wild cane emerged from seed introduced with the silt deposit or from seed lying on the surface of the silt.

Two possibilities existed for the reduction of wild cane control in the second replication: (1) The flooding resulted in the break-down or movement of the herbicide in the soil; and (2) since the silt covered the original treated soil, uptake of the herbicide by wild cane might have been hindered and caused the reduction of wild cane control. Although the first possibility was not negated, the site of uptake experiment showed that trifluralin, nitralin, diallate and triallate must be absorbed through the shoots of wild cane to cause injury. Vernolate was found to injure wild cane when absorbed through either the root or the shoot. Since the silt was above the treated soil it was concluded that uptake of the herbicide by wild cane was indeed an important factor in explaining the variability in the performance of these herbicides.

Just as there are differences in rainfall and temperatures from year to year and soil types from location to location, the performance of any given herbicide may be as variable. If the herbicides used in this study were ranked in order of their performance, they would be ranked in the same order at all locations, but the degree of performance by each herbicide varied between locations. None of these herbicides should be expected to control 100% of the wild cane infestation nor should they be expected to perform the same year after year. It is important to follow the directions on the label in order to maximize performance by herbicides and minimize crop injury.

SUMMARY

Research data on the chemical control of wild cane is limited. Wild cane has been difficult to control in sorghum and corn because of poor crop tolerance to herbicides which give effective wild cane control. Its early maturing, shattering seed enhances the problem by increasing the amount of seed in the soil. In the past few years several herbicides selective for grasses have been labeled for use in soybeans.

Six herbicides labeled for use in soybeans and three experimental herbicides were evaluated in this study. Four site-years of data were obtained with trifluralin at 1.12 and 2.24 kg/ha, vernolate at 3.36 kg/ha, nitralin at 1.40 and 1.68 kg/ha, and a trifluralin-vernolate combination at 1.12 plus 2.24 kg/ha. Two site-years of data were obtained from plots treated with diallate and triallate at 2.24 and 3.36 kg/ha, alachlor at 3.36 kg/ha, Torpedo, BAS 3870, SD 30187 at 1.68 kg/ha, and a combination of trifluralin-nitralin at 1.12 plus 1.40 kg/ha. In addition to the herbicide treatments, herbicide treated plots receiving supplemental cultivations and hand weeded plots were evaluated.

All herbicides used in this study reduced wild cane stands in soybeans. Trifluralin and vernolate gave good to excellent control of wild cane. BAS 3870 showed some potential in controlling wild cane and should be investigated further. Nitralin gave inconsistent wild cane control, and was considered as marginal in giving acceptable wild cane control. The performance of diallate, triallate, Torpedo, SD 30187 and alachlor was less than acceptable in controlling wild cane.

The performance of trifluralin and nitralin at the higher rates was equal to the performance of these chemicals at the recommended rate. The use of herbicide combinations did not prove feasible. The performance of the combinations was equal to the performance of the more effective herbicide in the combination.

Vernolate at the recommended rate can injure soybeans early in the season. Injury symptoms disappeared later in the season and were not reflected in soybean yields or seed weight.

Variations in seed weight and soybean plants per foot of row could not be attributed to the amount of wild cane infestation or herbicide injury.

Cultivation reduced the yield of wild cane when the herbicide alone controlled less than 65% of the wild cane. Cultivation alone will not remove enough wild cane from heavily infested areas to obtain maximum soybean yields. Significant soybean yield reductions were noted in plots producing 448 to 672 kg/ha dry weight of wild cane.

Site of uptake is important to consider when applying preplant incorporated herbicides. Trifluralin, nitralin, diallate and triallate are absorbed through the shoot of wild cane and should not be incorporated more than 5 to 8 cm deep. Vernolate can control wild cane when absorbed through the roots or shoots of wild cane but appeared slightly more active when absorbed through the shoot.

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APPENDIX

Table 1. Analysis of variance for wild cane yield at Location 1, 1969.

Source of variation	df	MS	F
Replications	2	7.227	4.726
Treatments	31	42.555	27.832*
Error	62	1.529	

*Significant at the .01 level.

Table 2. Analysis of variance for soybean yield at Location 1, 1969.

Source of variation	df	MS	F
Replications	2	4.578	4.824
Treatments	31	9.231	9.726*
Error	62	0.949	

*Significant at the .01 level.

Table 3. Analysis of variance for wild cane yield at Location 2, 1969.

Source of variance	df	MS	F
Replications	2	37.050	5.717*
Treatments	31	29.555	4.561*
Error	62	6.480	

*Significant at the .01 level.

Table 4. Analysis of variance for soybean yield at Location 2, 1969.

Source of variance	df	MS	F
Replications	2	5.167	6.208*
Treatments	31	3.552	4.267*
Error	62	0.832	

*Significant at the .01 level.

Table 5. Analysis of variance for wild cane yield at Location 1, 1970.

Source of variation	df	MS	F
Replications	2	454,207	4.613
Treatments	27	1,051,518	8.896*
Error	54	118,200	

*Significant at the .01 level.

Table 6. Analysis of variance for soybean yield at Location 1, 1970.

Source of variation	df	MS	F
Replications	2	4.091	0.284
Treatments	27	27.579	1.917
Error	54	14.387	

Table 7. Analysis of variance for wild cane yield at Location 3, 1970.

Source of variation	df	MS	F
Replications	2	289,911	1.409
Treatments	27	1,316,543	6.398*
Error	54	205,768	

*Significant at the .01 level.

Table 8. Analysis of variance for soybean yield at Location 3, 1970.

Source of variation	df	MS	F
Replications	2	27.408	1.758
Treatments	27	125.226	8.032*
Error	54	15.591	

*Significant at the .01 level.

Table 9. Correlations for the field data for 1969 and 1970 at all locations.

	Soybean yield	Cane control	Soybean injury	Plants/ ft. row	Weight/ 100 beans	Cane dry wt.
Soybean yield	--	0.72	0.19	-0.18	0.30	-0.41
Cane control	0.72	--	0.16	0.12	0.11	-0.82
Soybean injury	0.19	0.16	--	-0.37	0.15	-0.12
Plants/ ft. row	-0.18	0.12	-0.37	--	-0.22	-0.18
Weight/ 100 beans	0.30	0.11	0.15	-0.22	--	0.10
Cane dry wt.	-0.41	-0.82	-0.12	-0.18	0.10	--

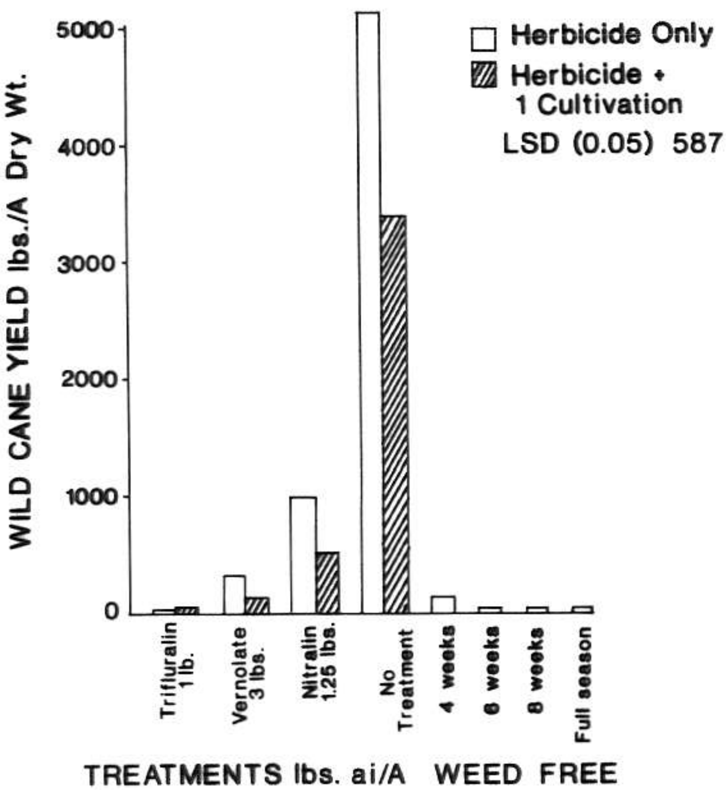

Fig. 1. Wild cane yield with herbicide treatment vs herbicide treatments with one cultivation: Location I, 1969.

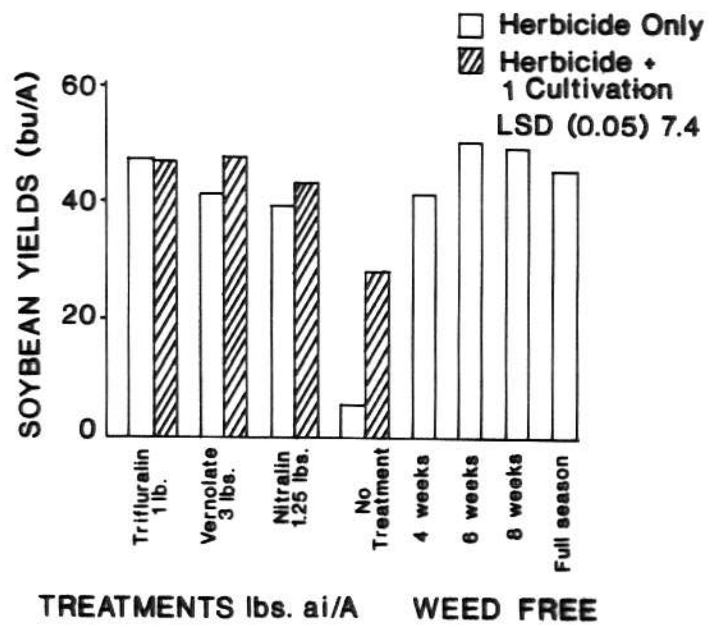

Fig. 2. Soybean yield with herbicide treatments vs herbicide treatments with one cultivation: Location I, 1969.

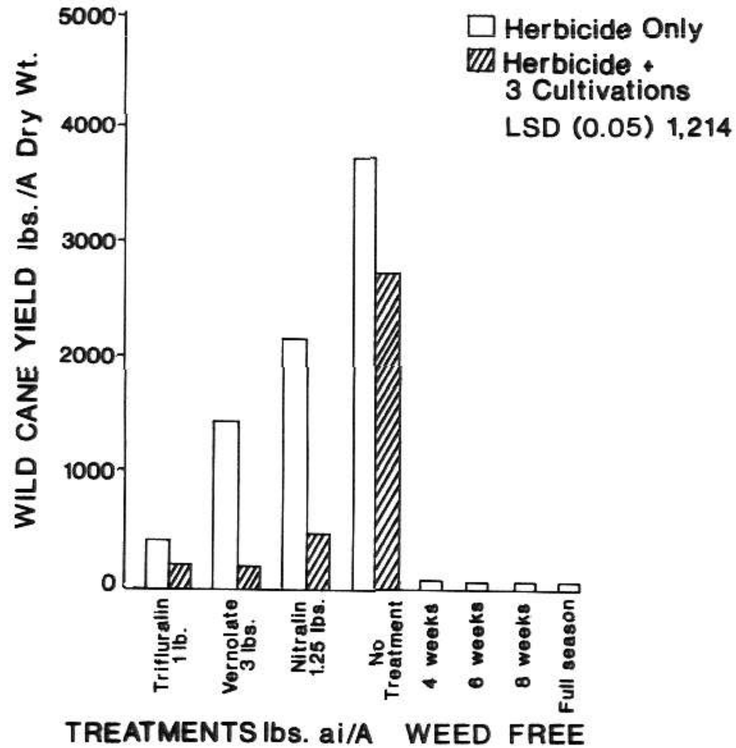

Fig. 3. Wild cane yield with herbicide treatment vs herbicide treatments with 3 cultivations: Location 2, 1969.

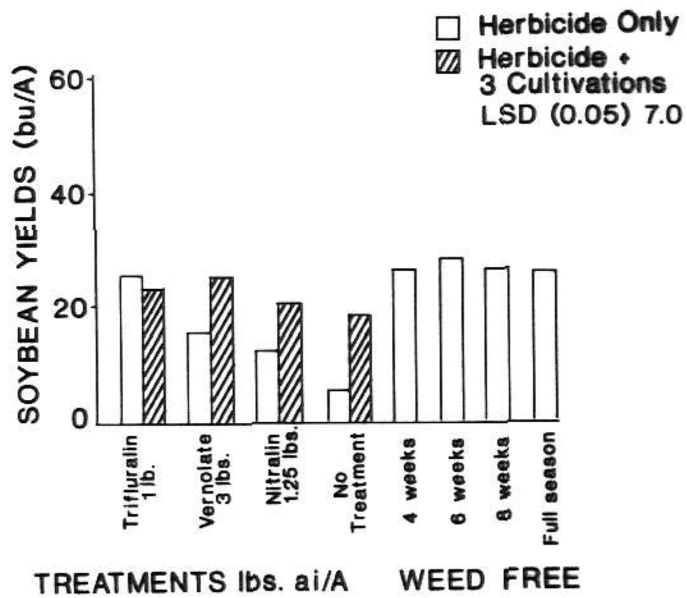

Fig. 4. Soybean yield with herbicide treatments vs herbicide treatments with three cultivations: Location 2, 1969.

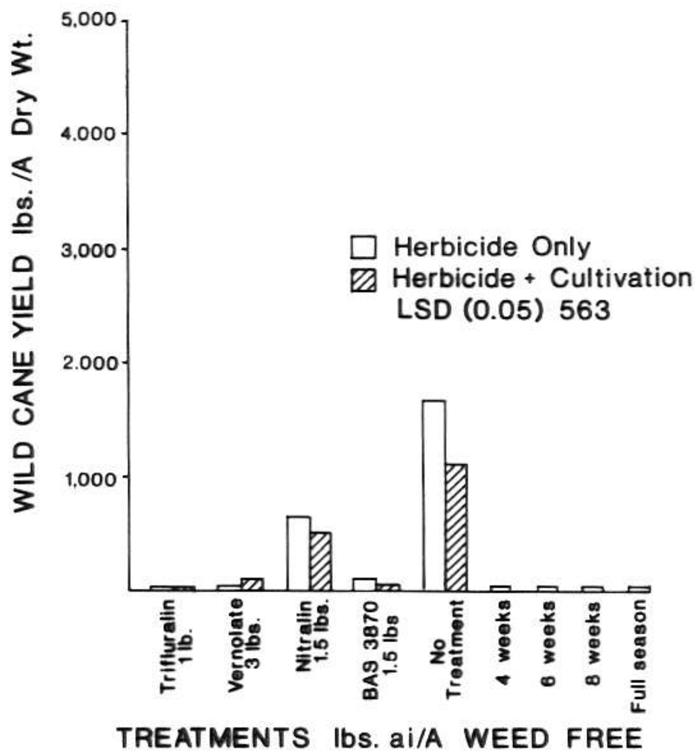

Fig. 5. Wild cane yields with herbicide treatment vs herbicide treatment plus cultivation: Location I, 1970.

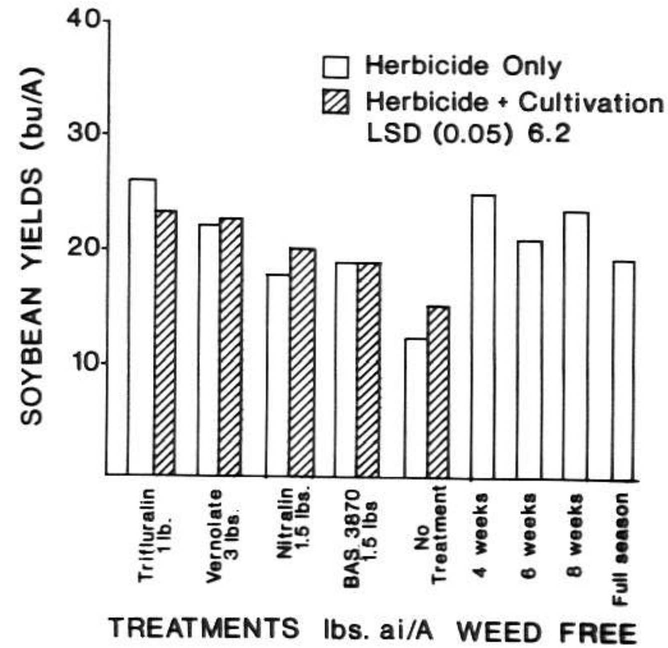

Fig. 6. Soybean yield with herbicide treatments vs herbicide plus cultivation: Location I, 1970.

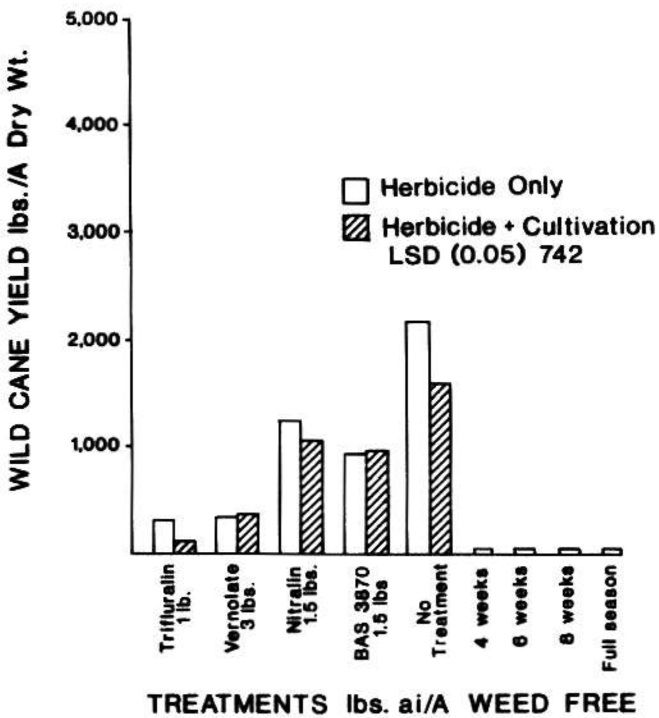

Fig. 7. Wild cane yield with herbicide treatments vs herbicide plus cultivation: Location 3, 1970.

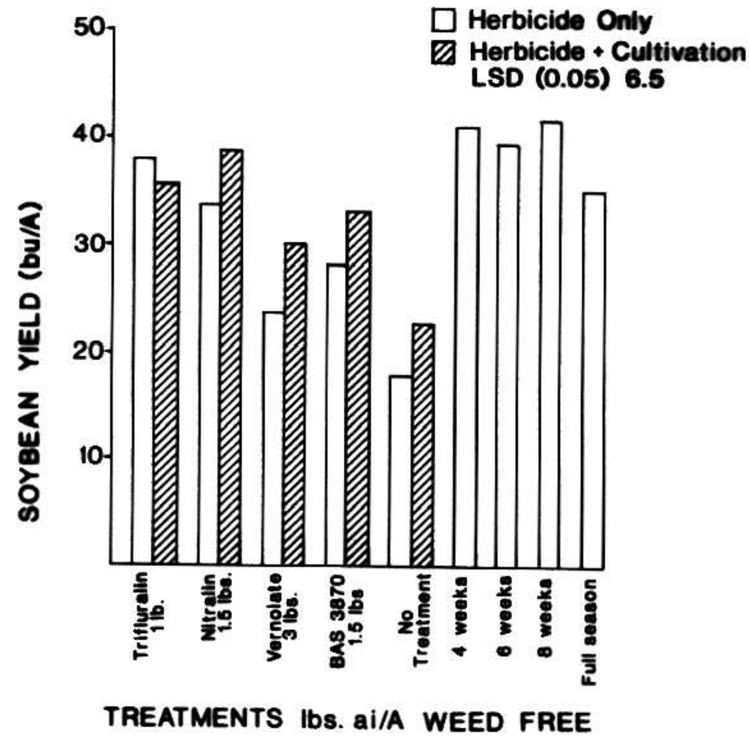

Fig. 8. Soybean yield with herbicide treatments vs herbicide treatment plus cultivation: Location 3, 1970.

CHEMICAL CONTROL OF WILD CANE, *SORGHUM BICOLOR*, IN SOYBEANS, *GLYCINE MAX*

by

THOMAS C. ZAVESKY

B. S., Kansas State University, 1969

AN ABSTRACT OF A MASTER'S THESIS

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Six registered and three experimental soybean herbicides were evaluated for wild cane control at two locations near Manhattan, Kansas in 1969 and 1970. Supplemental cultivations were used in some herbicide-treated plots, and hand-weeded plots were included to study the effects of competition between soybeans and wild cane.

There was no significant difference between cultivated and uncultivated treatments if the herbicides gave acceptable control of wild cane. If the plot areas were maintained weed free for six weeks, wild cane did not infest the plots. Four hundred forty-eight to 672 kg (dry wt/ha) of wild cane were required to significantly reduce soybean yields. Trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) and S-propyl dipropylthiocarbamate (vernolate) gave excellent control of wild cane. BAS 3780 gave good control of wild cane, and 4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline (nitralin) gave marginally acceptable control. Injury symptoms in soybeans caused early in the season by vernolate disappeared after six weeks. Soybean yields were directly influenced by the amount of wild cane control. Injury due to herbicides, or wild cane infestations, were not reflected in soybean stand count or seed weight.

Site of uptake studies were conducted to explain differences in wild cane control by herbicides in the experiment. Trifluralin, nitralin, S-(2,3-dichloroallyl) diisopropylthiocarbamate (diallate) and S-(2,3,3-trichloroallyl) diisopropylthiocarbamate (triallate) were absorbed through the shoot of wild cane and Kansas orange sorgo. Vernolate was absorbed through the roots and shoots of both species.