

Asulam and Other Postemergence Herbicides for Sugarcane¹

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ABSTRACT

Three herbicide experiments were conducted at the Lajas Research and Development Center to evaluate asulam (methyl sulfanilylcarbamate) alone or in combination with other postemergence herbicides from 1980 to 1982. In the first experiment with sugarcane cv. P.R. 1028, application of asulam at 3.25 kg/ha, preceded by an early postemergence application of metribuzin [(4-amino-6-dimethyl)-3-methylthio-1,2,4-triazin-5 (4H)-one] at 4.48 kg/ha, controlled weeds best (83% after 15 weeks) for the highest yield (218.4 tons cane/ha or 31.1 tons sugar/ha). Asulam alone (2.80 and 3.74 kg ai./ha) applied 5 weeks after planting was inferior in total weed control (59% and 71%) and a lower yield was obtained (111.8 and 99.9 tons cane/ha or 13.0 and 12.1 tons sugar/ha, respectively). In the second experiment, with sugarcane cv. P.R. 980, postemergence application of asulam (3.74 kg ai./ha) gave better control of grasses (75%) when applied 4 weeks after planting than at 6 weeks (68%). Asulam sprayed either 4 or 6 weeks after planting was not phytotoxic to sugarcane. In the third experiment, also with sugarcane cv. P.R. 980, dicamba (2-Methyl-3,6-Dichloro-*o*-anisic acid) at 0.56 kg ai./ha and Weedmaster^{ms} (a mixture of 10.3% dicamba + 29.6% 2,4-D) at 2.34 and 4.68 L/ha gave excellent control of broadleaf weeds (84% to 90%). These results were similar to those from the treatment with 2,4-D (86%) and two handweeding (89%). The yields obtained from herbicide treated plots (113.0 to 117.6 tons cane/ha) were inferior to those from hand-weeded check plots (160.1 tons cane/ha).

INTRODUCTION

Herbicides are essential components of cultural practices for sugarcane production in Puerto Rico and other countries. At present, there are several registered herbicides for the control of weeds in sugarcane (2). Evaluation of new herbicides is essential since many grasses and broadleaf weeds create severe problems in sugarcane plantations. Information on the use of herbicides is extensively available in the United States and other parts of the world (4, 5, 6, 7, 8, 9, 10). Asulam has been especially effective for the control of grasses such as johnsongrass [*Sorghum halepense* (L.) Moench] in sugarcane (4, 5, 8, 10). Terbacil (3-tert-butyl-5-chloro-6-methyluracil), fenac[(2,3,6-trichlorophenyl) acetic acid] and trifluralin (a,a,a 6-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) have been used commercially for preemergence control of itch-grass (*Rott-*

¹ Manuscript submitted to Editorial Board January 14, 1986.

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boellia exaltata L.f.) and several other weeds (7, 9). This study was conducted to evaluate asulam alone and in combination with other postemergence herbicides in order to improve selective weed control in sugarcane plantations.

MATERIALS AND METHODS

Three herbicide experiments were conducted at the Lajas Research and Development Center from 1980 to 1982. In the first experiment, sugarcane cv. P.R. 1028 was planted in a Vertisol (Udic Chromusterts, very fine, montmorillonitic, isohyperthermic) on April 8, 1980. Nine herbicide treatments were arranged in a randomized complete block design with four replications (table 1). Plots in all experiments measured 6.1 × 6.1 m with four rows 1.5 m apart. Fertilizer 15-5-10 at the rate of 896 kg/ha was applied over the row immediately after planting sugarcane.

TABLE 1.—Herbicide treatments in sugarcane in 1980 (Experiment 1)

Initial treatment	Rate	Weeks after planting	Second treatment	Rate	Weeks after planting
	<i>kg ai./ha</i>			<i>kg ai./ha</i>	
Asulam	2.80	5	Asulam	2.80	12
Asulam	3.74	5	Asulam	3.74	12
Metribuzin	2.24	3	Asulam	3.25	7
Metribuzin	4.48	3	Asulam	3.25	7
Ametryn	6.72	1	Ametryn	3.36	6
Diuron	6.72	1	Diuron	3.36	6
Ametryn	6.72	3	Ametryn/2,4-D	3.36/1.12	6
Hand-weeded check ¹					
Non-weeded check					

¹ Three hand-weedings were performed 3, 6 and 12 weeks after planting.

In 1981–82 two experiments were conducted with sugarcane cv. P.R. 980. Sugarcane cuttings were planted August 4, 1981 in a randomized complete block design with six treatments and four replications in both experiments. This time fertilizer 16-4-4 at the rate of 1086 kg/ha was applied over the rows 3 weeks after planting. The second experiment included postemergence applications of asulam at 2.80 and 3.74 kg ai./ha on two different dates. The first treatment of asulam was 4 weeks after planting when sugarcane measured 25 to 30 cm in height. The second treatment of asulam was 6 weeks after planting when sugarcane reached 35 to 50 cm in height. Both asulam treatments were repeated 4 weeks after the initial application. A general application of 2,4-D at 1.12 kg ai./ha was sprayed to asulam-treated plots to control broadleaf weeds.

Experiment 3 was conducted to evaluate banvel and Weedmaster™ for the control of broadleaf weeds tolerant to 2,4-D. Asulam at the rate of 2.80 kg ai./ha was also sprayed on treated plots to reduce grass weed competition. In all experiments herbicides were sprayed 4 weeks after planting with a handpump sprayer with a spray volume of 537 L/ha. Cultivated checks were hoed 4 and 8 weeks after planting. Weed control ratings and phytotoxicity evaluations were made at 8, 13 and 15 weeks after planting in the 1980-81 experiments, and 8 and 11 weeks after planting in 1981-82. Percent weed control data were recorded on different dates by visual ratings of herbicide treated plots versus the non-weeded check. To record total control, an average control data for all weed species (sedges, grasses and broadleaves) was included. Total rainfall was 90.7 cm in the 1980-81 experiment and 109.9 cm in 1981-82. Furrow irrigation was applied as needed in all experiments to supplement rainfall (1). Sugarcane plants were harvested approximately 12 months after planting. At harvest 10-cane samples from each plot were taken to determine sucrose content. Total cane yield from each plot (two inner rows) was determined, cane tonnage and sugar yields per hectare were calculated.

RESULTS AND DISCUSSION

EXPERIMENT 1

The predominant weed species in the experimental plots, listed in decreasing order of abundance were johnsongrass, crabgrass (*Digitaria sanguinalis* L.), ticklegrass (*Panicum trichoides* Swatz.), junglerice [*Echinochloa colonum* (L.) Link], alexandergrass [*Brachiaria plantaginea* (Link) Hitchc.], morning glory [*Ipomoea tiliacea* (Willd.) Choisy] and purple nutsedge (*Cyperus rotundus* L.). Table 2 summarizes data on weed control at three different dates. An early postemergence application of metribuzin (4.48 kg ai./ha) followed by asulam (3.25 kg ai./ha) gave the best weed control and yield (cane and sugar tonnage). Ametryn (6.72 kg ai./ha) in early postemergence application 1 or 3 weeks after planting and repeated at 3.36 kg ai./ha resulted in good weed control and yield. Standard diuron treatment was inefficient in weed control. Asulam treatments at 2.80 and 3.74 kg ai./ha applied 5 weeks after planting were inferior in total weed control and yield. Although asulam controlled grasses, including johnsongrass, sugarcane growth was severely affected by the initial weed competition. When metribuzin was applied early (3 weeks after planting) followed by asulam, sugarcane growth was not affected by weed competition. Data on cane yield is presented in Table 3.

TABLE 2.—Effect of herbicides on weed control at three different dates in 1980 (Experiment 1)

Treatments	Weeks after planting	Weed control Averages (%) ¹					
		8 weeks		13 weeks		15 weeks	
		GC	TC	GC	TC	GC	TC
<i>kg ai./ha</i>							
Asulam (2.80)	5 and 12	66	65	48	26	66	59
Asulam (3.74)	5 and 12	74	68	47	38	78	71
Metribuzin (2.24)/Asulam (3.25)	3 and 7	34	28	61	71	80	78
Metribuzin (4.48)/Asulam (3.25)	3 and 7	55	43	76	81	85	83
Ametryn (6.72 + 3.36)	1 and 6	85	75	87	65	68	63
Diuron (6.72 + 3.36)	1 and 6	61	61	51	34	53	49
Ametryn (6.72 + 3.36)/2,4-D (1.12)	3 and 6	74	70	82	79	66	74
Hand-weeded check	3, 6 and 12	96	91	100	100	96	91
Non-weeded check		0	0	0	0	0	0

¹ Mean ratings of four replications with 1 to 100 representing poor to excellent weed control. GC = Grass control; TC = Total weed control.

TABLE 3.—Effect of herbicide applications on yield of sugarcane in 1980 (Experiment 1)

Treatments	Weeks after planting	Sugarcane yield ^{1,2}	
		Tons cane/ha	Tons sugar/ha
<i>kg ai./ha</i>			
Asulam (2.80)	5 and 12	111.8 c	13.0 c
Asulam (3.74)	5 and 12	99.9 c	12.1 c
Metribuzin 2.24/Asulam (3.25)	3 and 7	153.7 b	19.9 b
Metribuzin (4.48)/Asulam (3.25)	3 and 7	218.4 a	31.1 a
Ametryn (6.72 + 3.36)	1 and 6	157.5 b	21.5 b
Diuron (6.72 + 3.36)	1 and 6	129.2 bc	15.9 bc
Ametryn (6.72 + 3.36) 2,4-D (1.12)	3 and 6	185.9 b	24.4 b
Hand-weeded check	3, 6 and 12	181.4 b	24.6 b
Non-weeded check	—	2.2 d	0.2 d
CV (%)		19.6	23.9

¹ Yields in columns followed by the same letter do not differ significantly at the 5% probability level as determined by Duncan's multiple range test.

² Average of four replications in metric tons per hectare.

EXPERIMENT 2

Table 4 shows the efficacy of asulam treatments against predominant grass weeds. Asulam sprayed on two different growth stages at 2.80 and 3.74 kg/ha rates was not toxic to sugarcane. Johnsongrass was the most predominant weed in the experimental plots with an average of 82 plants/m², followed by crabgrass, junglerice, and ticklegrass with 11, 11 and 13 plants/m², respectively. Table 5 shows mean evaluation of plots. Asulam (3.74 kg ai./ha) followed by a single application of 2,4-D gave good control

TABLE 4.—Percentages of grass control by species after foliar treatment with asulam to sugarcane at two different growth stages (Experiment 2)

Treatment ¹	Rate	Weed control 8 and 11 weeks after planting (%) ²							
		Johnsongrass		Crabgrass		Ticklegrass		Junglerice	
		8 Weeks	11 Weeks	8 Weeks	11 Weeks	8 Weeks	11 Weeks	8 Weeks	11 Weeks
	<i>kg ai./ha</i>								
Asulam	2.80 ³	45	44	100	100	97	90	98	99
Asulam	3.74 ³	91	64	100	100	100	100	99	100
Asulam	2.80 ⁴	15	20	100	100	56	100	78	94
Asulam	3.74 ⁴	17	76	100	99	36	100	76	98
Hand-weeded check		98	89	100	100	100	100	100	100
Non-weeded check		(82) ⁵	—	(11) ⁵	—	(13) ⁵	—	(11) ⁵	—

¹ 2,4-D was applied to asulam-treated plots 4 weeks after planting sugarcane.

² Mean ratings of four replications with 1 to 100 representing poor to excellent weed control.

³ Sugarcane 25–30 cm in height 4 weeks after planting.

⁴ Sugarcane 35–50 cm in height 6 weeks after planting.

⁵ Average number of plants/m².

of grasses when applied 4 weeks after planting. The application of asulam at 2.80 kg/ha was inefficient against johnsongrass since regrowth of this grass took place. During the 1980 experiment, johnsongrass control was improved with an early application of metribuzin. Our results in 1981 suggest the need of one preemergence or early postemergence treatments with a standard herbicide in order to reduce weed population before the application of asulam.

Table 6 shows data on cane yield and sugar production. Hand weeded check resulted in the highest yields, but not significant differences were observed when compared with asulam at 3.74 kg ai./ha applied four weeks after planting. All herbicide treatments contributed to good sugar yield when compared with non-weeded check.

TABLE 5.—Effect of asulam treatments on the control of weeds in sugarcane in 1981 (Experiment 2)

Treatment ¹	Rate kg ai./ha	Average weed control 8 and 11 weeks after planting ²			
		Grass control		Total weed control	
		8 Weeks	11 Weeks	8 Weeks	11 Weeks
Asulam	2.80 ³	65	51	58	56
Asulam	3.74 ³	87	75	91	76
Asulam	2.80 ⁴	25	29	28	39
Asulam	3.74 ⁴	15	68	15	75
Hand-weeded check		96	96	94	95
Non-weeded check		0	0	0	0

¹ 2,4-D was applied to asulam-treated plots 4 weeks after planting sugarcane.

² Mean ratings of four replications with 1 to 100 representing poor to excellent weed control.

³ Sugarcane 25–30 cm in height 4 weeks after planting.

⁴ Sugarcane 35–50 cm in height 6 weeks after planting.

EXPERIMENT 3

This experiment was conducted to evaluate herbicides for the control of broadleaf weeds in sugarcane which are not efficiently controlled by 2,4-D. Grass weed species were similar to those in experiment 2. Broadleaf weeds comprised only 30% of the total weed population. The most abundant species were morning glory, niruri (*Phyllanthus niruri* L.), spurge (*Euphorbia heterophylla* L.) and wirebush (*Melochia pyramidata* L.). All herbicide treatments showed excellent control of these broadleaf weeds, very similar to hand-weeded check (table 7). Table 8 shows data on tonnage of cane and sugar yield. None of the herbicide treatments were better than hand-weeded checks in cane tonnage or sugar yield.

TABLE 6.—*Effect of asulam treatments on sugarcane yield in 1981-82 (Experiment 2)*

Treatment	Rate kg ai./ha	Weeks after planting	Sugarcane yield ^{1,2}	
			Tons cane/ha	Tons sugar/ha
Asulam	2.80	4 and 8	111.1 b	9.4 b
Asulam	3.74	4 and 8	135.7 ab	13.2 ab
Asulam	2.80	6 and 10	116.5 b	9.8 ab
Asulam	3.74	6 and 10	128.8 b	10.5 ab
Hand-weeded check		4 and 6	158.1 a	15.1 a
Non-weeded check		—	56.4 c	3.7 c
CV (%)			14.1	24.5

¹ Yields in columns followed by the same letter do not differ significantly at the 5% probability level as determined by Duncan's multiple range test.

² Average of four replications in metric tons per hectare.

TABLE 7.—*Effect of broadleaf weed killers and asulam on the control of weeds in sugarcane in 1981 (Experiment 3)*

Treatment	Rate/ha	Weed control 8 and 11 weeks after planting (%) ¹					
		Broadleaf		Grasses ²		Total control	
		8 Weeks	11 Weeks	8 Weeks	11 Weeks	8 Weeks	11 Weeks
Weedmaster ⁶	2.34 L	100	85	84	58	81	69
Weedmaster ^{6s}	4.68 L	100	90	81	64	83	71
Dicamba	0.56 kg ai.	94	84	58	51	68	61
2-4 D	1.12 kg ai.	97	86	79	58	78	61
Hand-weeded check		98	89	95	95	94	95
Non-weeded check		0	0	0	0	0	0

¹ Average of four replications with 1 to 100 representing poor to excellent weed control.

² Asulam at the rate of 2.8 kg/ha was applied 4 weeks after planting sugarcane.

TABLE 8.—*Effect of broadleaf weed killers and asulam on sugarcane yield in 1981-82 (Experiment 3)*

Treatment	Rate/ha	Sugarcane yield ^{1,2}	
		Tons cane/ha	Tons sugar/ha
Weedmaster ⁶	2.34 L	113.0 b	10.1 a
Weedmaster ^{6s}	4.68 L	113.0 b	9.8 a
Dicamba	0.56 kg ai.	117.6 b	10.2 a
2-4-D	1.12 kg ai.	105.9 b	10.9 a
Hand-weeded check		160.1 a	15.1 a
Non-weeded check		57.7 c	3.7 b
CV (%)		8.4	38.9

¹ Yields in columns followed by the same letter do not differ significantly at the 5% probability level as determined by Duncan's multiple range test.

² Average of four replications in metric tons per hectare.

Sugarcane yield obtained on hand-weeded check plots were on the expected range (3). Application rates of 2.80 kg/ha of asulam seem to be inadequate for grass weed control. The high population of johnsongrass not completely controlled by asulam reduced the effectiveness of the herbicides under study and this turn contributed to lower sugarcane yields.

RESUMEN

En el Centro de Investigación y Desarrollo de Lajas se hicieron en 1980 y 1981-82 tres experimentos con caña de azúcar para evaluar el herbicida asulam solo y en combinación con otros herbicidas. El mejor control de malezas y rendimientos de la caña, tanto en tonelaje de caña como en azúcar producida, se logró en 1980 con una aplicación posemergente temprana de 4.48 kg ia./ha de metribuzin seguida por una de 3.25 kg ia./ha de asulam. Con asulam aplicado solo, a 2.80 y 3.74 kg ia./ha, 5 semanas después de sembrar la caña, no se controlaron las malezas ni el rendimiento de la caña fue bueno. En uno de los experimentos del 1981-82, la aplicación posemergente de 3.74 kg ai./ha de asulam controló mejor las malezas cuando se aplicó 4 semanas después de sembrar que cuando se aplicó a las 6 semanas. El asulam aplicado a las 4 ó 6 semanas después de sembrar no fue tóxico para la caña. En otro de los experimentos de 1981-82 se evaluaron los herbicidas dicamba y Weedmaster™ para controlar las malezas de hoja ancha que toleran el 2,4-D. Con 0.56 kg ia./ha de dicamba y 2.34 y 4.68 L/ha de Weedmaster™ se logró controlar excelentemente las malezas de hoja ancha, un control muy similar al de 2,4-D y 2 desyerbos. Los rendimientos de caña obtenidos con estos herbicidas fueron inferiores a los del testigo desyerbado. Estos rendimientos más bajos pueden atribuírse al control inadecuado de la yerba johnson (*Sorghum halepense*) del asulam, el cual se aplicó en forma general en todas las parcelas a las que se les aplicaron los tratamientos de herbicidas.

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