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Herbicide Evaluation in Three Cucurbits[1]

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ABSTRACT

Three herbicide experiments were conducted at the Juana Díaz Research Center in 1980. Preemergence applications of chloramben (3-amino-2-5-dichlorobenzoic acid) at the rates of 4.48 or 8.96 kg ai/ha and postemergence application of DCPA (dimethyl tetrachloroterephthalate) at 11.2 or 22.4 kg ai/ha provided an excellent control of predominant weeds in pumpkin—(*Cucurbita moschata* (Duchesne) Pair). There were no significant differences ($P = .05$) in pumpkin yields among herbicide treatments and hand-weeded or non-weeded checks. DCPA at 11.2 and 22.4 kg ai/ha and chloramben at 6.72 kg ai/ha controlled weeds excellently in cucumber (*Cucumis sativus L.*) and watermelon—(*Citrullus lannatus* (Thumb.) Matsm. & Nakai)—during the first 7 weeks. The highest yield of cucumber (20,925 kg/ha) was obtained with DCPA at 11.2 kg ai/ha, whereas the hand-weeded check yielded 16,594 kg/ha. The highest yield of watermelon (51,697 kg/ha) was obtained in the hand-weeded check plots, but good yields of watermelons were also obtained with DCPA at 11.2 kg ai/ha, chloramben at 3.36 kg ai/ha, bensulide (0,0-diisopropyl phosphorodithioate s-ester with N-(2-mercaptoethyl)benzenesulfonamide) at 5.6 kg ai/ha and naptalam (N-1-naphthylphthalamic acid) at 6.72 and 13.44 kg ai/ha, respectively.

INTRODUCTION

Vegetable production is at the present one of the most important agricultural enterprises in Puerto Rico. Total gross income from vegetable crops in 1981–82 was $18.8 million (3). Of this amount pumpkin and cucumbers contributed with $6.7 million. Because of their short growth span and growing habits, vegetable crops need timely weed control to prevent competition of weeds and to facilitate harvesting (4).

Chemical weed control offers a cheap alternative to hand-weeding and improves the efficiency of vegetable production. Few herbicides were available for cucurbits in Puerto Rico before 1977, when chloramben and naptalam were recommended for cucumbers and watermelons, respectively (10, 11). Information on chemical weed control in cucurbits is extensively available in the United States (1, 2, 5, 6, 8, 9, 12). The most

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commonly used herbicides for weed control in cucurbits are chloramben and bensulide (5, 7, 12). These herbicides have shown good selectivity to pumpkin and cucumbers (1, 5, 9). Dinitroanilines weed killers such as trifluralin (α,α,α-trifluro-2,6-dinitro-N-N-dipropyl-p-toluidine) and ethalfluralin[(N-Ethyl-N-(2-methyl-2-propenil)-2,6-dinitro-4-(trifluoromethyl)benzenamine] have shown great potential as herbicides for cucurbits (2, 6, 8).

The performance of bensulide, chloramben, DCPA and trifluralin was studied for chemical weed control in pumpkin, cucumber and watermelon. The present paper reports the findings of our research in 1980.

MATERIALS AND METHODS

Three experiments with pumpkin, cucumber and watermelon were conducted at the Juana Díaz Research Center, on the southern coast of Puerto Rico. The experiments were conducted on a San Antón clay loam (Mollisol, pH 7.3 and organic matter 2.1%). The soil was carefully prepared, with recommended practices, before the vegetables were seeded. Fertilizer, irrigation and pest control practices were performed according to recommendations of the Agricultural Experiment Station (10).

Pumpkin cv. Borinquen was direct seeded on April 17, 1980 in a partially balanced incomplete block design with 10 treatments and 4 replications. Each plot consisted of two 9.0 m-long rows, 3.6 m apart. Plants were spaced 1.8 m apart. Bensulide and trifluralin were applied to the soil and incorporated with a rototiller immediately April 14, 1980. Chloramben was applied at planting, and DCPA was applied after emergence when pumpkin seedlings had developed 4 to 5 true leaves, after weeding. Fruits were harvested August 4, 15 and 20, 1980.

Cucumber cv. Gemini 7 was seeded April 18, 1980, with the same experimental design as for pumpkin, with 12 treatments and 4 replications. Individual plots consisted of two rows 5.5 m long and 3.6 m apart. Plants were spaced 0.3 m apart. Bensulide and trifluralin were applied and incorporated to the soil April 15, 1980. Chloramben was applied at planting, and naptalam 4 days later as preemergence treatments. DCPA was applied as in the pumpkin experiment. Cucumbers were harvested June 4 and 20, 1980.

Watermelon cv. Charleston Gray was seeded April 22, 1980, with the same experimental design and number of treatments as in the cucumber experiment. Individual plots consisted of two rows 5.5 m long and 3.36 m apart. Plants were spaced 0.9 m apart. Bensulide and trifluralin were sprayed and incorporated into the soil the day before planting. Naptalam, chloramben and DCPA were applied as in the cucumber experiment. Watermelons were hand picked June 23 and August 14, 1980.

RESULTS AND DISCUSSION

Trifluralin at the rates of 1.12 and 2.24 kg ai/ha was the only herbicide which caused crop phytotoxicity. This herbicide caused reduction in stands of pumpkin and cucumber. According to literature (7, 12) this herbicide should be applied between seedling rows and only when crops have developed 3 to 4 true leaves to obtain crop tolerance. Preemergence application of chloramben and postemergence application of DCPA, also at both rates, provided the best weed control in pumpkin during the first 7 weeks (table 1). On the basis of the number of weeds present and weed

TABLE 1.—*Effect of herbicides on weed control and yield in pumpkin*

Treatment	Rate	Weed control[1] at 4th week	Predominant weed species[2]	Weed weight at 7th Week[3]	Yield[3]
	kg/ha	%		*kg/16.7m²*	*kg/ha*
Bensulide	5.60	19	A, D, C, B, E	39.9 cd	22,343 ab
Bensulide	11.20	20	C, D, A, B, F	31.7 bc	21,872 ab
Chloramben	4.48	83	A, H, C	9.0 ab	21,493 ab
Chloramben	8.96	95	A, H, C, H	1.0 a	18,873 ab
DCPA	11.20	92	A, H, C	3.7 a	20,060 ab
DCPA	22.40	91	A, H, I	1.5 a	21,432 ab
Trifluralin	1.12	50	C, A, E, I, H	23.1 b	15,778 b
Trifluralin	2.24	78	A, C, H	9.9 a	15,891 b
Hand-weeded	twice	91	A, E, J, I	7.7 a	25,215 a
Non-weeded check	—	0	A, E, B, D, J, F, C	54.1 d	21,998 ab

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

[2] Weed species in order of abundance as follows: A = *Echinochloa colonum*; B = *Amaranthus spp*; C = *Cleome gynandra*; D = *Trianthema portulacastrum*; E = *Eleusine indica*; F = *Datura stramonium*; G = *Ipomoea tiliacea*; H = *Cyperus rotundus*; I = *Panicum trichoides*; J = *Leptochloa filiformis*.

[3] Means followed by the same letters do not differ significantly at P = .05 using the paired-*t* test.

weights, bensulide (5.6 and 11.2 kg ai/ha) and trifluralin (1.12 kg ai/ha) were deficient in weed control when compared to that in handweeded check plots. Table 1 also shows there were no significant differences in yield among the herbicide-treated plots. The highest yield of pumpkin (25,215 kg/ha) was obtained with the handweeded check. It exceeded significantly only those of the trifluralin treatments.

In cucumber, DCPA at both rates, and chloramben at 6.72 kg ai/ha gave excellent control of predominant weeds (table 2). Bensulide and naptalam (at rates evaluated) were inefficient in weed control. The highest yield of cucumber (20,925 kg/ha) was obtained with DCPA at the rate of 11.2 kg/ha. This yield exceeded significantly those obtained

with trifluralin and naptalam (at both rates), with bensulide (5.6 kg/ha), and in the non-weeded check.

DCPA at 11.2 and 22.4 kg ai/ha and chloramben at 6.72 kg ai/ha controlled weeds excellently during the first 7 weeks in watermelon (table 3). Deficient weed control was observed at both rates of bensulide and with the 1.12 kg ai/ha rate of trifluralin. The highest yield of watermelon (51,697 kg/ha) was obtained with two hand weedings. Good yields of watermelons were also obtained when bensulide (5.6 kg ai/ha), chloramben (3.36 kg ai/ha) and naptalam (6.72 and 13.44 kg ai/ha) were used. Low yields similar to those of non-weeded plots were obtained with

TABLE 2.—*Effect of herbicides on weed control and yield in cucumber*

Treatment	Rates	Weed control at 4th week[1]	Predominant weed species[2]	Weed weight at 7th week[3]	Yield[3]
	kg/ha	%		*kg/10.0 m²*	*kg/ha*
Bensulide	5.60	9	C, A, B, D, E	21.0 bcd	9,408 c
Bensulide	11.20	16	C, D, B, A, E	14.2 bc	11,761 abc
Chloramben	3.36	66	A, I, J	12.1 b	11,272 abc
Chloramben	6.72	93	A, J	2.9 a	11,885 abc
DCPA	11.20	90	D, A, C, B	3.2a	20,925 a
DCPA	22.40	94	D, A, J	5.2 a	14,392 abc
Naptalam	6.72	8	C, A, H, E, G	23.9 cd	8,422 bc
Naptalam	13.44	10	H, A, G, C	27.6 d	9,707 bc
Trifluralin	1.12	62	C, A, G, H,E	12.4 b	4,972 c
Trifluralin	2.24	86	H, C, A, J, F	6.4 a	9,015 bc
Hand-weeded	twice	96	—	0.0 a	16,594 ab
Non-weeded check	—	0	A, C, B, E, J, F	28.9 d	5,362 c

[1] Mean rating of four replications with 1 to 100 representing poor to excellent weed control.

[2] Weed species in order of abundance as follows: A = *Echinochloa colonum*; B = *Amaranthus spp*; C = *Cleome gynandra*; D = *Trianthema portulacastrum*; E = *Eleusine indica*; F = *Datura stramonium*; G = *Ipomoea tiliacea*; H = *Cyperus rotundus*; I = *Panicum trichoides*; J = *Leptochloa filiformis*.

[3] Means followed by the same letters do not differ significantly at P = .05 using the paired-*t* test.

trifluralin at 1.12 and 2.24 kg ai/ha, chloramben at 6.72 kg ai/ha, and bensulide at 11.2 kg ai/ha.

A single application of DCPA at 11.2 kg ai/ha after a hand-weeding was sufficient to control late germinating weeds in pumpkin, cucumber and watermelon. The improved weed control by DCPA resulted in increased yields of all three vegetables. Chloramben at 4.48 kg ai/ha was efficient in weed control for pumpkin but inconsistent at the rate of 3.36 kg ai/ha for cucumber and watermelon. Yields of pumpkin and watermelon were commercially acceptable for our tropical conditions when chloramben at the lower rate was used with these crops.

RESUMEN

En el Centro de Investigación de Juana Díaz en 1980 se realizaron tres experimentos con herbicidas. La aplicación preemergente de 4.48 y 8.96 kg ia/ha de chloramben y de 11.2 y 22.4 kg ia/ha de DCPA, posemergente a la cosecha después de desyerbada, controlaron las malezas excelentemente en la calabaza. En calabaza no hubo diferencias significativas (P = .05) en rendimiento entre los distintos tratamientos evaluados y el testigo desyerbado o sin desyerbar. DCPA a 11.2 y 22.4 kg/ha y chloramben a 6.72 kg ia/ha controlaron las malezas eficientemente en pepinillo y sandía durante las primeras 7 semanas. El rendimiento más alto de pepinillo

TABLE 3.—*Effect of herbicides on weed control and yield in watermelon*

Treatment	Rate	Weed control at 4th week[1]	Predominant weed species[2]	Weed weight at 7th week[3]	Yield[3]
	kg/ha	%		*kg/10.0 m²*	*kg/ha*
Bensulide	5.60	8	C, D, B, F	16.4 bc	31,040 a–d
Bensulide	11.20	6	C, F, B, A	12.3 ab	17,838 b–d
Chloramben	3.36	46	D, B, A	21.5 bcd	35,089 a–c
Chloramben	6.72	88	D, A, B	4.9 a	12,400 cd
DCPA	11.20	86	A, C, D, J	6.1 a	39,879 ab
DCPA	22.40	85	C, A, D, I	8.5 a	47,090 a
Naptalam	6.72	26	A, C, I	28.4 d	30,806 a–d
Naptalam	13.44	36	A, C, J	23.9 bcd	28,859 a–d
Trifluralin	1.12	39	C, A, F	14.6 b	9,038 cd
Trifluralin	2.24	71	C, A	10.0 a	7,479 d
Hand-weeded	twice	85	—	0.0 a	51,697 a
Non-weeded check	—	0	A, C, D, J, B, I	28.9 d	7,823 d

[1] Mean rating of four replications with 1 to 100 representing poor to excellent weed control.

[2] Weed species in order of abundance as follows: A = *Echinochloa colonum*; B = *Amaranthus spp*; C = *Cleome gynandra*; D = *Trianthema portulacastrum*; E = *Eleusine indica*; F = *Datura stramonium*; G = *Ipomoea tiliacea*; H = *Cyperus rotundus*; I = *Panicum trichoides*; J = *Leptochloa filiformis*.

[3] Means followed by the same letters do not differ significantly at P = .05 using the paired-t test.

(20,925 kg/ha) se obtuvo cuando se usaron 11.2 kg ia/ha de DCPA; este rendimiento fue muy similar al del testigo desyerbado. El rendimiento más alto de sandías (51,697 kg/ha) se obtuvo en el testigo desyerbado. También se lograron buenos rendimientos de sandías con DCPA a 11.2 y 22.4 kg ia/ha, chloramben a 3.36 kg ia/ha, bensulide a 5.6 kg ia/ha y naptalam a 6.72 y 13.44 kg ia/ha.

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