Broadleaf weed control in peppers with herbicides applied pre-transplant[1]

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ABSTRACT

Two herbicide field experiments were conducted with transplanted pepper at Juana Díaz and Lajas Agricultural Experiment Substations. The first experiment was performed with cv. Blanco del País, from December 1, 1987 to March 23, 1988, at Juana Díaz. Pre-transplant treatments with oxyfluorfen (0.14 kg ai/ha), alone and combined with metolachlor (2.24 kg ai/ha), cinmethylin (1.47 ka ai/ha), pendimethalin (1.65 kg ai/ha), paraquat (0.56 kg ai/ha) and fluazifop-P (0.25 kg ai/ha), gave excellent control of broadleaf weeds during the first 3 weeks. Highest phytotoxicity (19%) was recorded at 6 weeks with the oxyfluorfen plus conmethylin treatment. Oxyfluorfen (0.14 kg ai/ha), plus handweeding at 6 weeks, gave the highest pepper yield (31,200 kg/ha). Other herbicide treatments provided significantly ($P = 0.05$) lower yields. The second experiment was conducted at the Lajas Substation with cv. Cubanelle, from January 21, 1988 to May 2, 1988. Paraquat (0.56 kg ai/ha) pre-transplant treatments in mixture (separately) with oxyfluorfen (0.14 kg ai/ha), fluazifop-P (0.25 kg ai/ha) and trifluralin (1.12 kg ai/ha) gave excellent control of broadleaf weeds during the first 3 weeks. Oxyfluorfen treatments gave generally poor control of broadleaf weeds at Lajas. The highest pepper yield (20,945 kg/ha) at Lajas was obtained from the control treatment (pre-transplant rotavation plus two handweedings).

RESUMEN

Represión de malezas de hoja ancha en pimientales con herbicidas aplicados antes de trasplantar

En la Subestación Experimental Agrícola de Juana Díaz se hizo un experimento con pimiento Blanco del País desde el 1ro. de diciembre de 1987 al 23 de marzo de 1988. Los tratamientos antes de trasplante oxifluorfen (0.14 kg. i.a./ha.) solo y en mezcla con metolaclor (2.24 kg. p.a./ha.) cinmetilin (1.47 kg. p.a./ha.), pendimetalin (1.65 kg. p.a./ha.), paraquat (0.56 kg. p.a./ha.) y fluazifop-P (0.25 kg. p.a./ha.) reprimieron excelentemente las malezas de hoja ancha durante las primeras 3 semanas. La fitotoxicidad más alta (19%) a las 6 semanas se registró con el tratamiento de oxifluorfen (0.14 kg. p.a./ha.) + cinmetilin (1.47 kg. p.a./ha.). El mayor rendimiento de pimientos (31,200 kg./ha.) se obtuvo con el tratamiento de oxifluorfen (0.14 kg. p.a./ha. en combinación con un desyerbo manual a las 6 semanas. Con los demás tratamientos de herbicidas el rendimiento del pimiento fue significativamente ($P = 0.05$) más bajo. En la Subestación de Lajas un experimento similar con pimiento

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Cubanelle se hizo del 21 de enero de 1988 al 2 de mayo de 1988. Los tratamientos con paraquat antes de trasplantar (0.56 kg. p.a./ha.), en mezclas con oxifluorfen (0.14 kg. p.a./ha.), fluazifop-P (0.25 kg. p.a./ha.) y trifluralin (1.12 kg. p.a./ha.) reprimieron excelentemente las malezas de hoja ancha durante las primeras 3 semanas. La mayoría de los tratamientos de oxifluorfen solo o en mezclas no las reprimieron tan bien. El mayor rendimiento de pimientos (20,945 kg./ha.) en Lajas, se obtuvo con el tratamiento testigo (terreno trillado antes de trasplantar más dos desyerbos).

INTRODUCTION

Local production of pepper (*Capsicum annuum* L.) was 4,558 metric tons in 1985-86, with a farm value of $3.09 million (2). In the same period, 3,919 mt were imported from the Dominican Republic, which represents 46% of Puerto Rico's consumption. Weed-control costs in peppers have been estimated at 19 to 27% of total labor expenses (4, 7). Under our tropical conditions, the continual movement and high population densities of weed species usually result in poor weed control when using registered herbicides. Ordinarily, preemergence herbicides are recommended for peppers, (1, 3). Weed-control research has been conducted in recent years in an effort to improve herbicide efficiency and to reduce weeding expenses (6, 8, 9, 10, 11).

Weed management often requires a combination of cultural, mechanical, and chemical techniques to achieve optimum control, including minimized cost and environmental impacts. The results of two experiments conducted at Juana Díaz indicate that napropamide or rice straw-mulching, together with manual weeding, was the most effective technique for maximizing pepper yield (11). Postemergence treatments with glyphosate and paraquat further improved weed control and pepper yields (8). However, the integration of plastic mulching with postemergence paraquat (5) was the most profitable system for yield (29,494 kg/ha) and net income ($15,342/ha).

Plastic mulching appears to be promising for pepper production, but disposal of residual plastic wastes is an uncertain factor at present. Additional information is needed to establish a weed management program for peppers in Puerto Rico. The objective of this study was to evaluate pre-transplant treatments with oxyfluorfen and paraquat, alone and in combination with preemergence herbicides for control of broadleaf weeds newly emerging in pepper seedbeds.

MATERIALS AND METHODS

Two field experiments were conducted with transplanted peppers at the Juana Díaz and Lajas substations, from 1 December 1987 to 2 May 1988. Drip irrigation was administered for 2 weeks at Juana Díaz and

furrow irrigation for 3 weeks at Lajas. Both sites being "semi-arid", irrigation was applied to induce weed germination before transplanting peppers. Herbicide treatments were applied to emerged weeds two days before transplanting at both localities. The experiments consisted of 10 treatments with four replications in a randomized complete-block design. Heavy rain (309 mm) fell one week before transplanting at Juana Díaz, but only 35 mm at Lajas.

At Juana Díaz pepper seedlings of cultivar Blanco del País were transplanted December 3, 1987. The soil at Juana Díaz is a Mollisol, consisting of 44.5% sand, 32.2% silt, 23.3% clay and 1.53% organic matter with pH 6.9. Each plot (5.03 m wide and 9.1 m long) consisted of three beds with two rows per bed and 0.3 m spacing between plants. Control plots consisted of seedbed rotavation followed by hand-weeding at 3 and 6 weeks after transplanting. Plots treated with oxyfluorfen alone (0.14 kg ai/ha), and in combination with pendimethalin (1.65 kg ai/ha), were also hand-weeded 6 weeks after transplanting. Shallow cultivation between beds was performed in all plots 4 and 9 weeks after transplanting. A commercial fertilizer 15-5-10 was administered at the rate of 746 kg/ha 2, 4 and 7 weeks after transplanting. Insects and diseases were controlled with weekly sprayings of permethrin (0.2 - 0.5 kg ai/ha) or oxamil (0.3 - 1.0 kg ai/ha) in combination with copper hydroxide at 0.2 to 1.4 kg ai/ha. Drip irrigation was applied twice weekly throughout the experiment. Total rainfall during the experiment at Juana Díaz was 69.6 mm. Peppers were harvested from the two inner rows in four pickings between February 10 and March 23, 1988.

At Lajas, seedlings of cv. Cubanelle were transplanted January 21, 1988. Plots (4.6 m × 11.0 m) consisted of six rows spaced 0.76 m apart, with a distance of 41 cm between plants. Check plots and those treated with oxyfluorfen alone (0.14 kg ai/ha), and in combination with pendimethalin, were weeded in the same manner as at Juana Díaz. The soil is a Vertisol consisting of 30.4% sand, 38.2% silt, 31.4% clay, and 1.68% organic matter, with pH 6.69. Furrow irrigation was applied four times from January 22 to March 24, 1988. Insects were controlled with cabofuran (2.24 kg ai/ha) administered at transplanting and by weekly spraying with fenverelate (0.1 kg ai/ha), oxamil (0.56 kg ai/ha), or with diazinon (0.28 kg ai/ha). For disease control copper hydroxide (1.7 kg ai/ha), maneb (1.7 kg ai/ha), benomyl (0.28 kg ai/ha) and chlorothalonil (0.5 - 1.2 kg ai/ha) were used sequentially, alone and in combination. The fertilizer formulation 10-10-8 was applied at the rate of 1,120 kg/ha January 29 and February 29, 1988. Total rainfall during the experiment was 299 mm. Peppers were harvested from the four inner rows, in four pickings between March 23 and May 2, 1988.

RESULTS AND DISCUSSION

All oxyfluorfen treatments gave excellent control of broadleaf weeds during the first 3 weeks (table 1). At this time, weed populations were reduced significantly (P = 0.05) by most of the pre-transplant treatments, as compared to paraquat (0.56 kg ai/ha) plus fluazifop-P (0.25 kg ai/ha) treatment in which population density was the highest at 32.8 weeds/m². The economically allowable weed populations in pepper, established by Liu et al. (6), include 2 to 5 plants/m² for pigweed (*Amaranthus dubius* Mart); 5 to 10 plants/m² for junglerice [*Echinochloa colona* (L.) Link] and 20 plants/m² for horse purslane (*Trianthema portulacastrum* L.). For plots treated with oxyfluorfen alone (0.14 kg ai/ha), and in combination with pendimethalin (1.65 kg ai/ha), it was necessary to hand-

TABLE 1.—*Effect of pre-transplant herbicides on control of broadleaf weeds, phytotoxicity to pepper plants and yield of pepper cv. Blanco del país, at Juana Díaz, Puerto Rico*

		Broadleaf weed control at[1]				Phytotoxicity at[2]		Pepper yield[3]
		3 Weeks		6 Weeks				
Treatment	kg ai/ha	% Control	Weeds/m²	% Control	Weeds/m²	3 Weeks	6 Weeks	kg/ha
Oxyfluorfen[4]	0.14	98	2.3 bc	81	11.0 ab	0.0	0.0	31,200 a
Oxyfluorfen	0.28	98	0.8 c	90	3.3 b	1.3	0.3	19,255 c
Oxyfluorfen	0.14	100	0.0 c	85	11.5 ab	2.5	0.5	21,997 c
Metolachlor	2.24							
Oxyfluorfen	0.14	90	2.0 bc	85	11.0 ab	3.8	1.9	20,032 c
Cinmethylin	1.47							
Oxyfluorfen[4]	0.14	90	14.0 bc	69	13.3 ab	2.5	0.6	23,394 bc
Pendimethalin	1.65							
Oxyfluorfen	0.14	96	6.8 bc	93	10.3 ab	0.0	0.0	21,097 c
Paraquat*	0.56							
Oxyfluorfen	0.14	96	5.0 bc	81	10.8 ab	0.0	0.0	20,284 c
Fluazifop-P	0.25							
Paraquat	0.56	84	32.8 a	86	15.3 a	0.0	0.0	20,653 c
Fluazifop-P[5]	0.25							
Paraquat[5]	0.56	84	16.0 b	92	12.0 ab	0.3	0.0	23,773 bc
Trifluralin	1.12							
Check[6]	——	100	0.0 c	84	18.3 a	0.0	0.0	28,110 ab

[1]Mean ratings of 4 replications with 0 = no control, 70 or less = poor, 80-89 = good and 90-100 = excellent control at 3 and 6 weeks after transplanting.

[2]Phytotoxicity ratings 3 and 6 weeks after transplanting with 0 = no effect and 10 complete plant kill.

[3]Means followed by the same letter do not differ significantly (P = 0.05), Duncan's multiple range test.

[4]Weeded by hoe 6 weeks after transplanting.

[5]Directed treatment, repeated at 3 weeks after transplanting.

[6]Rotavated before transplanting, followed by handweedings at 3 and 6 weeks.

weed 6 weeks after transplanting because their weed population densities had surpassed acceptable economic thresholds. Weed control was excellent 6 weeks after transplanting when oxyfluorfen was used alone and combined with paraquat. Control was also excellent with paraquat and trifluralin in combination.

Moderate phytotoxicity was recorded at 3 weeks when oxyfluorfen plus metolachlor was applied (table 1). Cinmethylin and pendimethalin also caused some injury to pepper. At 6 weeks highest phytotoxicity was caused by oxyfluorfen plus cinmethylin.

Oxyfluorfen applied alone and weeding six weeks after transplanting gave the highest yield of peppers (31,200 kg/ha). Other treatments, besides the control, produced significantly lower yields. Yield reduction in most treated plots could be attributed to the interference of broadleaf weeds and herbicide phytotoxicity on pepper. Herbicides caused stunting of pepper plants. A pre-transplant treatment of oxyfluorfen at 0.14 kg ai/ha, followed by hand-weeding, offered selective weed control and improved yield in drip irrigated plots.

Lajas Experiment

Excellent broadleaf weed control was recorded at 3 weeks with paraquat combined with oxyfluorfen and with fluazifop-P and trifluralin (table 2). At this time broadleaf weeds such as pigweed and horse purslane were maintained at significantly low levels with the paraquat plus trifluralin combination. The control consisting of pre-transplant rotavation, similarly restricted weed levels. Handweeding performed 6 weeks after transplanting also improved weed control with oxyfluorfen when administered alone and combined with pendimethalin (table 2). Some slight phytotoxicity was recorded in pepper when treated with two rates of oxyfluorfen alone and when mixed separately with metolachlor, cinmethylin, pendimethalin and fluazifop-P. The highest yield of pepper (20,945 kg/ha) was obtained in control plots. There were no significant yield differences associated with oxyfluorfen plus pendimethalin or with paraquat plus trifluralin.

The results of this experiment are different from those obtained at Juana Díaz. One reason for the poor weed control offered by most of the oxyfluorfen treatments at Lajas might be that drought conditions which prevailed during the induced-germination period. During this 3-week period, only 35 mm of rain fell there and hardy weeds might have become more resistant to oxyfluorfen treatments. Postemergence oxyfluorfen should be applied when weeds are in their 2- to 4-leaf stage in order to obtain effective weed control, as in the Juana Díaz experiment.

TABLE 2.—*Effect of pre-transplant herbicides on control of broadleaf weeds, phytotoxicity to pepper plants and yield of pepper Cubanelle at Lajas, Puerto Rico*

		Broadleaf weed control at[1]				Phytotoxicity at[2]		Pepper yield[3]
		3 Weeks		6 Weeks				
Treatment	kg ai/ha	% Control	Weeds/m²	% Control	Weeds/m²	3 Weeks	6 Weeks	kg/ha
Oxyfluorfen[4]	0.14	23	73 ab	98	4 c	0.0	1.4	13,247 bc
Oxyfluorfen	0.28	35	96 a	10	92 a	0.0	0.3	7,508 c
Oxyfluorfen	0.14	51	50 b	13	41 bc	0.5	1.3	9,327 c
Metolachlor	2.24							
Oxyfluorfen	0.14	35	61 ab	8	45 bc	1.0	1.5	7,389 c
Cinmethylin	1.47							
Oxyfluorfen[4]	0.14	81	21 cb	98	1 c	0.0	1.1	17,675 ab
Pendimethalin	1.65							
Oxyfluorfen	0.14	92	21 cb	70	33 bc	0.0	0.0	14,165 b
Paraquat*	0.56							
Oxyfluorfen	0.14	13	65 ab	0	57 ab	0.0	0.3	3,659 d
Fluazifop-P	0.25							
Paraquat[5]	0.56	89	46 b	61	59 ab	0.0	0.0	9,747 c
Fluazifop-P	0.25							
Paraquat[5]	0.56	93	14 c	80	29 bc	0.1	0.0	17,431 ab
Trifluralin	1.00							
Check[6]	——	97	2 c	98	4 c	0.0	0.0	20,945 a

[1]Mean ratings of 4 replications with 0 = no control, 70 or less = poor, 80-89 = good and 90-100 = excellent control at 3 and 6 weeks after transplanting.

[2]Phytotoxicity ratings 3 and 6 weeks after transplanting with 0 = no effect and 10 complete plant kill.

[3]Means followed by the same letter do not differ significantly (P = 0.05), Duncan's multiple range test.

[4]Weeded by hoe 6 weeks after transplanting.

[5]Directed treatment, repeated at 3 weeks after transplanting.

[6]Rotavated before transplanting, followed by handweedings at 3 and 6 weeks.

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