Chemical weed control in pumpkin[1]

Li C. Liu,[2] Elvin Caraballo,[3] Ismael Reyes-Soto[4] and Nilsa Acín[5]

ABSTRACT

Two herbicide experiments on pumpkin were conducted in a San Antón loam at Fortuna substation from 1989 to 1990 to evaluate clomazone, chloramben, DCPA, metolachar and certain sequential combinations. In the first experiment, clomazone at 1.12 and 2.24 kg ai/ha applied pre-plant gave excellent control of most grasses. Chloramben at 4.48 kg ai/ha provided only fair weed control. Chloramben in sequential application with bentazon + fluazifop mixture greatly improved weed control. DCPA at 11.2 kg ai/ha controlled weed slightly better than chloramben. DCPA in sequential application with bentazon + fluazifop mixture also improved weed control. The highest pumpkin yield was obtained with the weeded check, which was significantly superior to all herbicide treatments. There were no significant yield differences among the herbicide treatments. In the second experiment, the best weed control treatment was clomazone at 2.24 kg ai/ha applied as pre-plant + sequential application of paraquat at 0.56 kg ai/ha. Metolachor at 2.24 and 4.48 kg ai/ha gave good grass control (80-93%), but only fair (46-70%) on broad leaf weeds. Chloramben at 4.48 kg ai/ha only fairly controlled weeds. DCPA at 11.2 kg ai/ha gave good grass control, but was weak on broadleaf weeds. Chloramben or DCPA in sequential application with paraquat at the rate of 0.56 kg ai/ha controlled weeds better than either used alone. The highest pumpkin yield was obtained with clomazone at 2.24 kg ai/ha + paraquat at 0.56 kg ai/ha, followed by the weeded check and clomazone at 1.12 kg ai/ha. These three treaments differed significantly from the four remaining herbicide treatments.

RESUMEN

Control químico de yerbajos en calabaza

En un suelo San Antón de la subestación de Fortuna se realizaron en 1989-90 dos experimentos de campo para evaluar herbicidas en calabaza. En el primer experimento, con clomazone aplicado antes de la siembra a razón de 1.12 y 2.24 kg. p.a./ha., se logró un excelente control de las gramíneas. Chloramben solo, a razón de 4.48 kg. p.a./ha., no controló adecuadamente las malezas, pero la aplicatión subsiguiente de bentazon + fluazifop las controló mucho mejor. El DCPA a razón de 11.2 kg. p.a./ha., solo o en secuencia con el bentazon + fluazifop, controló las malezas eficazmente. El mayor rendimiento de calabaza se obtuvo en parcelas testigo desyerbadas a mano. No hubo diferencias significativas en rendimiento entre los tratamientos de herbicidas. En el segundo experimento, el tratamiento que mejor controló las malezas fue aplicación

[1]Manuscript submitted to Editorial Board 7 February 1991.

[2]Plant Physiologist, Department of Crop Protection.
[3]Research Assistant, Department of Horticulture.
[4]Associate Horticulturist, Department of Horticulture.
[5]Associate Chemist, Department of Crop Protection.

presiembra de 2.24 k.g. p.a./ha. de clomazone seguido por una aplicación de 0.56 k.g. p.a./ha. de paraquat. Metolachlor a razón de 2.24 y 4.48 kg. p.a./ha., y DCPA, a razón de 11.2 kg. p.a./ha., fueron eficaces para controlar las gramíneas, pero no las malezas de hoja ancha. Chloramben y DCPA, en aplicación en secuencia con paraquat a razón de 0.56 k.g. p.a./ha., controlaron mejor las malezas que cada uno aplicado solo. El mayor rendimiento de calabaza se obtuvo en parcelas tratadas con clomazone a razón de 2.24 kg. p.a./ha. + paraquat a razón de 0.56 kg. p.a./ha., seguido por las parcelas testigo desyerbadas a mano; finalmente por las parcelas tratadas con clomazone a razón de 1.12 k.g. p.a./ha. + paraquat a razón de 0.56 k.g. p.a./ha. No se encontraron diferencias significativas entre estos tres tratamientos.

INTRODUCTION

Pumpkin, *Cucurbita moschata* (Duchense) Poir., is second only to tomato among vegetable crops of economic importance in Puerto Rico. In 1987-88, 20,140 mt was produced, with a farm value of $7.9 million (2). Weeds interfere with pumpkin production by competing with the crop for light, water and nutrients and by exerting an allelopathic effect (3). Chemical weed control offers a viable alternative to manual weeding for increasing pumpkin production. Even though several herbicides are registered for use in Puerto Rico on pumpkin (1), few of these provide acceptable weed control. Semidey et al. (7) reported that chloramben and DCPA provided an acceptable control of weeds in pumpkin for seven weeks. Trifluralin and bensulide were either too toxic or ineffective. Almodóvar et al. (4) evaluated diquat for post-emergence control of weeds in pumpkin. They found that all rates of the herbicide controlled morning glory excellently; the highest rate resulted in an 85% control of wild poinsettia. Control of weeds was less efficient with diquat at the three rates (0.56, 1.12 and 2.24 kg ai/ha) tested. Therefore, there is a need to evaluate herbicides for grass control in pumpkin in Puerto Rico. The development of clomazone and metolachlor as grass killers (8), together with the ready availability of fluazifop-P-butyl for grass control in broadleaved crops (8), has provided a more effective means to control grass in various crops. The present stuoy was initiated in an attempt to generate efficacy, phytotoxicity and yield data in pumpkin for clomazone [2-(2-chlorophenyl)methyl-4,4-dimethyl-3-isoxazolidinone] and metolachlor [2-chloro-N-(2 ethyl-6-methylphenyl)-N-(2-methoxy) acetamide]. The effectiveness of certain combinations of bentazon and fluazifop with chloramben or DCPA and the combination of clomazone with paraquat for weed control in pumpkin were also determined.

MATERIALS AND METHODS

First Experiment

The first experiment was established on a San Antón loam at the Fortuna Substation, located in the southern semiarid region of Puerto

Rico. The soil is a Mollisol, fine loamy mixed isohyperthermic, 1.7% organic matter and pH 7.0. A randomized complete block design with four replications was used. Table 1 lists the herbicides and their rates of application. The plots were 5.5 X 9.1 m, with three 9.1–m rows, and a planting distance of 0.9 m within the row. The pre-plant applications of clomazone[6] (COMMAND[7]), chloramben (AMIBEN) and DCPA (DACTHAL) were made 15 March 1989. An R & D sprayer with a four-nozzle boom was used to deliver a spray volume of 139 L/ha. Pumpkin cultivar Borinquen was seeded the day after the herbicide applications. The postemergence application of bentazon[6] (BASAGRAN) and fluazifop-P (FUSILADE) was made 7 April 1989. Check plots were hand weeded once, on 10 April 1989. A furrow irrigation system was used during the course of the experiment. Plants were fertilized once with 100 kg N, 100 kg P, and 80 kg k per hectare in mid April. Insects and diseases were controlled by alternate sprays of either Bravo 500 at 2.34 L/ha + Javelin at 2.34 L/ha mixture or Benlate at 0.56 kg ai/ha + Javelin at 2.34 L/ha mixture, starting 28 March 1989 and until 30 July 1989. Other cultural practices followed the standard recommendations (5). Weed control and phytotoxicity were rated periodically. Marketable pumpkins were picked twice (12 July and 30 August 1989).

Second Experiment

The experiment was conducted at the same substation in a San Antón loam. The experiment was similar to the other in plot size, experimental design and application equipment and method. Table 2 lists the herbicides and their rates of application. Pre-plant applications of clomazone, metolachlor[6] (DUAL) and chloramben were made 6 March 1990, and pumpkin cultivar Borinquen was planted the next day. Postemergence application of DCPA was made 10 days after planting, with a knapsack sprayer and a spray volume of 936 L/ha. The fertilization practice was the same as in the first experiment. Fungicides used included Kocide, Benlate and Bravo at their recommended rates. Sevin, Thiodan and Dipel were used for insect control. Check plots were hand weeded three times (9 April, 10 May and 29 May 1990). Drip irrigation was used during the course of this experiment. Weed control and phytotoxicity were rated periodically. Fruits were picked twice, starting 95 days after planting and terminating by the end of July.

[6]Compound not registered for pumpkin.

[7]Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

TABLE 1.—*Effect of herbicide treatments on weed control, phytotoxicity and yield of pumpkin (1988-89).*

Treatment	Weed control[1]				Phytotoxicity[2]		Yield[3]
	Broadleaf		Grasses				
	4-6-89	5-4-89	4-6-89	5-4-89	4-6-89	5-4-89	
	%	%	%	%			*kg/ha*
1. Clomazone 1.12 kg ai/ha	50	20	95	90	0	0	2,762 bc
2. Clomazone 2.24 kg ai/ha	65	28	98	94	0	0	5,281 b
3. Chloramben 4.48 kg ai/ha	48	30	80	78	0	0	4,145 bc
4. Chloramben4.48 kg ai/ha	50	43	78	98	0	0	3,758 bc
+ (Bentazon 1.12 kg ai/ha	50	43	78	98	0	1.0	3,758 bc
+ fluazifop 0.56 kg ai/ha)							
5. Chloramben 4.48 kg ai/ha	50	69	83	100	0	1.0	3,651 bc
+ (Bentazon 2.24 kg ai/ha							
+ fluazifop 1.12 kg ai/ha)							
6. DCPA 11.4 kg ai/ha	70	56	90	83	3.0	3.0	3,170 bc
7. DCPA 11.4 kg ai/ha	75	58	89	100	4.0	4.3	1,346 bc
+ (Bentazon 1.12 kg ai/ha							
+ fluazifop 0.56 kg ai/ha)							
8. DCPA 11.4 kg ai/ha	74	63	91	100	4.3	4.3	2,778 bc
+ (Bentazon 2.24 kg ai/ha							
+ fluazifop 1.12 kg ai/ha)							
9. Weeded check	–	96	–	96	0	0	13,953 a
10. Nonweeded check	0	0	0	0	0	0	161 c

[1]Weed control ratings are based on 0-100%: 0 = no control; 100 = perfect control.
[2]Phytotoxicity evaluations are based on 0 to 5 scale: 0 = no injury; 100 = complete stand reduction.
[3]Means bearing the same letter or letters do not differ significantly at 0.05 probability level.

TABLE 2.—*Effect of herbicide treatments on weed control, phytotoxicity and yield of pumpkin (1989-90).*

Treatment	Weed control[1]				Phytotoxicity[2]		Yield[3]
	Broadleaf		Grasses				
	4-2-90	4-30-90	4-2-90	4-30-90	4-2-90	4-30-90	
	%	%	%	%			*kg/ha*
1. Clomazone 1.12 kg ai/ha + paraquat 0.56 kg ai/ha	38	85	93	90	0	1.0	8,740 a
2. Clomazone 2.24 kg ai/ha + paraquat 0.56 kg ai/ha	61	89	100	93	0	1.0	12,285 a
3. Metolachor 2.24 kg ai/ha	46	18	80	65	0	0	1,271 c
4. Metolachor 4.48 kg ai/ha	70	20	93	68	0	0	3,031 bc
5. Chloramben 4.48 kg ai/ha	38	15	45	30	0	0	895 c
6. Chloramben 4.48 kg ai/ha + paraquat 0.56 kg ai/ha*	53	85	55	70	0	1.0	8,068 ab
7. DCPA 11.2 kg ai/ha	15	30	75	55	0	0	1,108 c
8. DCPA 11.2 kg ai/ha + paraquat 0.56 kg ai/ha*	40	80	75	60	0	1.0	6,641 abc
9. Weeded check	–	90	–	85	0	0	9,565 a
10. Non-weeded check	0	0	0	0	0	0	2,240 c

[1]Weed control ratings are based on 0-100%: 0 = no control; 100 = perfect control.
[2]Phytotoxicity evaluations are based on 0 to 5 scale: 0 = no injury; 100 = complete stand reduction.
[3]Means bearing the same letter or letters do not differ significantly at 0.05 probability level.
* Not registered for pumpkin.

RESULTS AND DISCUSSION

First experiment

Predominant weed species in the experimental plots were Johnson grass (*Sorghum halanpense* L.), jungle rice (*Echinocloa colonum* L.), crabgrass (*Digitaria sanguinalis* L.), wild poinsettia (*Euphorbia heterophylla* L.), datura (*Datura stramonium* L.), horse purslane (*Trianthema portulacastrum* L.), pigweed (*Amaranthus dubius* Mart. ex Thell.), wild bean [*Vigna luteola* (Jacq.) Benth.], spider flower (*Cleome gynandra* L.), purple nutsedge (*Cyperus rotundus* L.), itch grass (*Rottboellia exaltata* L.f.), and prickly poppy (*Argemone mexicana* L.). Clomazone at either rate provided an excellent control of most grasses, but was less effective on broadleaf weeds (table 1). Wild poinsettia and horse purslane were partially controlled by clomazone; pigweed and spider flower escaped control. Chloramben at 4.48 kg ai/ha alone provided good grass control but only fair control of broadleaf weeds. Chloramben in sequential application with a bentazon + fluazifop mixture greatly improved grass control but did not control broadleaf weeds. DCPA at 11.2 kg ai/ha alone provided better control of both broadleaf weeds and grasses than chloramben alone. DCPA in sequential application with a bentazon + fluazifop mixture again provided excellent grass control. Chloramben alone caused no crop injury, but in sequential application with bentazon + fluazifop mixture resulted in slight leaf burning, which was apparently caused by bentazon. The injury was later outgrown. DCPA alone at 11.2 kg ai/ha significantly reduced germination and resulted in a poor pumpkin stand. The same injury and stand reduction were noted for DCPA in sequential application with bentazon + fluazifop mixture. Fluazifop is known to be highly selective to broadleaf crops, including pumpkin (8). Therefore, the injury was attributed to bentazon.

The highest pumpkin yield was obtained from the weeded check (table 1). This treatment differed significantly from all other treatments. There were no significant yield differences among different herbicide treatments. The unweeded check yielded significantly lower than the weeded check and the treatment with clomazone alone at 2.24 kg ai/ha.

Second Experiment

There were fewer species in this experiment than in the first. Itch grass and prickly poppy were not present. Clomazone at either 1.12 or 2.24 kg ai/ha in sequential application with paraquat at 0.56 kg ai/ha provided the most efficient control of both grasses and broadleaf weeds. Apparently, clomazone initially controlled most grasses; the leftover broadleaf weeds were controlled by the follow-up paraquat application

(table 2). Metolachor at either rate was more effective in controlling grasses than broadleaf weeds. Chloramben at 4.48 kg ai/ha fairly controlled both grasses and broadleaf weeds. Chloramben in sequential application with paraquat had improved weed control at the second evaluation date. DCPA at 11.2 kg ai/ha controlled grasses more effectively than broadleaf weeds. DCPA in sequential application with paraquat again improved broadleaf weed control. None of the initial herbicide treatments caused any apparent crop injury. The slight crop injury noted at the second evaluation date was due to the drift effect of the sequential application of paraquat. This injury was of contact nature and the plants recovered rapidly with no detrimental effect.

The highest pumpkin yield was obtained in plots treated with clomazone at 2.24 kg ai/ha in sequential application with paraquat at 0.56 kg ai/ha, followed by the weeded check and the treatment with clomazone at 1.12 kg ai/ha in sequential application with paraquat at 0.56 kg ai/ha. These three treatments differed significantly in yield with chloramben alone at 4.48 kg ai/ha.

It is worth noting that in the first experiment the sequential applications of bentazon + fluazifop provided an excellent control of most grasses encountered, particularly Johnson grass. Since bentazon is effective only as a broad leaf killer (8), apparently fluazifop was responsible for controlling grasses. It is also important to note that in the second experiment pumpkin yield was greatly increased whenever paraquat was included as a follow-up post directed treatment. This finding suggests the need for a good selective postemergence herbicide for weed control in local pumpkin production.

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