Herbicide Evaluation for Sweet Potatoes[1]

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ABSTRACT

Two herbicide experiments were carried out in 1980 to evaluate Alachor and Metribuzin alone or combined for weed control in sweet potato cultivar Miguela at the Isabela and Fortuna Substations, Metribuzin at 1.12 kg ai/ha rate controlled effectively both broadleaf weeds and grasses. A minimum rate of 6.73 kg ai/ha of Alachor was needed for acceptable weed control. Metribuzin at the 1.12 kg ai/ha rate in combination with Alachor at the 3.36 kg ai/ha rate provided the best weed control. There was no visible herbicide injury to sweet potato plants at the Isabela Substation. Moderate crop injury as a consequence of Metribuzin application at 2.24 kg ai/ha was apparent at the Fortuna Substation. The highest tuber yield was obtained with Metribuzin at 1.12 kg ai/ha in combination with Alachor at 3.36 kg ai/ha at both Substations. Metribuzin at 1.12 kg ai/ha rate alone or in combination with any other herbicide also produced good tuber yield. Sweet potatoes with standard herbicide treatments, Diphenamid and Chloramben, yielded poorly because of weed competition.

INTRODUCTION

Sweet potatoes (*Ipomoea batatas* (L.) Lam.) rank third (next to yams and taniers) in economic importance among the root crops in Puerto Rico. During fiscal year 1979–80, 9,449 metric tons of sweet potatoes were produced with a gross income of 3.34 million dollars (1). In the same year, 5,026 metric tons of sweet potatoes had to be imported from the Dominican Republic to meet local demands. One of the major factors limiting local sweet potato production has been the scarcity and high cost of labor needed to combat weeds. Chemical weed control offers a viable alternative to handweeding and contributes greatly toward increasing sweet potato production.

Information concerning enhanced sweet potato production through chemical means has been extensive in the United States (2, 3, 4, 7, 8, 9, 10, 11, 12). The only local published work is that of Vélez-Ramos and Morales (13). They evaluated herbicides Diphenamid (N,N,-dimethyl-2,2-diphenylacetamide), DCPA (dimethyl-tetrachloroterephthalate), and Chloramben (3-amino-2,5 dichlorobenzoic acid) and their mixtures for weed control in 1971 and 1972. Effective weed control was achieved through the use of Diphenamid alone or in combination with Chloramben or DCPA. As the new compounds with herbicide activity are being made available at a fast pace and the said experiments by Vélez-Ramos and Morales were conducted 5 years ago, there is need for the Agricultural

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Experiment Station constantly to update this herbicide research on sweet potatoes. Two herbicide experiments on sweet potatoes were thus carried out in an attempt to evaluate 4-amino-6-tert-butyl-3(methylthio)-as-triazin-5(4H)-one (Metribuzin) and 2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide (Alachor)[3]. Diphenamid and Chloramben were also included as standard herbicides in this investigation.

MATERIALS AND METHODS

Two herbicide field experiments were conducted at the Isabela and Fortuna Substations, located in the humid northwestern and dry southern coast of Puerto Rico, respectively. At Isabela, the experiment was established on a Coto clay (Oxisol with a pH of 5.8, organic matter of 2.8%). At Fortuna, the experiment was conducted on a San Antón sandy loam (Mollisol with a pH of 7.4, organic matter 1.7%). The Isabela experiment was begun September 30, 1980 and harvested March 31, 1981; the Fortuna experiment was started October 3, 1980 and harvested March 20, 1981. Miguela cultivar vines were planted on top of the ridge. Randomized complete block designs with four replications were used at both sites. Each plot contained four rows measuring 6.1 m long and 0.91 m apart. Four herbicides, Metribuzin, Alachor, Diphenamid, and Chloramben were applied either alone or in combination with each other. Table 1 shows the rates of each herbicide used. All the herbicides were sprayed in 318 l/ha volume of water the next day after planting. Hand-weeded and nonweeded controls were also included in both experiments. Two handweedings were performed to the weeded check 1 and 2 months after planting. Visual weed control ratings and phytotoxicity evaluations were made periodically. Both fields at the Isabela and Fortuna Substations were irrigated with approximately 2.54 cm of water immediately following the planting of the vines. Periodic irrigation was needed to maintain optimum growth of the plants. Irrigation was especially needed at the Fortuna Substation.

Pest management included one application of Furadan 10G at the rate of 22 kg/ha at the Isabela Substation and two applications at the rate of 28 kg/ha each at the Fortuna Substation. Periodic sprayings of Diazinon AG-500, ranging from 7 l/ha to 8.5 l/ha in a volume of water equivalent to 935 l/ha, were needed for insect control at the Fortuna Substation. Diazinon was not applied at the Isabela Substation. An additional application of Lannate at 1.9 l/ha rate in a volume of water equivalent to 935 l/ha was also performed at the Fortuna substation. A 6-6-12 fertilizer at

[3] 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 tuber yield of sweet potatoes at the Isabela Substation, September 1980*

Treatment	kg ai/ha	Weed control ratings at 8 weeks[1]			Phyto-toxicity[2]	Tuber yield[3]
		Broadleaf	Grasses	Average		
		%	%	%	%	*kg/ha*
Diphenamid	11.2	28	50	39	0	22,358 cd
Chloramben	4.48	24	26	25	0	18,869 de
Alachor	3.36	33	74	54	0	30,088 ab
Alachor	6.73	40	81	61	0	34,279 ab
Metribuzin	1.12	76	64	70	0	29,193 ab
Metribuzin	2.24	89	86	88	0	34,228 ab
Diphenamid + Chloramben	11.2 + 4.48	45	49	47	0	28,074 bc
Diphenamid + Alachor	11.2 + 3.36	34	84	59	0	31,584 ab
Diphenamid + Metribuzin	11.2 + 1.12	71	80	76	0	32.519 ab
Chloramben + Alachor	4.48 + 3.36	36	79	58	0	34.432 ab
Chloramben + Metribuzin	4.48 + 1.12	76	75	76	0	35,601 a
Alachor + Metribuzin	3.36 + 1.12	86	91	89	0	35,703 a
Handweeded check		93	93	93	0	32,092 ab
Nonweeded check		0	0	0	0	12,837 e

[1] Weed control ratings are based on a scale of 0–100: 0 = no control; 100 = complete control.

[2] Phytotoxicity evaluations are based on a scale of 0–100: 0 = no stand reduction; 100 = complete stand reduction.

[3] Tuber yield is the average of four replications. Values followed by one or more letters in common do not differ statistically (P = 0.05).

the rate of 454 kg was applied 5 weeks after planting at both sites. The tubers were harvested approximately 5 months after planting. The data was analyzed statistically.

RESULTS AND DISCUSSION

ISABELA EXPERIMENT

The predominant weed species present in the experimental plots are listed in their decreasing order of abundance; spurge (*Euphorbia heterophylla* L.), jungle rice (*Echinochloa colona* (L.) Link.), scarlet bean (*Marcroptilium lathyroides* (L.) Urban), morning glory (*Ipomoea tiliaceae* (Willd.) Choisy), lion's ear (*Leonotis nepetifolia* (L.) R. Br. in Ait.f.), crabgrass (*Digitaria sanguinalis* (L.) Scop.), ground cherry (*Solanum nodiflorum*), sicklepod (*Cassia obtusifolia* L.), niruri (*Phyllanthus niruri* L.), southern sida (*Sida acuta* Burm f.), woodsorrel (*Oxalis intermedia* A. Rich.), Johnson grass (*Sorghum halepense* (L.) Pers.), and southern sandbur (*Cenchrus echinatus* L.). Standard herbicides Diphenamid and Chloramben, at present registered for use in sweet potatoes, did not give adequate control of broadleaf weeds and grasses at the end of the 8th week (table 1). Alachor at either rate controlled grasses effectively but failed to control satisfactorily broadleaf weeds, especially spurge. Metribuzin at 1.12 kg ai/ha rate gave excellent control of broadleaf weeds and grasses. Among the herbicide mixtures studied, Metribuzin at 1.12 kg ai/ha plus Alachor at 3.36 kg ai/ha rate provided the best weed control. The mixtures containing Metribuzin at 1.12 kg ai/ha generally gave good weed control. None of the herbicides used in the experimemt controlled Johnson grass effectively. There was no visible crop injury noted in this experiment even at the higher rate of herbicide application. Metribuzin at 1.12 kg ai/ha plus Alachor at 3.36 kg ai/ha rate produced the highest marketable tuber yield (table 1). This combination was followed closely by Chloramben at 4.48 kg ai/ha plus Metribuzin at 1.12 kg ai/ha, and Diphenamid at 11.2 kg ai/ha plus Metrubuzin at 1.12 kg ai/ha. High tuber yield was also obtained with Metribuzin and Alchor applied alone at a higher rate. Both herbicides at their lower rate also contributed good yields. Diphenamid alone at 11.2 kg ai/ha and Chloramben alone at 4.48 kg ai/ha yielded poorly.

FORTUNA EXPERIMENT

The predominant weed species present in the experimental plots are listed in their decreasing order of abundance were crabgrass (*Digitaria sanguinalis* (L.) Scop.), jungle rice (*Echinochloa colona* (L.) Link.), horse purslane (*Trianthema portulacastrum* L.), spider flower plant (*Cleome spinosa* Jacq.), pigweed (*Amaranthus dubius* Mart. ex Thell.) jimson weed (*Datura stramonium* L), red spiderling (*Boerhaavia coc-*

cinea Mill.), spurge (*Euphorbia heterophylla* L.), lion's ear (*Leonotis nepetifolia* (L.) R. Br. in Ait. f.), goose grass (*Eleusine indica* L. Gaertn.), and purple nutsedge (*Cyperus rotundus* L.). Weed control performance achieved by Diphenamid and Chloramben alone was slightly better than that at the Isabela Substation (table 2). However, it was still not good enough to be commercially acceptable. Metribuzin applied alone at 1.12 kg ai/ha rate controlled effectively broadleaf weeds and grasses. Increasing Metribuzin to 2.24 kg ai/ha improved weed control somewhat. Alachor at both rates gave fair to good control of grasses but did not control well spider flower plant and horse purslane. Metribuzin at 1.12 kg ai/ha plus Alachor at 3.36 kg ai/ha provided the best weed control. All the mixtures containing Metribuzin seemed to give good weed control. There was moderate crop injury encountered as the rate of Metribuzin was increased to 2.24 kg ai/ha (table 2). However, only slight crop injury was noted when Metribuzin was applied at 1.12 kg ai/ha. This observed injury was outgrown and no longer visible at the time of harvest. Slight crop injuries were also apparent when Metribuzin at 1.12 kg ai/ha was mixed with Alachor, Chloramben or Diphenamid. Again, the injury symptoms disappeared completely after 3 months. Metribuzin at 1.12 kg ai/ha ranked second in enhancing tuber production. With Chloramben at 4.48 kg ai/ha plus Alachor 3.36 kg ai/ha the third highest yield was obtained. All mixtures containing Metribuzin at 1.12 kg ai/ha rate contributed to good tuber yields. With Diphenamid alone at 11.2 kg ai/ha yields were low.

Differential phytotoxic response of the Miguela cultivar to Metribuzin at the two substations could be attributed to the difference in edaphic conditions. The Coto clay of Isabela contained a considerably higher clay and organic matter content than the San Antón sandy loam of Fortuna. In a previous adsorption study of herbicides, one of the authors (5) found that adsorption of Metribuzin was positively correlated with organic matter and clay content. Thus Metribuzin would be adsorbed in a greater quantity by Coto clay than by San Antón sandy loam. Consequently, the risk of Metribuzin injury to sweet potatoes is greater at Fortuna than at Isabela. Phytotoxicity evaluations on differential sweet potato injury at the two localities confirmed this expectation. Using pigeon peas (*Cajanus cajan* (L.) Huth) as a test species, one of the authors (6) demonstrated under greenhouse conditions, that Metribuzin at the recommended rate of 1.12 kg ai/ha was more phytotoxic to pigeon peas in San Antón loam than in Coto clay. It is believed that the same phytotoxicity relationship holds for sweet potatoes.

On the basis of this investigation, we would assume that sweet potato plants are tolerant to Metribuzin up to 2.24 kg ai/ha in heavier clay soils. However, the safety margin of Metribuzin is greatly reduced in light-textured soils. Porter (8) reported that in Louisiana 0.56 kg ai/ha rate of Metribuzin provided good weed control in sweet potatoes.

TABLE 2.—*Effect of herbicide treatments on weed control, phytotoxicity, and tuber yield of sweet potatoes at the Fortuna Substation, October 1980*

Treatment	kg ai/ha	Weed control ratings at 8 weeks[1] Broadleaf	Grasses	Average	Phyto-toxicity[2]	Tuber yield[3]
		%	%	%	%	*kg/ha*
Diphenamid	11.2	33	54	44	0	26,162 b
Chloramben	4.48	31	33	32	0	27,850 ab
Alachor	3.36	25	69	47	0	24,382 b
Alachor	6.73	38	80	59	5	28,501 ab
Metribuzin	1.12	81	75	78	4	39,232 a
Metribuzin	2.24	88	80	84	26	23,263 bc
Diphenamid + Chloramben	11.2 + 4.48	54	55	55	0	29,437 ab
Diphenamid + Alachor	11.2 + 3.36	45	69	57	0	28,704ab
Diphenamid + Metribuzin	11.2 + 1.12	83	68	76	11	33,312 ab
Chloramben + Alachor	4.48 + 3.36	59	71	65	0	35,886 ab
Chloramben + Metribuzin	4.48 + 1.12	85	74	80	6	35,540 ab
Alachor + Metribuzin	3.36 + 1.12	90	88	89	6	40,006 a
Handweeded check		90	90	90	0	23,812 bc
Nonweeded check		0	0	0	0	12,430 c

[1] Weed control ratings are based on a scale of 0–100: 0 = no control; 100 = complete control.

[2] Phytotoxicity evaluations are based on a scale of 0–100: 0 = no stand reduction; 100 = complete stand reduction.

[3] Tuber yield is the average of four replications. Values followed by one or more letters in common do not differ statistically (P = 0.05).

RESUMEN

Dos experimentos con herbicidas se realizaron en las Subestaciones de Isabela y Fortuna de la Universidad de Puerto Rico para evaluar el grado de control de malezas proporcionado por Alachor, Metribuzin y sus mezclas en el control químico de yerbajos en batatas de la variedad Miguela. Metribuzin a razón de 1.12 kg ai/ha controló eficazmente tanto yerbajos de hoja ancha como gramíneas. Alachor requirió una dosis mínima de 6.73 kg ai/ha para ser eficaz en el control de los yerbajos. Metribuzin a razón de 1.12 kg ai/ha en combinación con Alachor a razón de 3.36 kg ai/ha fue más eficaz para el control de los yerbajos de hoja ancha y gamíneas. No hubo síntomas de daño en la plantas como consecuencia de los herbicidas en la Subestación de Isabela, pero sí los hubo moderadamente en la Subestación de Fortuna como consecuencia de Metribuzin a razón de 2.24 kg ai/ha. Con la mezcla de Metribuzin a razón de 1.12 kg ai/ha y Alachor a razón de 3.36 kg ai/ha se logró el rendimiento más alto de batatas en ambas Subestaciones. Con Metribuzin a razón de 1.12 kg ai/ha solo o en combinación con cualquiera de los otros herbicidas se lograron buenos rendimientos. Con los herbicidas registrados, Diphenamid y Chloramben, los rendimientos fueron bajos.

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