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GLYPHOSATE FOR WEED CONTROL IN CASSAVA

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ABSTRACT

Two herbicide field experiments were conducted in 1980 at the Corozal and Isabela Agricultural Substations to evaluate Glyphosate /N-(phosphonomethyl) glycine/ at 1.0, 2.0 and 4.0% applied either as pre-plant or pre-plant plus post-emergence directed spray for weed control in cassava. Both experiments were carried out on small plots (4.9 x 6.1 m) arranged in a randomized complete block design with four replications. Weed control ratings and phytotoxicity evaluations were made periodically. The edible tubers of cassava were harvested and yield data analyzed statistically.

Two applications of Glyphosate (pre-plant plus post-emergence) provided better sustained weed control than a single pre-plant application at both substations. However, two applications of Glyphosate had caused greater crop injury than a single application. Consequently, when plots received two applications, they did not outyield plots with only a single one. Among the different concentration of Glyphosate tested, it is indicated that Glyphosate at 1% applied either pre-plant or post-emergence is sufficiently high enough for controlling major weeds encountered in the experimental plots. Tuber yield of cassava was not significantly increased with higher rates of Glyphosate application.

INTRODUCTION

Although cassava (*Manihot esculenta* Crantz) is not a major root crop in Puerto Rico, it is highly relished by local people as a carbohydrate diet. In 1979-80, 3,243,240 kg of cassava were produced with a farm value of $920,000 dollars (Anonymous 1980). One of the major constraints limiting cassava production has been the high and rising cost of labor needed to combat weeds. Chemical weed control offers a viable alternative to alleviate scarce and undependable labor supply and contributes greatly toward increasing cassava production.

There are a few pre-emergence herbicides with marginal selectivity for controlling weeds in cassava. Atrazine or Diuron at 1.8 to 3.5 kg/ha was recommended for weed control in the Caribbean (Kassasian and Seeyave 1968). Crop injury has encountered in these herbicides at or above 2 kg/ha

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(Patel 1971, Anonymous 1972). Fluometuron has been used safely for pre-emergence weed control in cassava in South America (Anonymous 1972, Barrios 1973), but it encountered phytotoxicity problem in Nigeria (Anonymous 1974). In Colombia, Doll et al. (1976) established the selectivity of 37 pre-emergence and pre-plant incorporated herbicides in cassava. Those herbicides classified as highly selective were not necessarily the ones giving adequate weed control. Oxyfluorfen and Oxadiazon have been reported to provide excellent weed control in cassava, however, crop injury was noted when both herbicides were used at rates higher than recommended one (Anonymous 1978). Because of the marginal selectivity of cassava to most pre-emergence herbicides mentioned above, the search for a new herbicide with modified timing of herbicide application merits special attention. The present study was thus carried out in an attempt to determine the feasibility of applying Glyphosate as a pre-plant or pre-plant plus post-emergence applications for weed control in cassava.

MATERIALS AND METHODS

Cassava field experiment no. 1

This experiment was established on a Coto clay (Oxisol, with soil pH 5.9, and organic matter 2.1%) at the Isabela Substation located in the northwestern part of the Island. A randomized complete block design with four replications was used. The planting distance was 0.6 m within the row. The field was ploughed and prepared in mid April to allow sufficient time for weeds to become established. The pre-plant application of Glyphosate at 1.0, 2.0 and 4.0% was made May 23, 1980. A knapsack sprayer was used to apply herbicide at a spray volume of 468 l/ha. Cassava cultivar Chilena, a fast growing variety with large canopy, was planted in two-nodes cuttings two weeks after herbicide application. The post-emergence application of Glyphosate at 1.0, 2.0 and 4.0% was performed July 23, 1980 to only half number of plots which received a pre-plant application of Glyphosate at 1%. Fertilization and pesticide managements followed the standard practice for the region. Periodic evaluations were made on the effectiveness of individual herbicide treatments and apparent crop injury on cassava using a scale of 0 to 100. A detailed description of this scale can be found at the footnote of each table. The edible tubers were classified as marketable or non-marketable at harvest time (June 9, 1981). Only the marketable tuber yield were analyzed statistically.

Cassave field experiment no. 2

This experiment was established on a Corozal clay (Ultisol with soil pH 5.0, organic matter 2.8%) at the Corozal Substation located in the northcentral mountain region. The same randomized complete block with four replications was used. The field was similarly ploughed and prepared as in the previous experiment. The same size of plot and planting distance were adopted. The pre-plant application of Glyphosate

at 1.0, 2.0 and 4.0% was made March 7, 1980. Cassava cultivar Llanera, a slow growing variety with small canopy, was similarly planted on March 11, 1980. The post-emergence application of Glyphosate at 1.0, 2.0 and 4.0% was made May 20, 1980. Weed control ratings and phytotoxicity evaluations were made periodically. The edible tubers were harvested November 25, 1980.

RESULTS AND DISCUSSION

Cassava experiment no. 1

The predominant weed species present in the experimental plots are listed in their decreasing order of abundance; crabgrass (Digitaria sanguinalis (L.) Scop.), pigweed (Amaranthus dubius Mart.), spurge (Euphorbia heterophylla L.), morning glory (Ipomoea tiliacea (Willd.) Choisy), jungle rice (Echinochloa colonum (L.) Link), woodsorrel (Oxalis intermedia A. Rich.), goose grass (Eleucine indica (L.) Gaertn.), para grass (Brachiaria purpurescens (Raddi) Hnr.), and dayflower (Commelina diffusa Burm. f.). A single pre-plant application of Glyphosate at 1% gave excellent control of most above-mentioned weeds (table 1). Increasing Glyphosate concentration to 4% improved weed control only slightly. All pre-plant applications of Glyphosate regardless of its concentrations did not provide sustained weed control. Two applications of Glyphosate at 1% (pre-plant plus post-emergence application) gave better sustained weed control. This is particularly true with Glyphosate 1% as pre-plant treatment followed by Glyphosate at 4% as post-emergence treatment. No apparent crop injury was noted for plots receiving Glyphosate at 1 to 2% as pre-plant application. Glyphosate at 4% as a post-emergence did cause slight leaf chlorosis on some of cassava plants. The injury symptoms were later outgrown. Slight to moderate crop injury was noted for plots receiving two applications of Glyphosate. Apparently, the second application of Glyphosate was chiefly responsible for the observed injury. The weeded check produced the highest tuber yield among all the treatment. It was then followed by one application of Glyphosate at 2%, one application of Glyphosate at 1% and one application of Glyphosate at 4%. All plots receiving two applications of Glyphosate yielded considerably lower than a single application. It suggests that two applications of Glyphosate has no advantage over a single application.

Cassava experiment no. 2

The predominant weed species in the experiment plots are listed in their decreasing order of abundance: jungle rice (Echinochloa colonum (L.) Link.), woodsorrel (Oxalis intermedia A. Rich.), scarlet bean (Macroptilium lathyroides (L.), purslane (Portulaca oleracea L.), niruri (Phyllanthus niruri L.), spurge (Euphorbia heterophylla L.), pepper weed (Lepidium virginicum L.), purple nut-sedge (Cyperus rotundus L.), and red tassel flower (Emilia sonchifolia (L.) DC.). Pre-plant application of Glyphosate at 1 to 4% gave excellent control of most weeds mentioned above. However, new weeds reinfested the area after 2 months. Those

plots receiving a single pre-plant and post-emergence application of Glyphosate showed poor weed control at the second evaluation date. Those plots receiving both pre-plant and post-emergence of Glyphosate showed better sustained weed control. No crop injury was noted for all plots receiving a single pre-plant application of Glyphosate irrespective of its concentrations. While those plots receiving two applications of Glyphosate has resulted in moderate crop injury. The injury was again caused chiefly by the drift effect of Glyphosate occurred during the second application. The highest tuber yield of cassava was registered with plots receiving a pre-plant application of Glyphosate at 4%. Other pre-plant applications of Glyphosate at 1% and 2% ranked second and third in yield. Those plots receiving two applications of Glyphosate yielded poorly. The low yield of cassava was the direct result of crop injury suffered during the post-emergence application of Glyphosate. The higher the concentration of Glyphosate applied during the post-emergence, the lower the tuber yield recorded.

The findings from the two foregoing herbicide experiments indicate that with fast growing Chilena variety, the canopy of cassava plants would close in much quicker and make it a better competitor with weeds. In this case, what we need is a single preplant application of Glyphosate to get rid of the initial weed competition. However, for slow growing cultivar such as Llanera, a safe second application of Glyphosate seems needed. As most cassava cultivars are highly susceptible to the drift of Glyphosate, a rope wick or similar device could be used to avoid herbicide drift during the application process. Another approach is to delay the timing of second Glyphosate application. As the cassava plants grow old, the lignified stalks tend to become more resistant to Glyphosate drift.

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Table 1. Effect of different concentrations of Glyphosate on weed control, phytotoxicity, and yield of cassava, cultivar Chilena, at the Isabela Substation.

Herbicide treatments	Weed control[1]			Phytotoxicity[2]			Tuber yield[3] (kg/ha)
	6-10-80	8-19-80	Ave.	6-10-80	8-19-80	Ave.	
1. Glyphosate 1% (pre-plant)	95	39	67	0	0	0	24,441 a
2. " 2% "	97	45	71	0	0	0	24,454 a
3. " 4% "	100	51	76	10	10	10	23,223 ab
4. Glyphosate 1% (pre-plant) + Glyphosate 1% (postemergence)	95	95	95	0	20	10	22,120 ab
5. Glyphosate 1% (pre-plant) + Glyphosate 2% (postemergence)	94	99	97	0	28	14	18,534 ab
6. Glyphosate 1% (pre-plant) + Glyphosate 4% (postemergence)	95	100	98	0	49	25	17,155 b
7. Weeded check	90	95	93	0	0	0	24,757 a
8. Non-weeded check	0	0	0	0	0	0	16,650 b

1/ Weed control ratings are based on a scale of 0 to 100, where 0= no control, 100= complete control.

2/ Phytotoxicity evaluations are based on a scale of 0 to 100, where 0= no crop injury, 100= completely affected.

3/ Tuber yield is the average of four replications. Values followed by the same letter in the same column are not statistically different (P= 0.05).

Table 2. Effect of different concentrations of Glyphosate on weed control, phytotoxicity, and yield of cassava, cultivar Llanera, at the Corozal Substation.

Herbicide treatments	Weed control[1]			Phytotoxicity[2]			Tuber yield[3]
	4-7-80	6-3-80	Ave.	4-7-80	6-3-80	Ave.	(kg/ha)
1. Glyphosate 1% (pre-plant)	90	15	53	0	0	0	7,515 a
2. " 2% (")	93	18	56	0	0	0	7,400 a
3. " 4% (")	95	20	58	0	0	0	7,553 a
4. Glyphosate 1% (pre-plant) + Glyphosate (postemergence)	90	98	94	0	16	8	4,195 a
5. Glyphosate 1% (pre-plant) + Glyphosate 2% (postemergence)	91	100	96	0	28	14	2,441 b
6. Glyphosate 1% (pre-plant) + Glyphosate 4% (postemergence)	93	100	97	0	33	17	1,755 b
7. Weeded check	90	90	90	0	0	0	5,340 a

1/ Weed control ratings are based on a scale of 0 to 100, where 0= no control, 100= complete control.

2/ Phytotoxicity evaluations are based on a scale of 0 to 100, where 0= no crop injury, 100= completely affected.

3/ Tuber yield is the average of four replications. Values followed by the same letter in the same column are not statistically different (P= 0.05).