Preliminary Research on timing of weed control in Yams (Dioscorea rotundata Poir) and Taniers (Xanthosoma sp.)

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ABSTRACT

Preliminary experiments on effects of weed competition at various stages of growth were conducted on yams (Dioscorea rotundata Poir) and taniers (Xanthosoma sp.) at Corozal, in the central hill lands of Puerto Rico. In yams, no response resulted for hand weeding conducted for more than 2.5 months from planting. Weed competition during the first 2.5 months of crop growth did not significantly decrease yields. Data suggests the critical period for maintaining yams weed free is between 2.5 and 4.0 months after planting.

Results of the tanier experiment indicate greater detrimental effect on yield when weed competition is allowed during the first 5.5 months from planting than when allowed only during the later part of the growing season. Highest yields were obtained from hand weeding for 5.5 months or more. However, no significant differences in yield were recorded from weeding throughout the growing season, hand weeding only during the initial 2.5 months of crop growth, and allowing weed competition only during the initial 2.5 months from planting.

The findings in both experiments are preliminary. Additional experiments with both crops are being conducted. Concrete recommendations will be made once the research is completed.

Introduction

Yams are the most important root and tuber crop grown in Puerto Rico. The island's production, worth $8 million at the farm level during 1980-81, amounted to 14,560 m (Puerto Rico's Dept. Agric., 1981). Price per kg was 55 cents and annual per capita consumption was 4 kg. The amount represents 78% of the per capita consumption during 1955-56.

Taniers are Puerto Rico's second most important root and tuber crop (Dept. Agric., 1981). Worth $ 5.5 million at the farm level during 1980-81, production was 11,113 m with a price per kg of 50 cents. The per capita consumption per year was 6 kg. This amount represents 67% of the per capita consumption during 1955-56.

Yams and taniers are grown mainly in the humid hills of central Puerto Rico. The size of plantings ranges from less than 0.8 to 1.2 ha (González-Villafañe et al, 1980). Mechanization has not been possible because of sloping nature of the land, moist condition of the soil during most of the year, and high costs of machinery for small farm units. Weeds thrive in warm humid conditions under which the crops are grown (Kasasian 1967; Orsenigo 1970; Pacheco et al, 1973). The long growing season of 7 to 10 months for yams and 9 to 12 months for tainers increases the weed competition problem (Doll and Piedrahita, 1976; Kay, 1973; Montaldo, 1972). Use of herbicides in these crops is not permitted in Puerto Rico, because none have been registered with the government. Hand weeding is the only alternative available at present for weed control. However, hand labor is scarce and expensive.

Topography of the terrain and high rainfall in the central mountain region of the island results in soil erosion where protective ground cover is not available. Hand weeding accounts for 27% of the production costs of yams (González-Villafañe and Espinet, 1980). Weeds, although detrimental for crop production, serve as ground cover and prevent erosion. Therefore, it would be desirable to determine the stage(s) of crop growth cycle when weeds have an adverse effect on its production (Kasasian and Seeyave, 1969). If weeds are controlled only at stages when they are detrimental, the cost of production could be lessened and soil erosion reduced. This study is objective to determine growth stages of yam and tanier in which weed competition has a detrimental effect on yield.

Materials and Methods

A timing-of-weed-control experiment on white-fleshed yam (Dioscorea rotundata Poir) cultivar Guinea Negro began at the Agricultural Experiment Substation in Corozal, July 29, 1981. Corozal is in the central hilly region of Puerto Rico at 200 m elevation. The average minimum and maximum temperatures are 19° and 30°C, respectively. The annual average temperature is 25°C with a mean monthly variation of 5°C. The mean annual rainfall is 1,650 mm. The soil is a Corozal clay which is a clayey, mixed isohyperthermic, Aquic Tropudults derived from early tertiary volcanic conglomerates. It has a fine, subangular, very strong blocky structure; the predominant clay minerals are kaolinite and vermiculite.

The soil pH range at planting was 5.0 to 5.4. Soil had been limed at the rate of 2.24 mt/ha 2.5 months before planting. It was limed again 4 weeks after planting with 2.0 mt/ha. The organic matter content at the top 30 cm of the soil ranged from 2.2% to 3.2%. Phosphorus ranged from 0 to 2 ppm (Bray I method), potassium from 178 to 393 ppm, calcium from 1,538 to 1,929, and magnesium from 103 to 149 ppm. Soil texture was 23% sand, 48% clay and 29% silt. Fertilizer was applied twice, at 1 month and at 3 months after planting. A total of 180 ks/ha N, 78 kg/ha P, 300 kg/ha K, and 60 kg/ha Mg were applied. The 8-8-12 analysis applied is the standard fertilizer used for root and tuber crops in Puerto Rico. Sulpo-mag (18.3% K and 10.8% Mg) was the source of Mg and of one-third of the K utilized.

Cut yam tubers were immediately dipped for 15 minutes in a solution of 10 ml of thiabendazole and 10 ml of oxamyl per liter of water. After applying fungicide and nematicide dip, seed pieces were spread in a shaded area and allowed to dry and suberize for 3 days prior to planting.

Seed pieces weighting 112 to 128 g were planted on top of the beds. They were completely covered with soil. Beds were spaced 1.5 m apart and tuber sec-

tions were spaced 30 cm within the row. Each experimental plot included 4 rows 4.6 m long. There were 60 plants per plot. The experimental design followed a partially balanced incomplete block arrangement with 10 treatments replicated 5 times.

A month after planting, yam vines were tied to a wire 1.5 m over the ground level. Aldicarb was applied to the soil at 0.22 g a.i. per m of bed length. Applications of oxamyl and methomyl were made to the foliage in the later part of the season for further control of nematodes and insects.

Treatments included hand weeding for 2.5, 4.0, 5.0, 6.5, or 7.5 months and then allowing weed growth for the remainder of the growing season. In another set of treatments, weeds were allowed to compete for 2.5, 4.0, 5.0, 6.5, or 7.5 months from planting, and from then on the plots were hand weeded until harvest.

The experiment was harvested May 13, 1982, 9.5 months after planting.

A timing-of-weed-control experiment on tanier (Xanthosoma sp.) cv. Alers was planted at the Corozal Experiment Substation August 27, 1981. The experiment had the same climatic and edaphic conditions as the one for yams as it was planted in the adjoining field.

Planting material was prepared by taking the main corm, cutting and discarding its distal and proximal ends, and cutting the remainder into 94 g sections. The seed pieces received the same fungicide and nematicide treatments as the yam sections.

Seed pieces were planted on top of the bed and completely covered. Planting distance was 91 cm between the beds and 46 cm within the row. Each plot comprised 4 beds 6.4 m long. There were 12 treatments replicated 5 times in a partially balanced incomplete block design. All the treatments in the yam experiment were included in the tanier experiment. Two additional treatments, hand weeded for the first 9 months, and weed competition for the same period of crop growth, were included in the tanier experiment.

The predominant weed species in both experiments were guinea grass (Panicum maximum Jacq.), crabgrass (Digitaria sanguinalis (L.) Scop.), caesarweed (Urena lobata L.), goosegrass (Eleusine indica), spurge (Euphorbia heterophylla L.), jungle rice (Echinochloa colonum (L.) Link), bermuda grass (Cynodon dactylon (L.) Pers.), spreading dayflower (Commelina diffusa), and cundeamor (Momordica charantia L.). Other weed species in the experimental area included purple nutsedge (Cyperus rotundus L.), sensitive plant (Mimosa pudica L.), southern sida (Sida acuta Burn.f.), Phaseolus lathyroides, Emilia sonchifolia, pigweed (Amaranthus dibius Mart.), and oxalis (Oxalis martiana).

Results and Discussion

In the yams experiment, treatments in which weeds were allowed to compete with the crop during the first 4 months or more from planting yielded significantly less than when weed competition was allowed only during the first 2.5 months from planting, or than any of the other treatments (Table 1). This indicated that weed control must begin during the first 4 months after planting to prevent a yield loss. Significant differences were noted between treatments where weeds competed for the first 4 months, and where they competed for 6.5 or more months. Thus, results show that even if the fields have not been weeded for the

first 4 months, a benefit still results from hand weeding if done no later than 4 months after planting (Table 1).

Table 1. Total yield of white-fleshed yam (Dioscorea rotundata cv. Guinea Negro) at Corozal, Puerto Rico, 1981-82.

	Treatment	Yield[1]
		m/ha
1	Hand weeded for 2.5 months, free weed growth thereafter	18.507 a
2	" " " 4.0 " " " " " " " "	20.621 a
3	" " " 5.0 " " " " " " " "	23.750 a
4	" " " 6.5 " " " " " " " "	22.865 a
5	" " " 7.5 " " " " " " " "	20.978 a
6	Weed competition for 2.5 months, hand weeding thereafter	21.239 a
7	" " " " 4.0 " " " " " " " "	13.205 b
8	" " " " 5.0 " " " " " " " "	7.155 bc
9	" " " " 6.5 " " " " " " " "	5.870 c
10	" " " " 7.5 " " " " " " " "	6.033 c
	C.V. = 16.19%	

[1]Means followed by one or more letters in common do not differ significantly at the 5% level of probability.

No statistical differences in yield were found for hand weeding only the first 2.5 months (then allowing weed competition), and hand weeding during the whole season. However, yields tended to be lower when hand weeding was done the first 2.5 months, than where plots were weeded for 4 or more months. Results indicate that if the crop is kept weed free during the first 4 months of growth, allowing weed competition thereafter does not affect yield. Statistically, there was no advantage for hand weeding the yam fields for more than 2.5 months from planting.

The results of this experiment are not conclusive. The experiment should be repeated in different locations, but always taking into account the predominant weed species in the yam growing region. However, the experimental data indicates that the critical period for hand weeding is 2.5 months from planting. There was no statistical differences between plots which were weed free at 2.5 months and those hand weeded year long. At the same time, there was no difference in yield between plots in which weed competition was allowed during the first 2.5 months and then hand weeded for the rest of the season and those where hand weeding was done during the whole season. Thus it appears weeds do not adversely affect yield during the first 2.5 months of crop growth. Yams, therefore, should be kept weed free in the period from 2.5 months to 4 month after planting.

In the experiment with taniers, no statistically sifnificant differences were found between the treatments where weeds were controlled year around and where they were controlled for only the first 2.5 or more months from planting (Table 2). However, yields tended to be lower where hand weeding was done only to 4 months from planting vs. where weeds were controlled for a longer time. The tendency indicates that weeds may have a detrimental effect on tanier yield if they are controlled only for less than 4 months from planting.

Plots in which weeds were controlled for 5.5 months or more from planting yielded more than plots in which weeds were allowed to grow during the first 5.5 months or more and weeded thereafter (Table 2). The data clearly supports the hypothesis that weed competition has a greater effect on yield in the early stages of crop growth than during the later stages. Although no statistically significant differences were found between the treatments where weeds were controlled throughout the year and where weed competition was allowed for up to 4 months from planting, there was a tendency for the yield to be lower in all treatments in which initial weed growth was allowed.

Table 2. Total yield of taniers (Xanthosoma sp.) cv. Alers at Corozal, Puerto Rico, 1981-82.

	Treatment	Yield[1]
		m/ha
1	Hand weeding for 2.5 months, no weed control thereafter	6.521 abc
2	" " " 4.0 " " " " " " "	6.273 abc
3	" " " 5.5 " " " " " " "	8.273 ab
4	" " " 7.5 " " " " " " "	8.489 a
5	" " " 9.0 " " " " " " "	8.444 ab
6	" " " season long	7.651 abc
7	Weed competition for 2.5 months, hand weeding thereafter	5.847 abc
8	" " " " 4.0 " " " " " " "	5.469 bcd
9	" " " " 5.5 " " " " " " "	4.556 cde
10	" " " " 7.5 " " " " " " "	1.726 de
11	" " " " 9.0 " " " " " " "	2.533 e
12	" " " " season long	2.094 e
	C.V. = 34.77	

[1]Means followed by one or more letters in common do not differ significantly at the 5% level of probability.

Yield of taniers in the treatment in which weed competition was allowed only for the first 2.5 months from planting were significantly higher than in treatment in which weed competition was allowed for the first 7.5 months. The results indicate that cormel yield can be increased by hand weeding at 4.0 months from planting, even when initial damage from competition has already been done.

No differences in cormel yield were found between the treatments where weed competition was allowed during the first 5.5 months of crop growth and where weed competition was allowed the year around. However, yields did tend to be higher where weed competition was allowed during the first 5.5 months than where they were allowed for longer periods. The data indicate a substantial decrease in yield when weed competition is allowed for more than 4 months from planting. However, a tendency exists for yields to continue decreasing if weed competition is allowed to continue from 5.5 to 7.5 months or more after planting (Table 2).

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