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Yield of cocoyam cultivars propagated by the single bud method¹

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ABSTRACT

Experiments were conducted at the Isabela agricultural substation to determine the performance of several cocoyam cultivars with seed material obtained by the single bud propagation method. Twenty-two cultivars representing the three major groups of cultivated cocoyams were tested. In 1986 the best cultivars produced marketable cormel yields exceeding 9,900 kg/ha. Among the best cultivars were Alela and Viequera, two white varieties. In 1987 yields were similar to those of the previous year; varieties Alela and Vinola, a purple-fleshed cultivar, were the most outstanding. Yields of mother corms were also obtained both years in order to obtain an estimate of the harvest index (weight ratio of cormel to corm) for the different cultivars. Only cultivar Alela had a harvest index greater than unity, which is the expected minimum for an outstanding variety. Observations on the incidence of symptoms of mal seco (dry rot) showed that some cultivars were partly resistant to the disease. However, none was superior to Palma, an almost wild cultivar that does not produce cormels.

RESUMEN

Rendimiento de cultivares de yautía propagados por el método de una sola yema

En la subestación de Isabela se establecieron experimentos para determinar el rendimiento de variedades de yautía propagadas mediante la técnica de una sola yema. Se probaron 21 variedades, las cuales representaban las tres especies principales de yautías. En la cosecha de 1986 las mejores variedades produjeron más de 9,900 kg./ha. Las mejores variedades fueron Alela y Viequera, dos variedades blancas. En la cosecha de 1987 los resultados fueron similares a los del año anterior, pero las variedades Alela y Vinola, una variedad lila, fueron las más sobresalientes. Durante ambas cosechas se obtuvieron también datos de rendimiento del corno principal para obtener estimados del índice de cosecha, parámetro que relaciona el peso del corno y los cormelos. Solamente la cultivar Alela tuvo un índice de cosecha de más de 1, el índice mínimo esperado de una

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variedad superior. Observaciones sobre la incidencia de síntomas del mal seco demostraron que algunas variedades son parcialmente resistentes a esta enfermedad. Sin embargo, ninguna de las variedades comerciales fue superior a Palma, una variedad semisilvestre que no produce cormelos.

INTRODUCTION

Cocoyam (*Xanthosoma* spp) is still one of the most important root crops grown in Puerto Rico. In 1988 total production was estimated at 5,000,000 kg with a farm value of approximately \$3.12 million (4). One of the most important factors limiting commercial production of cocoyam in Puerto Rico is the "mal seco" (dry rot disease), a condition for which no successful field control methods are known. Recently Cedeño-Maldonado and Bosque-Vega (3) developed a technique for obtaining seed material free of inoculum of possible causal organisms of this disease. The technique, which permits rapid multiplication of cocoyam, offers the opportunity of growing the crop free of the disease under field conditions when complemented with adequate cultural practices. Following excellent preliminary results, the present study deals with the yield performance of all the varieties present in the local *Xanthosoma* collection to determine whether the technique is useful with all varieties and to determine yields with disease-free plant materials.

MATERIALS AND METHODS

The experiments were conducted in 1986 and 1987 at the Isabela substation. The 1986 experiment was planted in May and harvested in April 1987. The 1987 experiment was planted in June and harvested in May 1988. The soil type of the planting site was a Coto clay, an Oxisol.

Seed material consisting of mother corms was obtained from the variety collection established at the substation. Planting material was prepared according to the technique of Cedeño-Maldonado and Bosque-Vega (3) and planted in standard 2-inch diameter 48-hole flats filled with Osmocote. Plants were transplanted to the field after 60 days in the nursery.

The planting material was established in the field with a row and plant distance of 0.9 x 0.6 meter, respectively. Plants were set in the bottom of the furrow to permit better utilization of moisture.

The experimental layout consisted of randomized complete blocks with four replications. A replication had one row of 10 plants. Data were collected from all plants in the row. There were 40 experimental plants of each of the 22 varieties included in the experiment during each of the 2 crop years. Cultural practices included the application of a complete fertilizer 12-6-16 with minor elements at a rate of 150 g per plant divided in three applications at 30, 60 and 120 days after planting. Plants were irrigated by overhead sprinklers every 10 days if necessary. Weeds were controlled by applications of glyphosate herbicide supplemented by hand weeding. Plants were evaluated periodically for symptoms of "mal seco" and other diseases. Harvesting was by hand.

RESULTS AND DISCUSSION

Table 1 presents a list of the cultivars included in the study. All 22 varieties in the local collection were included. Alela is the standard variety in Puerto Rico; South Dade White is the standard variety in Florida. Varieties Choubotton, Charanelle, Dearies and Barbados have been extensively tested in Puerto Rico and elsewhere (5,6). Variety Palma, which does not produce cormels, was included with the purpose of evaluating its field performance because it is very resistant to the mal seco. The three cultivated species of cocoyam, *Xanthosoma caracu*, *X. violaceum*, and *X. atrovirens* were represented with at least one cultivar in the experiments.

Table 1 also shows marketable yield data for the 1986 and 1987 experiments. Only cormels exceeding 7.6 cm in length and 5 cm in diameter and weighing over 180 g were considered marketable. In 1986, eight cultivars produced marketable yields exceeding 9,900 kg/ha, a production considered adequate in terms of economic return. The best cultivar was Alela, which outyielded the second best, Viequera, by more than 2,500 kg. Other outstanding cultivares were Charanelle, Vinola, Blanca Española, Dearies and Blanca del País.

TABLE 1.—Marketable yields and incidence of mal seco disease of cocoyam cultivars from plants obtained by the single bud technique

Variety	1986		1987	
	Kg/ha	No. plants infected	Kg/ha	No. plants infected
Alela	23360a ¹	1.75 d	13400 ab	8.90 ab
Vinola	15772 abcd	2.00 c	14178 a	7.73 ab
Kelly	3194 fgh	2.00 c	2666 efg	5.73 ab
Choubotton	11381 bcdef	4.75 a	12595 ab	8.40 ab
Charanelle	18766 abc	4.25 a	11772 abc	8.40 ab
Blanca española	14575 bcde	5.00 a	11612 abc	7.3a ab
Morada	—	—	11506 abc	5.73 abc
Barbados	7388 defgh	4.50 a	10828 abcd	4.14 bed
Blanca dominicana	4992 fgh	5.00 a	10606 abed	8.73 ab
Viequera	19565 ab	3.75 a	10014 abed	8.06 ab
Dearies	11180 bcdefg	4.00 a	8305 abcde	4.77 bc
Blanca del País	10381 cdefg	4.25 a	7075 bedef	6.40 abc
Rascana	4391 fgh	5.00 a	6389 bedef	7.73 ab
Híbrido 1481	4792 fgh	3.25 b	4902 defg	7.06 ab
F ₃ VXX#1	4591 fgh	3.75 a	6134 cdefg	10.16 a
Aguadillana	0 h	5.00 a	2875 efg	4.73 bc
Bisley	0 h	5.00 a	2827 efg	3.73 bed
Dominicana	2196 fgh	4.00 a	19.6 fg	8.73 ab
Amarilla del País	0 h	4.25 a	0 g	10.06 a
Inglesa	1997	1.25 d	0 g	6.73 abc
South Dade White	5196 efg	5.00 a	8147 abcde	0.06 d
Palma	0	0 e	0 g	0 d

Table 2 compares present results with previous published results on yield. Cultivar Alela stands out as the highest yielding cultivar, with more than 2200 kg/ha over the second highest yielding cultivar. Average yields for 1986-87 obtained with the single bud technique compare favorably with yield obtained by using seed pieces (1,6). The highest yield obtained in the present report was that of Alela in 1986, with a total marketable production of 23,360 kg/ha (table 1) and a total yield (marketable and non-marketable) of 24,156 kg/ha (table 3), a figure approaching the yield limits under commercial conditions of production as estimated by Barrett (2).

In 1987 a total of 12 cultivars produced yields exceeding 9,900 kg/ha. Alela and Vinola, with more than 13,200 kg/ha each, were the best yielding varieties. Cultivars Charanelle, Blanca Española, Viequera, Choubotton, Barbados and Blanca Dominicana also produced acceptable yields.

Tables 3 and 4 present total yield of cormels (marketable and non-marketable) and yield of main corms. They also indicate the ratio of cormel to corm weight, or harvest index, for the 1986 and 1989 experiments. Total yield pattern followed the same trend as marketable yield.

TABLE 2.—Comparative marketable yield data in kg/ha of several cocoyam cultivars as reported in the literature

Variety	Cedeño-Bosque ¹	Abruña ⁷	Irizarry et al ⁷
Alela	18379	—	—
Vinola	14969	—	13200
Kelly	2900	5100	14599
Choubotton	12188	8397	14898
Charanelle	15268	7799	13299
Blanca española	13092	—	—
Morada	11506	14199	12698
Barbados	9108	8699	10498
Blanca dominicana	7799	—	—
Viequera	14788	13897	14100
Dearies	9742	12498	14799
Blanca del País	8727	—	—
Rascana	14300	12899	5390
Híbrido/481	4847	—	—
F ₃ VxK#1	5361	—	—
Aguadillana	2875	—	—
Bisley	2827	11700	11400
Dominicana	2055	3599	—
Amarilla del País	—	—	—
Inglesa	1995	11700	11099
South Dade White	6967	—	—

¹Average of crop years 1986 and 1987.

TABLE 3.—*Total yield and harvest index for cocoyam cultivars obtained during the 1986 crop year*

Variety	Corms kg/ha	Cormels kg/ha	Harvest index
Alela	18528 ab ¹	24156 a	1.342 a
Vinola	19166 a	18368 abc	0.977 a
Kelly	11378 abcde	7586 bcde	0.599 ab
Choubotton	11979 abcde	14175 abcde	0.757 a
Charanelle	18766 ab	22161 ab	1.163 a
Blanca española	11779 abcde	17967 abc	1.591 a
Morada	—	—	—
Barbados	8184 cdefg	6787 bcde	0.425 ab
Blanca dominicana	6787 cdefg	7187 bcde	1.053 a
Viequera	8034 abcde	22161 ab	1.664 a
Dearies	8785 cdefg	14175 abcde	2.041 a
Blanca del País	14757 abc	16370 abcd	1.218 a
Rascana	5390 efg	8983 abcde	1.757 a
Híbrido/481	10780 bcdef	6876 bcde	0.443 ab
F ₃ VxK#1	6189 defg	6987 bcde	1.127 a
Aguadillana	2794 fg	598 e	0.340 abc
Bisley	1995 g	1857 abc	0.451 ab
Dominicana	9182 cdefg	4803 cde	0.645 ab
Amarilla del país	7388 cdefg	2396 de	0.196 c
Inglesa	10780 bcdef	3793 cde	0.291 bc
South Dade White	11979 abcde	11579 abcde	0.933 a

Weight of main corm is included to provide information about total biomass yields because this parameter is also important inasmuch as the corms are useful as animal feed. In 1986 Alela, Vinola and Charanelle were superior in terms of corm weight. In 1987 hybrid/481 had the highest corm yield, but all cultivars produced better corm yields than in 1986. Cultivar Palma, which is commercially planted for its corms, produced the lowest yield; this finding could be attributed in part to the fact that it is a perennial variety which requires more than 1 year to develop fully.

Harvest index values, which indicate the partitioning of reserves between the edible and inedible parts of the plant, and relate to efficiency of use of photoassimilates, were discouraging in terms of the variability obtained during the 2 successive crop years. Ideally, a good variety should have a harvest index with a value greater than 1.0, but in our experiments only cultivar Alela belongs in that category. Symptoms of *mal seco*, more prevalent during the second year, could have been responsible for the low values obtained. In 1986, in addition to Alela, eight other varieties had a harvest index greater than unity. The data of Ab-ruña et al. (1) indicate that of 12 varieties tested 11 had cormel to corm ratios greater than 1. Inclusion of harvest index data in future studies merits consideration, and breeding studies to select for this trait should be encouraged.

TABLE 4.—*Total yield and harvest index for cocoyam cultivars obtained during the 1987 crop year*

Variety	Corms kg/ha	Cormels kg/ha	Harvest index
Alela	27119 bcde	16227 ab	1.004 a
Vinola	22328 bedef	16115 ab	0.698 a
Kelly	26545 bcde	3281 ef	0.100 bcd
Choubotton	23192 bedef	16436 a	0.702 a
Charanelle	20256 cdef	13816 abc	0.648 a
Blanca española	25428 bcde	14566 abc	0.558 a
Morada	29900 bcd	13655 abc	0.471 a
Barbados	35299 b	15074 abc	0.392 a
Blanca dominicana	24468 bcde	12553 abc	0.501 a
Viequera	24677 bcde	14359 abc	0.562 a
Dearies	25586 bcde	10892 abcd	0.398 ab
Blanca del País	16016 def	9119 abcde	0.794 a
Rascana	22759 bedef	11579 abcd	0.460 a
Hibrido/481	59814 a	7358 cde	0.090 a
F ₃ VxK#1	17921 def	9088 bcde	0.456 a
Aguadillana	18289 def	6065 def	0.279 abc
Bisley	33092 bc	6101 abc	0.140 abcd
Dominicana	23925 bcde	3865 ef	0.098 cd
Amarilla del país	1530 ef	0 f	—
Inglesa	29260 bcd	1261 f	0.098 bcd
South Dade White	26321 bcde	12367 abc	0.503 a
Palma	4995 f	0 f	—

Table 1 also presents data on visual evaluation of symptoms of mal seco disease. Nine months after planting, plants were observed for typical symptoms of the disease such as curling of the apical leaf, yellowing and death of the basal leaves and poor growth. More plants showed mal seco symptoms in 1987 than in the previous year. During both years some symptoms of the disease were observed in all cultivars except possibly cultivar Palma, which is very resistant or immune to the disease. The increase in the number of plants showing symptoms during the second year could have resulted from accidental contamination of the seed material. In 1986, cultivars Alela and Inglesa were statistically superior as to appearance of dry rot symptoms. Kelly and Vinola also showed only moderate symptoms. In 1987, only cultivars Inglesa, Bisley and Barbados looked similar to Palma; all other cultivars showed considerable symptoms of the mal seco.

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