Performance of Yellow-Fleshed Sweetpotato Cultivars at Two Locations in Puerto Rico[1]

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ABSTRACT

Yellow-fleshed sweetpotato cultivars were included in a series of trials conducted at the Isabela and the Fortuna Agricultural Substations from 1966–67 to 1972–73. At Isabela the soil is a Coto clay (Oxisol) and at Fortuna it is a San Antón silty clay (Mollisol). The cultivars were obtained from introductions, hybridization, and local collections. The experimental plots generally consisted of four rows 5.45 m (18.0 ft) long and 1.07 m (3.5 ft) apart. Cultivars Gem and R 59-36 yielded better at Isabela than at Fortuna. Cultivar L 963-3 was a heavy yielder at both locations. In general, Cobre yielded better at Isabela than at Fortuna.

At Isabela Gem yielded 34.4, 34.1, 36.6, 36.2 and 37.3 tons/ha during 1966–67, 1967–68, 1970–71, 1971–72 and 1972–73, respectively. Gem is a consistently high yielder; however, better yields (45.4 tons/ha) were obtained during 1971–72 at Fortuna. Cobre's best yield (32.7 tons/ha) was obtained at Fortuna in 1971–72. Cultivar L 963-3 yielded 29.4, 30.4, 37.9, and 24.9 tons/ha during 1967–68, 1970–71, 1971–72, and 1972–73, respectively, at Isabela. The best yields from cultivar R 59-36 (36.2 tons/ha) were obtained at Isabela during 1971–72.

Cultivars Gem, Cobre, and R 59-36 produced a sizable proportion of roots suitable for canning. A panel of experts concluded that cultivars Gem, Cobre, and R 59-36 peeled easily in a 10% NaOH solution at 214° to 216° F, that boiled sweetpotatoes were of acceptable quality, and that appearance and quality of the canned product was acceptable. Cultivar L 963-3 is more suitable for the fresh market than for canning. Gem had a high carotene content (13.20 mg/100 g).

INTRODUCTION

The relative importance in terms of acreage and crop value of yellow-fleshed sweetpotatoes (*Ipomoea batatas* (L.) Lam) has decreased.

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From the nutritional point of view, however, yellow-fleshed sweetpotatoes have a higher value than the white-fleshed types. According to Steinbaur and Kushman (3) they are good sources of energy, calcium, iron and other minerals, and of vitamins A and C. Typically, they produce around 1500 cal/kg in peeled roots. Haddock and Mirabal (1) found that yellow-fleshed sweetpotatoes were preferred by 47.7% of their interviewees in 1950, while the white-fleshed types were preferred by 43.1%. They concluded that the real problem with yellow-fleshed sweetpotatoes was not one of preference, but rather of limited supply.

Yellow-fleshed sweetpotatoes offer very good potential for industrial purposes. They can be canned and exported to the United States where they are much preferred over the white-fleshed types. Also, due to their high nutritive value, they should be recommended for local consumption.

In order to increase the supply, it is necessary to promote increases in the acreage devoted to this crop. The selection of high yielding, pure cultivars appears to be of utmost importance. The objective of a current research program is to find higher yielding, pure, yellow-fleshed sweetpotato cultivars with high nutritive value and with a wide range of adaptability to local conditions.

This program was initiated in the late 1940's when local and introduced cultivars were tested. During the first years the cultivars were very carefully screened for resistance to pests, yield potential, and agronomic characters. Outstanding selections from the screening tests were included in a series of formal, replicated field trials initiated in 1966-67.

MATERIALS AND METHODS

The experiments were conducted from 1966 to 1973 at the Isabela and Fortuna Agricultural Experiment Substations in northwestern and southern Puerto Rico, respectively. At Isabela the soil has been classified as Coto, a Tropeptic Haplorthox, clayey, kaolinitic isohyperthermic. It had a pH of around 4.8, and a CEC (NH_4OAc) of around 13.3 meq/100 g of dry soil in the topsoil. Sum of exchangeable bases was 5.0 meq/100 g in the topsoil and 1.8 meq in the subsoil. Aluminum ranged from 0.6 to 1.6 meq/100 g (2). At Fortuna the soil has been classified as San Antón silty clay, a Cumulic Haplustolls, fine loamy, mixed, nonacid, isohyperthermic. The pH approaches neutrality and CEC (NH_4OAc) ranges from around 29.37 meq/100 g in the topsoil to 29.94 meq in the subsoil.

The cultivars tested were obtained from a collection at the Isabela Substation and from introductions from other countries. Some were obtained through the courtesy of the Federal Experiment Station at Mayagüez (now the Mayagüez Institute of Tropical Agriculture). Preliminary field plantings for selection were made; and low yielding, off-shape

and disease-infested cultivars were discarded. The outstanding ones were kept for further trials. The experiments were usually started during the autumn months. During land preparation, Diazinon AG500[3] at the rate of 233.7 cm^3/1870 l of water per hectare (2 pt/100 gal/acre) was incorporated into the soil. The soil was plowed and disced twice. Rows were 1.07 m (3.5 ft) apart. The center of the row was mechanically opened leaving a small furrow where the vines were set. Vines 45.75 cm (18 in) long were planted. Enide 50W was applied as a preemergent herbicide at a rate of 13.45 kg/ha (12 lb/acre) immediately after planting. Plot size, experimental design, date of planting, number of replicates, and number of varieties tested in each trial were variable. Preventive insect control was followed by spraying with Diazinon AG500 at the rate of 1168 cm^3/957 l of water per hectare (1 pt/100 gal/acre) every 20 days. Fertilizer 6-6-12, at a rate of 1121 kg/ha (1000 lb/acre), was banded 2 weeks after planting. The rows were mechanically cultivated and the small areas alongside the vines were hand-hoed. Later, the ridge was mechanically raised. The two center rows of a four-row plot were harvested 5 months after planting. Either an Irish potato digger or a conventional plow were used to dig the crops. Sweetpotatoes were classified by passing them through a set of four sieves whose diameters varied from 6.35 to 2.54 cm (2.5 to 1.0 in). This classification gave an indication of the suitability of the crop for fresh market and canning purposes.

Most of the experiments were conducted simultaneously at the Isabela and the Fortuna Substations. The 1967–68, 1971–72, and 1972–73 screening tests included 18, 7, and 5 cultivars, respectively, at both sites. In 1970–71 when the experiments were conducted at the Isabela Substation only, nine cultivars were compared.

A batch of samples of fresh Gem, Cobre, R 59-36, and L 963-3 sweetpotatoes was sent to the Food Technology Laboratory for analysis and evaluation. The boiled and canned products were evaluated by a panel of tasters as to general appearance and quality. Each canned product was evaluated individually, and analyzed for Brix, reducing sugars, and carotene. A second batch was sent and evaluated both when boiled and after being canned. The same chemical analyses were made, except Brix.

The cultivars were not evaluated solely on yield performance. Due consideration was given to other factors such as nematode, insect, and disease resistance. Other important factors considered were growth habit, ease of propagation, plant vigor, ability of foliage to smother weeds

[3] Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico or an endorsement over other equipment or materials not mentioned.

quickly, and length, shape, flesh color, and cracking of roots. Observations were made at various intervals during the screening tests on the horticultural behavior of the cultivars. Some cultivars were not kept after the screening trials, and some were discarded during the formal replicated trials because of undesirable characteristics, even if they were good yielders. Due to the large and variable number of cultivars included in the replicated tests (from 5 to 49) and to the still larger number included in the previous screening tests, it was thought advisable to present data of only the four outstanding cultivars at each location throughout the 1966–73 formal testing period. The rank, based on yields plus the agronomic considerations previously mentioned, were determinant factors in the final selection of the outstanding cultivars.

RESULTS AND DISCUSSION

CULTIVAR DESCRIPTION

Gem, a cultivar with excellent marketing and processing qualities, was released by the North Carolina Agricultural Experiment Station in 1964. The vines are purplish green, trailing, and moderately long. Leaves are medium in size, deep green to purplish, with entire margins and a heart-shaped base. The leaf veins and petioles are purple. Foliage is moderately dense, providing a good cover for smothering weeds and protecting the soil. It propagates well, producing an abundance of sprouts. It is a high yielder with attractive roots which are uniform in shape, smooth, shortly tapered at both ends and often tend to be somewhat blocky in appearance. The skin is a light salmon and the flesh is a deep uniform orange or salmon color. The average set of roots per hill is good and the roots tend to size up evenly and early. Canning quality, as an average, has been good.

Cobre, also a cultivar with excellent marketing and processing qualities, was released by the U.P.R. Agricultural Experiment Station in the late 1950's. The vines are green, trailing, and long. The leaves are small to medium in size, green, with entire margins and with a heart-shaped base, purple veins, and green petioles which are purple at the base. The foliage is moderate to heavy, providing good cover for smothering weeds and protecting the soil. It propagates well. It is a moderate yielder with roots that are attractive, smooth, uniform, and spindle-shaped with a copper skin and a copper-salmon flesh. The roots tend to size up evenly and early.

L 963-3 is a cultivar suitable for the fresh market, introduced from Louisiana. It is a high yielder. The vines are purple, vigorous, intermediate in length. The leaves are large, green, with entire margins and a heart-shaped base. The petioles are purplish, ending in a purple base.

The foliage is thick, coarse, and provides good cover for smothering weeds and protecting the soil. It propagates well. The roots of L 963-3 are variable, spindle to globular, with a pink rugous skin and with a salmon-orange flesh.

R 59-36 is a cultivar that is also suitable for the fresh market and for canning. It is a self-pollinated seedling obtained from the Rico cultivar. The selection was done at this Station in 1959. It produces a large percentage of roots suitable for canning. The vines are light green, long and slender. The leaves are small to medium in size, smooth, light green, with entire margins and a heart-shaped base. The leaf veins are green with green pubescent petioles. The foliage is very thick, providing a good cover that smothers both broad-leaved weeds and grasses. It propagates well. It is a moderate yielder with attractive uniform, smooth, spindle-shaped roots with creamy skin and salmon flesh. The roots tend to size up early. Canning qualities are desirable.

YIELDS AT ISABELA

1966–67. Forty-nine sweetpotato cultivars, planted in October 1966, were harvested in March 1967. The experimental layout followed a triple lattice design with three replicates. Crop yields fluctuated between 27.0 tons/ha for Perla to 4.5 tons/ha for Blonda 39. Cultivar R 59-36 yielded 21.1% more than Cobre, the check cultivar. Cobre yielded 22.2 tons/ha, which was 8.5 tons/ha more than the yields obtained from L 963-3. UPR #3, which had been a commercial cultivar for a long time, yielded only 6.9 tons/ha. The extremely low yields obtained from UPR #3 in this crop and in previous ones probably can be attributed to the degeneration of this cultivar throughout the years.

1966–67. A second experiment with 14 cultivars was planted in October 1966 when vines of Gem, Nemagold, Taiwan 57, and Pellican Processor were obtained. The experiment was harvested 5 months later. The experimental layout followed a randomized block design with three replicates. Crop yields fluctuated from 34.1 tons/ha for Gem to 14.6 tons/ha for Nemagold. The Gem cultivar yielded 15.2% higher than Cobre, the check cultivar. Cultivars Taiwan 57 and Pellican Processor yielded 30.2 and 29.6 tons/ha, respectively. This was 1.0 and 0.4 ton/ha more, respectively, than the yield from Cobre.

1967–68. Eighteen cultivars, planted in October 1967, were harvested in March 1968. The experimental layout followed a randomized block design with four replicates. Crop yields ranged from 34.1 tons/ha for Gem to 13.0 tons/ha for R 58-18. Gem outyielded L 963-3 and R 59-36 by 4.7 and 10.1 tons/ha, respectively. Gem, L 963-3, and R 59-36 yielded 69.5, 46.0, and 19.3% more, respectively, than Cobre. There were no significant differences between means of Gem and L 963-3. Mean yields of L

963-3 and R 59-36 also did not differ significantly. However, Gem yielded significantly more than R 59-36 and Cobre. L 963-3 also yielded significantly more than Cobre. There were no significant differences between the mean yields of Cobre and R 59-36.

1970–71. Nine cultivars were planted in November 1970 and harvested 5 months later. The experimental layout followed a balanced lattice design with four replicates. Crop yields fluctuated between 42.1 tons/ha for Perla to 8.9 tons/ha for UPR #3. Gem yielded 36.6 tons/ha, a higher production than that obtained from Cobre and L 963-3, 26.7 and 20.3% more, respectively. L 963-3 yielded 30.4 tons/ha, i.e., 1.5 tons/ha higher than yields from check cultivar Cobre. There were no significant differences between the mean yields of Gem, L 963-3, and Cobre. However, Gem, Cobre, and L 963-3 yielded significantly more than UPR #3.

1971–72. Nine cultivars were planted in October 1971 and harvested in March 1972. The experimental layout followed a balanced lattice design with four replicates. Crop yields ranged from 37.9 tons/ha for L 963-3 to 23.9 tons/ha for Centennial. Cultivar L 963-3 yielded 4.7% more than Gem and R 59-36, respectively. Gem and R 59-36 outyielded Cobre by 5.9 tons/ha. Cobre, the check cultivar, yielded 30.2 tons/ha. There were no significant differences between the mean yields of the four outstanding cultivars.

1972–73. Five cultivars were planted in September 1972 and harvested 5 months later. The experimental design followed an incomplete block design with six replicates. Crop yields fluctuated from 37.3 tons/ha for Gem to 17.2 tons/ha for Cobre. Gem outyielded Cobre, R 59-36, and L 963-3 by 116.6, 93.1, and 49.6%, respectively. Cultivars L 963-3 and R 59-36 outyielded Cobre by 7.7 and 2.1 tons/ha, respectively. Gem yielded significantly higher than L 963-3, R 59-36, Cobre, and Perla but yields of L 963-3 were significantly higher than those of Cobre.

YIELDS AT FORTUNA

1966–67. Forty-nine cultivars, planted in September 1966, were harvested 5 months later. The experimental layout followed a triple lattice design with three replicates. Crop yields fluctuated from 21.5 tons/ha for L 963-3 to 1.2 tons/ha for Blonda 19. Cultivar L 963-3 yielded 10.8, 13.5, and 19.7 tons/ha more than the Cobre, R 59-36, and UPR #3 cultivars. Cobre, the check cultivar, yielded 33.7 and 485.1% more, respectively, than R 59-36 and UPR #3.

1967–68. Eighteen cultivars, planted in October 1967, were harvested in March 1968. The experimental layout followed a randomized block design with four replicates. Crop yields fluctuated from 25.4 tons/ha for Taiwan 57 to 1.7 tons/ha for R 58-12. Gem yielded 12.9, 4.6, and 18.2

tons/ha more, respectively, than Cobre, L 963-3, and R 59-36. L 963-3 outyielded the check cultivar Cobre by 8.3 tons/ha. However, Cobre yielded 163.4% more than R 59-36. There were no significant differences between the mean yields of Gem and L 963-3. However, Gem and L 963-3 yielded significantly higher than Cobre and R 59-36, respectively. There were no significant differences between the mean yields of Cobre and R 59-36.

1971–72. Nine cultivars, planted in November 1971, were harvested in April 1972. The experimental layout followed a balanced lattice design with four replicates. Crop yields fluctuated from 45.4 tons/ha for Gem to 28.1 tons/ha for UPR 59-46[4]. Cultivar Gem outyielded by 12.7, 8.0, and 11.5 tons/ha the Cobre, L 963-3, and R 59-36 cultivars, respectively. Cultivars L 963-3 and R 59-36 yielded 14.4 and 3.5% more, respectively, than the check cultivar Cobre.

Mean yields of Gem were significantly higher than those obtained from L 963-3, Cobre, and R 59-36. There were no significant differences between the mean yields of L 963-3 and R 59-36. The latter two cultivars did not differ significantly from the check cultivar Cobre.

1972–73. Five cultivars, planted in September 1972, were harvested 5 months later. The experimental layout followed an incomplete block design with six replicates. Crop yields fluctuated from 31.1 tons/ha for Gem to 11.2 tons/ha for Cobre. Gem yielded 8.0, 18.0, and 19.9 tons/ha more than L 963-3, R 59-36, and Cobre, respectively. Gem yielded significantly more than L 963-3. However, the mean yields of both cultivars were significantly higher than those of R 59-36 and Cobre. There were no significant differences between the mean yields of R 59-36 and Cobre.

LOCATION

Cultivars Gem and R 59-36 yielded higher when they were planted at Isabela in the northwest than at Fortuna in the south. An exception was recorded for Gem at Fortuna in 1971–72, when it yielded 45.4 tons/ha, higher than at any trial in Isabela. Cobre yields were higher at Isabela than at Fortuna, except in 1971–72 when the yield was higher at Fortuna. Cultivar L 963-3 yielded exceptionally well at both locations.

QUALITY EVALUATION

All cultivars peeled well in a 10% NaOH solution at 214° to 216° F. As shown in table 1, the boiled (water and salt) Cobre, L 963-3, and R 59-36 were rated as acceptable, but boiled Gem was rated close to questionable. These results led to further testing and a second batch of samples

[4] Seedling from UPR #3.

from Cobre, R 59-36, and Gem was evaluated. As shown in table 1, the samples of the three cultivars from the second batch were rated as acceptable.

The first sample from cultivar Gem differed from the second as to the amount of total sugars, i.e., it was higher in the first. The carotene content of Gem was higher than that of either R 59-36 or Cobre. These three cultivars have higher carotene contents than L 963-3. This difference was expected because of the lighter color of the flesh of L 963-3 cultivar.

Sweetpotatoes with diameters within 2.54 to 3.81 cm are preferred for canning. However, roots of larger diameters can be sliced and canned. About 37% of the Gem sweetpotatoes was suitable for canning whole, and 61% was better suited for the fresh market (table 2). However, almost 30% of the total yield was jumbo sized, which shows that 69% could be canned either whole or sliced and that 98% of the crop was marketable. Some 50% of the Cobre sweetpotatoes was suitable for canning whole and 47% for the fresh market. However, 13% of this yield was of the

TABLE 1.—*Quality rating[1] and chemical analysis of two batches of yellow-fleshed sweetpotatoes*

Cultivar	First batch (April 1972)					Second batch (March 1973)				
	Rating[2]	Brix	Sugar		Carotene	Rating		Sugar		Carotene
			Reducing	Total		Boiled	Canned[3]	Reducing	Total	
			%	%	*mg/100 g*			%	%	*mg/100 g*
Gem	0.2	10.0	1.2	8.1	5.5	0.5	0.8	3.2	7.1	13.2
Cobre	0.8	8.8	0.8	4.5	5.0	1.1	1.1	3.2	5.8	5.8
L 963-3	0.8	7.6	0.8	3.7	0.3	—	—	—	—	—
R 59-36	0.5	9.8	1.1	4.8	3.0	0.7	1.0	3.4	5.9	6.4

[1] Very acceptable, +2; acceptable, +1; slightly unacceptable, −1; not acceptable, −2; questionable, 0.

[2] Organoleptic test of boiled (salt and water) sweetpotatoes.

[3] Canned (sirup 35° Bx) sweetpotatoes.

TABLE 2.—*Percent of sweetpotatoes that passed through a set of different size sieves*

Cultivar	Percent passing through sieve of indicated diameter (cm)				
	6.35 or larger	5.05 to 6.35	3.81 to 5.05	2.54 to 3.81	Less than 2.54
Gem	29.80	31.96	27.74	9.24	1.26
Cobre	13.32	33.84	35.52	14.29	3.04
L 963-3	40.91	26.35	28.35	3.76	0.60
R 59-36	6.38	20.81	45.56	22.26	4.99

jumbo size. Nevertheless, 84% of the total yield was suitable for canning whole or sliced and 97% of the crop was marketable. L 963-3 produced a lighter-fleshed root than Cobre or Gem and yielded 41% jumbo sized sweetpotatoes. Some 96% of the crop had diameters larger than 3.81 cm. Because of these characteristics this cultivar qualifies better for the fresh market. Some 68% of the roots of R 59-36 was suitable for canning whole. It produced only 6% jumbo size sweetpotatoes. Nevertheless, 88% of the total yield was suitable for canning either whole or sliced, and 95% of the roots was marketable.

RESUMEN

Desde 1940 se ha mantenido en la Estación Experimental Agrícola una colección de batatas de pulpa anaranjada, que en Puerto Rico se designan como batatas mameyas. Dicha colección se aumentó a través de los años con nuevos cultivares por medio de introducciones, híbridos y selecciones locales. Estos cultivares se incluyeron en pruebas comparativas en las subestaciones de Isabela y Fortuna. En Isabela, el suelo es del tipo Coto arcilloso (Oxisol) y en Fortuna es un San Antón limoarcilloso (Mollisol). Se encontró que los cultivares Gem y R 59-36 producen mejor en Isabela que en Fortuna. El cultivar L 963-3 produce bien en ambas localidades, mientras que Cobre produce generalmente mejor en Isabella.

Gem alcanzó un rendimiento tan alto como de 45.4 Tm./Ha. en 1971–72 en Fortuna y tan bajo como de 21.5 Tm./Ha. en 1967–68 en Fortuna. Gem, sembrada en Isabela produjo en 1966–67, 34.4 Tm./Ha.; en 1967–68, 34.1; en 1970–71, 36.6; en 1971–72, 36.2 y en 1972–73, 37.3, lo que demuestra el consistentemente alto rendimiento de dicho cultivar. El rendimiento de Cobre fluctuó entre 32.7 Tm./Ha. en 1971–72 en Fortuna y 8.6 también en Fortuna en 1967–68. L 963-3 alcanzó un rendimiento de 37.9 Tm./Ha. en 1971–72 en Isabela y el más bajo fue de 13.7 en 1966–67 en la misma localidad. R 59-36 alcanzó su máximo rendimiento de 36.2 Tm./Ha. en 1971–72 en Isabela y el más bajo de 8.0 en 1966–67 en Fortuna. El cultivar UPR #3 bajó drásticamente en cantidad y calidad de raíces producidas a través de los años, lo que motivó que se le descartara.

Los cultivares Gem, Cobre y R 59-36 producen una gran cantidad de raíces de tamaño y forma adecuadas para el enlatado. En evaluaciones de un panel de catado se encontró que los tres cultivares pelan bien en una solución de 10 por 100 de soda a 214–216° F, que cuecen muy bien en agua y sal y que los tres cultivares son de apariencia aceptable. La calidad del producto enlatado fue aceptable. Los cultivares L 963-3 y Gem producen gran cantidad de raíces para el mercado fresco. El contenido de caroteno de Gem alcanzó un valor de 13.20 mg/100 g.

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