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YIELD EVALUATION OF SWEET POTATO CULTIVARS IN THE U.S. VIRGIN ISLANDS

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ABSTRACT

Several sweet potato (*Ipomoea batatas* (L.) Lam) cultivars were field planted in a series of germplasm evaluation trials in the U.S. Virgin Islands. The objective of these trials was to identify and select suitable cultivars for local production based upon yield, sweet potato weevil (SPW) tolerance, growth-vigor and culinary qualities. Cultivars evaluated were obtained from the USDA-Tropical Agriculture Research Station (TARS) in Mayaguez, Puerto Rico; St. Kitts; South Florida and local farmers in St. Croix. There was a tendency for high-yielding cultivars to have a higher percentage of storage roots infested by SPW. In Experiment 1, Miguela and Toquesita produced the highest total yields, while Toquesita had the highest marketable yield. Seventy nine percent of the storage roots produced by Miguela were damaged by SPW. Colorette, Perla, Agata and Amarista produced the highest total yield in Experiment 2. Colorette also produced the highest ($P<0.05$) quantity of marketable storage roots. Agata and Amarista suffered high levels of SPW damage. In Experiment 3, Twelve Prime produced the highest total ($P<0.05$), and marketable yields. Trompo Negro also produced a relatively good marketable yield. Of the cultivars evaluated in Experiment 4, Viola, Tapato and Sunny were the best yielding in terms of total storage roots (19.5, 16.4 and 14.3 ton/ha, respectively) and marketable storage roots (16.2, 14.2 and 13.1 ton/ha, respectively). Picadito produced the largest ($P<0.05$) storage roots, weighing an average of 438 g. In Experiment 5, Perla, Viola, Tapato and Sunny had the highest yields of sweet potato storage roots, while SKB-4, CS-2 and SKB-2 had the highest foliage yield. Tapato produced the largest sweet potatoes (438

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g). Sweet potato weevil damage ranged from 0.4 to 2.0 ton/ha. Trompo Negro and Black Rock had the lowest yields and smallest storage roots. Despite their relatively low sugar content, cultivars from TARS (Viola, Tapato and Sunny) had the best culinary qualities as rated by a consumer panel. The results of these evaluations seem to indicate that cultivars from TARS are superior to local cultivars and are better for sweet potato production in the Virgin Islands.

Sweet potato (*Ipomoea batatas* (L.) Lam) ranks seventh in the world among all food crops (FAO, 1984). Sweet potato is one of the world's highest yielding crops with a total food production and food value per unit area exceeding that of rice, while requiring relatively low fertilizer inputs (Selleck, 1982).

Compared to other root/tuber crops, sweet potato has nutritional advantages. Sweet potato roots have higher dry matter content than potato. Sweet potato ranks high in energy, carbohydrates, vitamin A (especially orange fleshed cultivars), vitamin C, calcium and iron. The storage roots of sweet potato are also a good source of dietary fiber (Hill, et al., 1984).

Sweet potato is adapted to the tropics, can be produced throughout the year and is readily propagated from its abundant foliage. It tolerates infertile soils and other tropical stresses and can yield as well as any root or tuber crop (Martin and Rhodes, 1983). The crop is also grown in temperate zones.

Sweet potato adapts well to both low and high input agricultural systems. Optimum to high yields are produced in areas with high levels of inputs and technology, such as the USA and Japan, as well as in many lesser developed tropical countries that use labor-intensive, low cost technology systems primarily for subsistence farmers (Jansson and Raman, 1991; Martin and Jones, 1986). Sweet potato can be grown on large acreages or small holdings. The crop is considered relatively drought-resistant but can be grown with applied irrigation (Hill, 1984).

In terms of acreage and production sweet potato is the second most important crop in the Caribbean after cassava (CIAT, 1986). Sweet potato is an important and significant crop for farmers in the Virgin Islands where it is the most popular root crop. In the Virgin Islands, sweet potato is grown primarily for human consumption of the edible storage roots.

Many cultivars of sweet potato are available in the Virgin Islands from local farmers, neighboring Caribbean nations, breeding programs in the USA, and the USDA-Tropical Agricultural Research Station (TARS) in Puerto Rico. Yields and consumer preferences are variable. It is therefore important to conduct continued germplasm evaluation studies.

The objectives of these trials were to identify locally adapted, consumer acceptable cultivars which produce high marketable yields, are easy to propagate, have good growthvigor, compete well with weeds and exhibit some degree of sweet potato weevil resistance/tolerance.

MATERIALS AND METHODS

Several sweet potato germplasm evaluations studies were conducted at the University of the Virgin Islands Agricultural Experiment Station, St. Croix. The soil is a Fredensborg clay loam (pH 7.8 - 8.4). This series consists of well drained soils formed over limestone or marl (Rivera et al., 1970). The trials involved cultivars obtained from USDA-TARS, others included were as follows:- from local farmers (Tano, Black Rock, Twelve Prime, Eda, CS-2 and Mc), St. Kitts (SKB-2 and SKB-4), and South Florida (Picadito).

All plots were established with terminal vine cuttings, 0.3 - 0.4 m long. Plot sizes were 3 m x 3.7 m and consisted of 3 rows spaced 1 m apart. Plants were spaced 0.3 m within rows. Micro-irrigation was applied for crop establishment and to prevent moisture stress, using Drip Strip Plus (Hardie Irrigation, El Cajon, CA.) tubing.

The experimental design was a randomized complete block with four replications. At harvest 10 plants from the center row of each plot were harvested. The foliage was cut at ground level and removed. Storage roots were then dug out of the soil, collected and sorted based upon size and SPW damage. Statistical analysis of data was performed using SAS General Linear Models procedure (SAS Institute, Cary, NC).

Experiments 1 to 3 each consisted of 10 cultivars and were harvested at 120 days after planting (DAP). At harvest the weight of all storage roots of marketable size was recorded as total yield. Sweet potato weevil infested yield was then determined and recorded as a percentage of the total yield (% SPW damage). Uninfested roots were recorded as marketable yield.

Experiment 4 evaluated seven cultivars and was harvested at 120 DAP. In addition to total and marketable yields data was also collected for mean storage root size and yield per plant. Consumer preference was determined by presenting boiled slices of each cultivar to a panel. The slices were assessed for color, appearance, softness, mouthfeel, sweetness, fiber and flavor.

Experiment 5 evaluated nine cultivars including the highest yielding cultivars from experiment 4. This trial was harvested at 150 DAP. Observations made were ease of propagation, plant vigor and ability to smother weeds. Plant foliage was harvested by cutting the main stem at ground level. Total foliage fresh weight was recorded and sub-samples were oven dried at 70° C to a constant weight, for dry matter determination. All storage roots were weighed and recorded as total yield. Storage roots were then separated into marketable and non-marketable categories. Marketable storage roots were then examined for SPW damage. The damaged storage roots were weighed and recorded. Data were collected for mean storage root size and yield per plant. After harvest, sub-samples of storage roots were peeled, sliced and dried at 70° C to a constant weight, for dry matter determination.

RESULTS AND DISCUSSION

Overall, high-yielding cultivars tended to have a higher percentage of storage roots infested by SPW. Yields were comparatively low from the cultivars evaluated in Experiment 1. Miguela (9.4 ton/ha) and Toquesita (9.0 ton/ha) produced total yields which were significantly higher ($P<0.05$) than Tano, Limonette, Tapato Fine and Sabino Red

(Table 1). The marketable yield of 4.8 ton/ha from Toquesita was higher ($P<0.05$) than the yield from Tano, Limonette and Sabino Red, even though Toquesita had 49% SPW damage. Whity Thany and Vida had marketable yields of 3.4 and 3.8 ton/ha, respectively. Miguela with a 79% SPW damage had a marketable yield of only 2.0 ton/ha. The high total yield from Miguela is consistent with traditionally high yields produced by this cultivar in Puerto Rico (Badillo-Feliciano, et al., 1976a).

Total yields from cultivars in Experiment 2 ranged from 5.2 to 21.2 ton/ha, and were much higher than from Experiment 1. Colorette produced a total yield of 21.2 ton/ha which was significantly higher ($P<0.05$) than all other cultivars except Perla, Agata and Amarista (Table 2). Colorette also produced a significantly higher quantity of marketable storage roots (9.9 ton/ha) than the other cultivars. Perla (6.8 ton/ha) and EAS-11 (5.2 ton/ha) had the next highest marketable yields. Agata and Amarista which had high total yields also had high SPW damage (79 and 74%, respectively) resulting in low marketable yields. In this experiment, Colorette was clearly the superior cultivar in terms of yield. Viola, a cultivar which has a good consumer acceptance, produced 5.3 ton/ha total yield and 4.0 ton/ha marketable yield, with a 27% SPW damage.

In Experiment 3, Twelve Prime had a significantly higher ($P<0.05$) total yield than all other cultivars tested (Table 3). Yields of marketable roots from this cultivar and Trompo Negro were the highest ($P<0.05$). Mont Blanc produced a total yield of 7.4 ton/ha which was superior ($P<0.05$) to most of the remaining cultivars. However, Mont Blanc, had only 1.7 ton/ha marketable yield due to 80% SPW damage.

Trompo Negro, despite its relatively good production of storage roots, had only 7% SPW damage resulting in a marketable yield of 5.3 ton/ha. Black Rock, a popular local cultivar for both farmers and consumers, produced low yields and had a relatively high level of SPW damage (51%).

Cultivars in Experiment 4 had negligible SPW damage. This was not necessarily due to weevil resistance/tolerance, but probably escape.

The plot was located in an area where sweet potato had not been established for a number of years. Total and marketable yields were generally good, due to the low incidence of SPW. Viola, Tapato and Sunny were the best yielding cultivars in terms of total (19.5, 16.4 and 14.3 ton/ha, respectively) and marketable (16.2, 14.2 and 13.1 ton/ha, respectively) storage roots produced (Table 4). These yields were higher ($P < 0.05$) than the yields of local cultivars Mc and Three Months. Cultivar Picadito produced the largest ($P < 0.05$) marketable storage roots, weighing an average of 438 g/root. Viola and Eda produced significantly more marketable storage roots per plant than Three Months. A consumer preference panel rated Viola, Tapato and Sunny as having good culinary qualities, despite their relatively low sugar content. These three cultivars were bred to produce in heavy soils in Puerto Rico (Martin, 1987).

In Experiment 5 cultivars SKB-4, CS-2 and SKB-2 each produced large quantities of fresh foliage (34.3, 28.1 and 27.2 ton/ha, respectively). The fresh and dry matter yields of foliage from these cultivars were significantly higher ($P < 0.05$) than from the other cultivars (Table 5). The foliage of Perla had the highest percent dry matter even though this cultivar produced the least foliage. Foliage yield was directly related to plant growth vigor and the ability of the cultivars to smother weeds. Vigorous vine growth significantly reduces the number of field weedings. Sweet potato foliage can be consumed as a leaf vegetable and fed to animals besides being used as planting material.

Cultivars from USDA-TARS (Puerto Rico), had the highest total and marketable yield (Table 6). This pattern is similar to the yield obtained in Experiment 4 (Table 4). Perla (28.6 ton/ha) and Viola (26.8 ton/ha) had a higher ($P < 0.05$) total yield than the remaining cultivars except Tapato and Sunny (Table 6). Perla, Viola and Tapato produced more ($P < 0.05$) marketable roots than all other cultivars except Sunny. Perla, a nonsweet type cultivar was the highest yielding. This cultivar has also produced high yields of 27 - 42.1 ton/ha in trials in Puerto Rico (Badillo-Feliciano, et al., 1976b). Trompo Negro and Black Rock had the lowest total and marketable yields. The highest yielding cultivars each had 2.0 ton/ha damaged by sweet potato weevil, with the exception of Tapato which had only 0.4 ton/ha, SPW damage. Tapato sweet potatoes with an average weight of 446 g/root, were larger ($P<0.05$) than all other cultivars tested. In Puerto Rico this cultivar produced such large roots that it was considered useful for industrial purposes (Martin, 1987). Black Rock and Trompo Negro produced the smallest sweet potatoes.

Trompo Negro and Black Rock produced less ($P<0.05$) fresh and dry biomass than the other cultivars (Table 7). The biomass produced by SKB-4, SKB-2, Viola and CS-2 was over 40 ton/ha fresh and 11 ton/ha dry, twice the amount produced for each parameter by the lowest-yielding cultivars (Trompo Negro and Black Rock).

Perla, Tapato and Sunny produces thin vines which make propagation, handling and crop establishment a little more tedious than for the other cultivars. These cultivars however, along with Viola, which produced a similar quantity of foliage, gave the highest root yields. An inverse relationship between foliage and storage root production is therefore apparent. Sajjapongse and Roan (1982) reported this relationship whereby excessive top growth may result in low root yield. There was a tendency for low yielding cultivars to have a higher percentage of dry matter in their storage roots, compared to the high yielding cultivars.

These trials suggest that the USDA-TARS cultivars are well adapted for sweet potato production in the Virgin Islands in terms of yield and SPW tolerance.

This indicates the possibility of improving the yield of sweet potatoes in the Virgin Islands by utilizing introduced germplasm. The local cultivars tended to produce low yields compared to the yields from the introduced cultivars. A similar finding was reported by Huett (1976) in Australia, where cultivars from the USA yielded 3 to 4 times as much storage roots as the local commercial cultivar.

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Table 1. Yield and storage root damage by SPW, of 10 sweet potato cultivars (Experiment 1).[z]

Cultivar	Total yield (ton/ha).	Marketable yield (ton/ha).	SPW damage (%).
Miguela	9.4 a	2.0 abc	79 ab
Toquesita	9.0 a	4.8 a	49 bc
Squish	5.7 ab	2.6 abc	51 bc
Whity Thany	5.4 ab	3.4 abc	38 cd
Vida	4.7 ab	3.8 ab	23 cd
EAS-12	4.2 ab	2.4 abc	42 cd
Tapato Fine	1.9 b	1.8 abc	4 d
Tano	1.3 b	1.1 bc	10 d
Limonette	0.9 b	0.9 bc	5 d
Sabino Red	0.3 b	0.04 c	88 a

[z] Mean separation within columns by Duncan's multiple range test, P = 0.05.

Table 2. Yield and storage root damage by SPW, of 10 sweet potato cultivars (Experiment 2).[z]

Cultivar	Total yield (ton/ha).	Marketable yield (ton/ha).	SPW damage (%).
Colorette	21.2 a	9.9 a	47 ab
Perla	12.6 ab	6.8 b	44 ab
Agata	12.2 ab	3.4 c	79 a
Amarista	11.4 ab	3.0 c	74 a
EAS-ll	8.0 b	5.2 b c	36 b
Suabor 2	7.1 b	4.7 b c	27 b
Suabor	6.2 b	3.6 b c	43 ab
Dunc	5.8 b	4.2 b c	32 b
Viola	5.3 b	4.0 b c	27 b
Bonaro	5.2 b	3.0 c	46 ab

[z] Mean separation within columns by Duncan's multiple range test, P = 0.05.

Table 3. Yield and storage root damage by SPW, of 9 sweet potato cultivars (Experiment 3).[z]

Cultivar	Total yield (ton/ha).	Marketable yield (ton/ha).	SPW damage (%).
Twelve Prime	16.6 a	7.1 a	56 ab
Mont Blanc	7.4 b	1.7 b	80 a
Trompo Negro	6.0 bc	5.3 a	7 b
EAS-15	3.7 cd	2.2 b	50 ab
EAS-13	3.6 cd	2.6 b	38 ab
EAS-10	3.5 cd	1.3 b	72 a
Black Rock	3.2 cd	1.8 b	51 ab
Ninety-Nine	1.8 d	0.8 b	80 a
St. Georges	0.6 d	0.4 b	11 b
Margarita	0.2 d	0.1 b	33 ab

[z] Mean separation within columns by Duncan's multiple range test, P = 0.05.

Table 4. Storage roots yield and size of 7 sweet potato cultivars (Experiment 4).[z]

Cultivar	Total yield (ton/ha).	Marketable yield (ton/ha).	Root size	Roots/plant (g).
Viola	19.5 a	16.2 a	266 bc	1.8 a
Tapato	16.4 a	14.2 a	275 bc	1.5 ab
Sunny	14.3 a	13.1 a	212 bc	1.6 ab
Eda	12.3 ab	10.5 ab	286 b	1.7 a
Picadito	12.2 ab	11.3 ab	438 a	1.2 ab
Mc	3.8 b	3.3 b	188 c	0.8 ab
Three Months	3.1 b	2.6 b	205 bc	0.6 b

[z] Mean separation within columns by Duncan's multiple range test, P = 0.05.

Table 5. Foliage yield of 9 sweet potato cultivars (Experiment 5). [z]

Cultivar	Fresh Matter (ton/ha).	Dry Matter (%).	Dry Matter (ton/ha).
SKB-4	34.3 a	19.0 b	6.6 a
CS-2	28.1 a	21.1 ab	6.0 a
SKB-2	27.2 a	19.5 b	5.3 a
Sunny	16.9 b	19.3 b	3.2 b
Viola	14.8 b	18.8 b	2.7 b
Black Rock	14.4 b	20.0 ab	2.8 b
Tapato	13.4 b	20.0 ab	2.6 b
Trompo Negro	12.2 b	17.8 b	2.2 b
Perla	9.2 b	23.2 a	2.1 b

[z] Mean separation within columns by Duncan's multiple range test, P = 0.05.

Table 6. Storage roots yield, size and SPW damage of 9 sweet potato cultivars (Experiment 5). - [z]

Cultivar	TOTAL Yield (ton/ha).	ROOTS OF MARKETABLE SIZE SPW[x] (ton/ha).	Yield (ton/ha).	Size (g).	Dry matter (ton/ha).
Perla	28.6 a	2.0	24.5 a	306 b	7.3 a
Viola	26.8 a	2.0	21.9 a	238 bcd	7.3 a
Tapato	22.9 ab	0.4	21.4 a	446 a	6.0 ab
Sunny	22.8 ab	2.0	17.3 ab	260 bc	5.1 bc
SKB-2	18.3 b	1.6	12.9 bc	275 bc	4.2 bc
CS-2	15.3 bc	0.8	9.2 cd	192 cd	3.4 cd
SKB-4	15.0 bc	1.7	10.3 cd	213 bcd	3.8 cd
Trompo Negro	8.1 cd	1.3	5.1 de	167 d	2.0 de
Black Rock	6.5 d	0.8	1.7 e	129 de	0.7 e

[x] SPW - Sweet potato weevil damaged storage roots of marketable size.
[z] Mean separation within columns by Duncan's multiple range test, P = 0.05.

Table 7. Biomass production of 9 sweet potato cultivars (Experiment 5).[z]

Cultivar	Fresh Biomass (ton/ha).	Dry Biomass (ton/ha).
SKB-4	49.3 a	12.1 a
SKB-2	45.5 a	11.3 a
Viola	41.6 a	11.6 a
CS-2	40.9 a	11.5 a
Sunny	39.7 a	9.9 a
Perla	37.8 a	10.6 a
Tapato	36.3 a	9.1 a
Black Rock	20.9 b	5.3 b
Trompo Negro	20.2 b	5.3 b

[z] Mean separation within columns by Duncan's multiple range test, $P = 0.05$.