GLADSTONE ROAD AGRICULTURAL CENTRE
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TUBER QUALITY AND YIELD OF EIGHT SWEET POTATO VARIETIES EVALUATED DURING 2008

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ABSTRACT

Sweet potato is growing in importance in The Bahamas as more emphasis is given to its agricultural production. There is limited published research on tuber quality and yield under local conditions. To identify cultivars with improved agronomic characteristics, eight white-fleshed sweet potato varieties were evaluated from November 2007 to May 2008 at the Gladstone Road Agricultural Centre. At 17.6 t/ha, the variety 'Six Weeks' had the best overall performance for marketable yield, followed by 'Antigua' which yielded 17.3 t/ha of marketable tubers. The other six varieties were all late maturing varieties and produced low yields averaging less than 4.5 t/ha among them.

Introduction:

Sweet potato is one of the world's most important food crops, with annual production exceeding 134 million tons in more than 9 million hectares (FAO, 1997). Of the staple food crops grown, including cassava, rice and maize, sweet potato is the one with the most potential for commercial exploitation. Sweet potato can grow well with limited inputs and under adverse growing conditions, but responds well to improved agronomic practices. It is important to keep the plants free of weeds until a complete canopy is developed. Diseases and insect pests are usually not a serious problem, but can be reduced by rotating with other crops, such as maize, and by not planting sweet potato within the same field for periods longer than three years. The sweet potato grows best in sandy, well drained soils. Planting sweet potato on mounds or ridges helps to improve drainage in low lying areas. The application of fertiliser and supplemental irrigation during the growth stage results in a higher percentage of well shaped, marketable tubers.

In the local food production system sweet potato is growing in importance, as more emphasis is given to its agricultural production. Sweet potato is one of the main crops identified in the FAO's Initiative for Soaring Food Prices (FAO website: http://www.fao.org). There is huge potential to improve the quality and yield of the local sweet potato production system through the introduction of high yielding varieties and the improvement of agronomic practices. As consumer demand for this crop increases, and other varieties of sweet potato become available, it is important to examine these new varieties along with the traditional varieties grown by the local farmers. For this reason, evaluation and selection of varieties are important steps in the improvement of sweet

potato production. The resulting data from trials such as presented here will assist farmers in making informed choices about the sweet potato varieties available to them.

Objectives:

The purpose of this experiment was to identify high yielding varieties producing good quality medium-sized tubers, with uniform and attractive root shapes. Another objective was to document the morphological characteristics of the sweet potato varieties collected locally. This trial complements the previous trial of 2007, in which four sweet potato varieties were evaluated for tuber quality and yield.

Materials and Methods:

Eight sweet potato varieties were evaluated for tuber yield at the Gladstone Road Agricultural Centre (GRAC), New Providence, from November 2007 to May 2008. Two-node cuttings of the selected sweet potato were rooted in polystyrene trays containing a potting mixture. The plantlets were propagated under green house conditions until they produced a well-developed root system and at least two fully expanded leaves. They were then transplanted to 200-ft long field plots. The usual cultural practices were observed to ensure that an even stand of plants was established in the field plots. The mean monthly maximum temperature for the trial period was 28^{o}C (83^{o}F) and the mean monthly minimum temperatures ranged from 18-24^{o}C (65-75^{o}F). The total rainfall for the period was 264.2 mm (10.4 in). The sweet potato selections used in this study and some of their characteristics are listed in table 1.

Table 1. Characteristics and origin of plant material used in the experiment.

VARIETY	ORIGIN	DESCRIPTION
Antigua	Antigua and Barbuda	Early maturing. Bushy erect plant,
CI001	Cat Island	Late maturing. Vigorous, spreading plant,
NP001	New Providence	Late maturing. Vigorous, spreading plant,
NP011	New Providence	Late maturing. Vigorous, spreading plant,
NP012	New Providence	Late maturing. Vigorous, spreading plant,
SA001	South Andros	Late maturing. Spreading plant,
Six Weeks	New Providence	Early maturing. Bushy semi-erect plant, tending to spread.
Solomon	Cat Island	Late maturing, up to 10 months. Vigorous, spreading plant,

After six months of growth, ten plants for each variety were randomly sampled from each of the plots and harvested. For each variety, the total number of tubers, total weight of tubers, number of marketable tubers and weight of marketable tubers were recorded. Tuber characteristics were described according to the Descriptors for Sweet Potato (Huamán, ed., 1991).

Statistical Analyses:

All experimental results were analysed using Instat+™ and ASSISTAT. Instat is an interactive statistical package, copyright © 1999-2005, Statistical Services Centre, University of Reading, UK. All rights reserved. ASSISTAT, Version 7.5 beta (2008),

website – http://www.assistat.com, by Fransisco de Assis Santos e Silva, Federal University of Campina-Grande City, Campina Grande, Brazil.

Results:

The analysis of variance (ANOVA) of the yield responses (Table 2) for the eight sweet potato varieties showed a statistical significance for total number of tubers, number of marketable tubers, total tuber weights and weight of marketable tubers at a 1.0 % level of confidence. This indicates that the average performances for these varieties, with respect to yield components, varied significantly.

Table 2. Analysis of variance (ANOVA) for total number of tubers, number of marketable tubers, total tuber weights and weight of marketable tubers among eight sweet potato varieties. Standard error is for each treatment mean. Error mean square has 47 df. *, ** and *** denote statistical significance at 5, 1 and 0.1% level of confidence, respectively. NS indicates differences between means not significant.

		----------Significance levels----------			
Source	df	No. of tubers/ plant	No. of marketable tubers	Total weight	Weight of marketable tubers
Varieties	7	**	**	**	**
Error	40				
Std. Err		0.5	0.2	0.09	0.09

Total and marketable yield (Table 3) was highest for the variety 'Six Weeks' and lowest for the variety 'SA001'. There was no significant difference in yield between the bushy variety, 'Antigua', and the moderately spreading variety, 'Six Weeks', which gave similar yields, as indicated in Table 3. Both of these varieties were significantly earlier in root tuber maturity than any of the other six varieties, based upon the marketable yields. 'CI001' and 'NP001', both late maturing and vigorously spreading plants, gave the next highest yields, though they performed well below 'Six Weeks' and 'Antigua'. Yields were generally low for the late maturing varieties among the sweet potato being evaluated.

Table 3. Yield components of eight sweet potato varieties at six months.

Variety	**Number of tubers/ plant**	**Total weight of tubers/plant kg** (lb)	**Weight of marketable tubers/plant kg** (lb)	**Marketable yield per plot kg** (lb)	**Marketable yield t/ha** (lb/acre)
Antigua	**6.5**	**1.64** (3.62)	**1.56** (3.44)	**62.4** (137.6)	**17.3** (15,464.3)
CI001	**5.0**	**1.10** (2.43)	**0.55** (1.21)	**22.0** (48.4)	**6.11** (5,452.2)
NP001	**10.5**	**1.40** (3.09)	**0.55** (1.21)	**22.0** (48.4)	**6.11** (5,452.2)
NP011	**2.5**	**0.50** (1.10)	**0.37** (0.82)	**14.8** (32.8)	**4.11** (3,667.8)
NP012	**3.8**	**0.44** (0.97)	**0.31** (0.68)	**12.4** (27.2)	**3.44** (3,073.0)
SA001	**3.2**	**0.42** (0.93)	**0.27** (0.60)	**10.8** (24.0)	**3.00** (2,676.6)
Six Weeks	**5.3**	**2.13** (4.70)	**1.58** (3.48)	**63.2** (139.2)	**17.6** (15,662.5)
Solomon	**4**	**0.56** (1.23)	**0.28** (0.62)	**11.2** (24.8)	**3.11** (2,775.6)

The average weight of tubers is an important factor that affects the quality and percentage of marketable tubers. The highest weight of tubers per plant was produced by the variety 'Six Weeks' followed by 'Antigua' and 'NP001'. These weights were significantly higher than the other five varieties of sweet potato.

In this trial, the weevil infestation was not severe and all varieties showed varying degrees of weevil attack present within the tubers. Roots damaged by weevil larvae had low quality and were unmarketable. However, there were differences in the degrees of infestation among the varieties. The roots of 'Six Weeks', 'Antigua', 'CI001' and 'NP001' were less damaged than the infested roots of 'NP011','NP012', SA001' and 'Solomon'.

Data on the storage root characteristics was collected for each of the eight sweet potato varieties (Table 4). Visual characteristics were assessed for tuber shape, surface defects, skin colour and flesh colour. Most of the sweet potato storage roots presented a red skin colour (4), followed by purple-red (2) and cream (2) skin colours. The predominant flesh colour was white (5), followed by cream (2) and pale-yellow (1). A secondary flesh colour, purple-red, manifested as scattered spots within the flesh, was observed in only one variety. The storage root data provide valuable information for improving methods of evaluation and selection of sweet potato varieties for inclusion in the germplasm collection at GRAC.

Table 4. Storage root data for the eight sweet potato varieties.

STORAGE ROOT DATA	**VARIETY**							
	ANTIGUA	**CI001**	**NP001**	**NP011**	**NP012**	**SA001**	**SIX WEEKS**	**SOLOMON**
1. Shape	ovate	obovate	round	obovate	obovate	obovate	round	round elliptic
2. Surface defects	longitudinal grooves	absent	absent	shallow horizontal restrictions	absent	longitudinal grooves	absent	absent
3. Skin colour								
a) predominant skin colour	purple-red	red	red	cream	red	purple red	red	cream
b) intensity of predominant skin colour	intermediate	dark	intermediate	intermediate	dark	intermediate	dark	pale
c) secondary skin colour	absent	absent	absent	absent	absent	absent	absent	white
4 Flesh colour								
a) predominant flesh colour	cream	white	white	white	white	cream	white	pale yellow
b) secondary flesh colour	absent	absent	absent	absent	absent	purple red	absent	absent
c) distribution of secondary flesh colour	absent	absent	absent	absent	absent	scattered spots in flesh	absent	absent

Discussion:

The results of this present study clearly show differences among the eight sweet potato varieties with respect to tuber quality and yield. The variety 'Six Weeks' had the best overall performance for marketable yield, followed by 'Antigua'. The varieties 'CI001', and 'NP001', which yielded significantly less than the two best performers, were the next best tubers, with similar marketable yields. The remaining four varieties, 'Solomon', 'NP011', 'NP012' and SA001', gave the lowest yields. 'Six Weeks' and 'Antigua' were the only early maturing varieties of the eight under study. Potentially, the marketable yields of the other six late maturing varieties might have been greater, had they been allowed to develop for a much longer period.

The data for this trial showed a significant improvement in yield components of the sweet potato varieties 'Antigua', 'NP001', 'Six Weeks' and 'Solomon', over the results of the previous year. In comparing these varieties, the results were consistent with those obtained during 2007, except for the variety 'Solomon', which saw an improvement in the quality and number of marketable tubers produced. This trial was conducted in a completely different field plot to the previous year, so it is probable that the root-knot nematode (*Meloidogyne* spp.) population was not significant enough to have had an effect on tuber quality and yield of the 'Solomon' sweet potato. The growing season was cooler and may have also played a role in improving tuber quality and yield. Nematodes thrive best in soils whose temperatures exceed 21^{o}C (70^{o}F). Jatala and Russell (1972) observed that the rate of development and total population of *Meloidogyne incognita* in roots of sweet potatoes increased with increasing temperature.

The increase in yield observed among the four varieties of this trial that were evaluated during 2007, may be attributed to the lower temperatures occurring during the early stages of development and the warmer temperatures during the latter stages of growth. The 2007 trial was conducted from April to October 2007, while the 2008 trial was started in November 2007 and concluded in May of 2008. In a study on climate effects on sweet potato, Sajjapongse and Wu (1989) found that subjecting sweet potato to cool weather during its root formation stage, and to warm weather in late April and May, during its root enlargement stage, enhanced root formation and stimulated root enlargement, resulting in higher yields.

Average yields for the varieties 'Antigua' and 'Six Weeks' were somewhat higher than the average for developing countries (CIP, 1999). Accordingly, marketable yields greater than 15 tons/ha are considered to be commercially feasible for a developing market economy. It is clear from these results that the two varieties 'Antigua' and 'Six Weeks' are excellent candidates for selection as they are in the desired maturity range and possess the greatest yield potential of all the varieties evaluated.

While it is intended to continue with the sweet potato evaluations, based on the results of the 2007 and 2008 trials, it is advisable to immediately propagate the two early maturing varieties 'Six Weeks' and 'Antigua' for distribution to local farmers. By reducing the growing period, early maturing sweet potato varieties have been proven to offer to farmers a quick return to production following adverse occurrences (Sitango and Dopo,

2004). Further studies in different growing seasons are required to better understand the variation in tuber quality and yield in sweet potato. More emphasis should be given on development of early maturing varieties possessing early growth vigour, semi-erect habit, pest resistance and tolerance to drought conditions.

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