GLADSTONE ROAD AGRICULTURAL CENTRE
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TUBER QUALITY AND YIELD OF FOUR SWEET POTATO VARIETIES EVALUATED DURING 2007

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ABSTRACT

A variety trial was conducted on four sweet potato varieties from April to October 2007 at the Gladstone Road Agricultural Centre. The variety 'Six Weeks', which is an early maturing variety with white flesh and high dry matter content, produced the highest marketable yield at 9.4 t/ha. One other early maturing variety, 'Antigua', yielded 7.3 t/ha and is also suitable for local production. The other two varieties are late maturing varieties and produced very low yields after six months of growth.

Introduction:

Sweet potato is an important crop commercially, constituting one of the world's most important carbohydrate food sources (Villareal, 1982). It is one of the world's highest yielding crops with total food production exceeding that of rice. As a crop, this plant species has a great potential for development because of its relatively short growing season and high nutritional value, compared to other starchy food sources. It also has a great potential for supporting agriculture on those areas affected by adverse growing conditions such as drought and saline soils. The sweet potato yields reasonably well, even in soils of low fertility.

The sweet potato is one of the more important staple food crops in the Bahamas and is grown primarily for the fresh market. Production has not been exploited to its fullest extent, however. In the northern Bahamas there has been a significant increase in the acreage planted, using improved sweet potato varieties. Varieties planted in the southeastern Bahamas are generally rainfed, with little or no supplemental irrigation. Generally, a crop may reach maturity within six to eight months, while many of the varieties grown in the southern islands take up to ten months to develop mature tubers. Early maturing varieties combined with improved agronomic practices provide the opportunity for increased productivity of the sweet potato crop.

Documentation is lacking on the performance of this crop species under local growing conditions. In order to assist farmers in improving production practices, agronomic data on the performance of this crop must be generated. The results of this experiment will represent the type of information that is required by farmers who wish to obtain early maturing varieties of sweet potato suitable for planting within their particular island.

Objectives:

The purpose of this experiment was to evaluate tuber quality and yield of select sweet potato varieties and to identify high yielding varieties that are acceptable to the fresh market. Another ongoing objective is to characterise the morphological variability existing among the sweet potato varieties collected locally.

Materials and Methods:

The study was carried out at the Gladstone Road Agricultural Centre, New Providence, from April to October 2007. Two node cuttings of 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. After two weeks of growth, the plants were transplanted directly to field plots. 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 experiments.

VARIETY	ORIGIN	DESCRIPTION
Antigua	Antigua and Barbuda	Early maturing. Bushy erect plant,
NP001	New Providence	Late maturing. Vigorous, 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,

The four sweet potato varieties were established in an open field in a randomised complete block design with four replications, on ridges 1.5 m apart, with a 0.6 m spacing between plants within rows. Each plot consisted of 40 plants with the plants arranged in a 5 x 8 plants per plot design. Tuber yield was determined from the actual area of each plot, which, according to Romani *et al*., (1993), provides a good estimate of true yield. This is also supported by Neppl *et al*., (2003) whose study indicated that interactions of centre row with border row were insignificant. The usual cultural practices were observed to ensure an even stand of plants in the experimental plots. Before planting, the field was sprayed with the herbicide DCPA (Dacthal) to prevent germination of broadleaf weed species, followed by Glyphosate (Roundup) to eliminate emerging weeds, in particular johnsongrass. Fertiliser application (200 lbs. per acre in 2 applications) occurred twice: 3 weeks after planting, and again after two months. Before each application of fertiliser, the plots were weeded and cultivated. The mean monthly maximum temperature for the trial period was 31^{o}C (88^{o}F) and the mean monthly minimum temperatures ranged from 19-26^{o}C (67-79^{o}F). The total rainfall for the period was 1283 mm (50.5 in).

After 6 months of growth, the plots were harvested and data for the total number of tubers, total fresh weight of tubers, number of marketable tubers and weight of marketable tubers were recorded. Tuber characteristics were described according to the classification system (Table 2) used in an early study of Martin and Rhodes (1983), who defined and categorised sweet potato roots based upon harvest, kitchen and table quality. Some modifications were made to this table, according to the Descriptors for Sweet Potato (Huamán, ed., 1991).

Quality characteristics measured included dry matter content, soluble sugars and protein content. Arrangements were made with the Food Safety Laboratories of the Department of Marine Resources for the analyses.

Table 2. Characteristics observed of sweet potato roots and system of rating

No.	**Characteristic**	**Method of determination**	**Scale and key**	**Desired state**
1	Storage roots per plant	Counting	-	Intermediate
2	Shape of root	Observing and estimating	1 round 2 round elliptic 3 elliptic 4 ovate 5 obovate 6 oblong 7 long oblong 8 long elliptic 9 long irregular or curved	-
3	Uniformity of shape	Observing and estimating	1 very irregular 2 50% or more irregular 3 25-50% irregular 4 mostly uniform 5 very uniform	Very uniform
4	Absence of lobes	Observing and estimating	1 very lobed 2 slightly lobed 3 without lobes	Absence
5	Absence of cracks	Observing and estimating	1 many cracks 2 few cracks 3 no cracks	Absence
6	Smoothness of surface	Observing and estimating	1 very irregular 2 somewhat irregular 3 very smooth	Smooth
7	External colour	Observing and estimating	1 white 2 cream 3 yellow 4 orange 5 brownish orange 6 pink 7 red 8 purple-red 9 dark purple	-
8	Internal colour	Observing and estimating	1 white 2 cream 3 dark cream 4 pale yellow 5 dark yellow 6 pale orange 7 intermediate orange 8 dark orange 9 strongly pigmented with anthocyanins	-
9	Uniformity of colour		1 very irregular 2 slightly irregular 3 very uniform	Very uniform

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 Francisco de Assis Santos e Silva, Federal University of Campina-Grande City, Campina Grande, Brazil.

Results:

Table 2. Characteristics of four sweet potato varieties at six months

	VARIETY			
CHARACTERISTIC	**ANTIGUA**	**NP001**	**SIX WEEKS**	**SOLOMON**
Storage roots per plant	6.7	7.3	5.9	5.5
Shape of root	ovate	round	round	round elliptic
Uniformity of shape	very uniform	25-50% irregular	mostly uniform	50% or more irregular
Absence of lobes	longitudinal grooves	absent	absent	absent
Absence of cracks	absent	absent	absent	absent
Smoothness of surface	smooth	smooth	smooth	smooth
External colour	purple-red	red	red	cream
Internal colour	cream	white	white	pale yellow
Uniformity of colour	very uniform	very uniform	very uniform	very uniform

The analysis of variance (ANOVA) of the yield responses (Table 3) for the four 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.

Table 3. Analysis of variance (ANOVA) for total number of tubers, number of marketable tubers, total tuber weights and weight of marketable tubers among four sweet potato varieties. Std Err is for each treatment mean. Error mean square has 191 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	No. of marketable tubers	Total weight	Weight of marketable tubers
Block	3	NS	NS	*	NS
Variety	3	**	**	**	**
Block x Variety	9	**	**	**	**
Std. Err		0.26	0.12	0.05	0.04

Tuber yield was based on the actual area of the whole plot and appeared to provide a good estimate of the true yield of the sweet potato. Marketable yield per plant (Table 4) was 0.66 kg, 0.26 kg, 0.85 kg and 0.01 kg for the varieties ‘Antigua’, ‘NP001’, ‘Six Weeks’ and ‘Solomon’, respectively. Therefore, the maximum yield was obtained from the variety ‘Six Weeks’.

Table 4. Yield components of four 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)	Yield **t/ha** (lb/acre)
Antigua	**6.7**	**0.98** (2.16)	**0.66** (1.46)	**26.4** (58.4)	**7.3** (6,542.5)
NP001	**7.3**	**1.11** (2.45)	**0.26** (0.60)	**10.4** (24.0)	**2.9** (2,577.4)
Six Weeks	**5.9**	**1.32** (2.91)	**0.85** (1.87)	**34.0** (78.4)	**9.4** (8,426.0)
Solomon	**5.5**	**0.27** (0.60)	**0.005** (0.01)	**0.4** (0.40)	**0.1** (99.2)

Both 'Solomon' and 'NP001' are late maturing varieties and did not produce a significant number of marketable-sized tubers after six months of growth. Results for the variety 'Solomon' were very low in comparison with the other three varieties. In most cases, no marketable tubers were produced. Root-knot nematode (*Meloidogyne* spp.) symptoms were observed on 'Solomon', which displayed evidence of a heavy infestation. The variety 'NP001' yielded a larger number of tubers than any of the other varieties, but tuber quality was reduced due to the presence of the sweet potato weevil (*Cylas formicarius*), which resulted in a lower yield of marketable tubers.

Moisture contents (%) for the four varieties were as follows: 'Antigua' (69.6), 'NP001' (66.0), 'Six Weeks' (68.0) and 'Solomon' (64.5). Due to unforeseen circumstances, analyses of soluble sugars and protein content have not been completed. It is expected that these results will be available at a later date, or with future studies on sweet potato tuber yield.

Plate 1. Damaged roots of 'Solomon' sweet potato at left, showing susceptibility to the root knot nematode. The sweet potato variety 'Antigua', with normal tubers, displaying resistance to the root knot nematode.

Results for the variety 'Solomon' were very low in comparison with the other three varieties. In most cases, no marketable tubers were produced. Evidence of root-knot nematode (*Meloidogyne* spp.) was observed on 'Solomon' (Plate 1), which displayed heavy infestation.

Discussion:

Mean marketable tuber yields were highest for the variety 'Six Weeks' followed by 'Antigua'. For a commercially feasible production of sweet potato in a developing market economy, average marketable yields are around 15 tons/ha (CIP, 1996). Average

yield per hectare in developing countries in the period 1990 to 1992 was 13.9 tons/ha (FAO Agrostat). Average yield for the four varieties were below those yields required for commercial success.

Results clearly indicate that 'Six Weeks' is superior in its yield potential and quality characteristics, compared to the other three varieties evaluated. The bushy variety 'Antigua' appears to be a more efficient plant, however, as it produced higher yields with a smaller plant size in comparison to the other spreading types. This is corroborated by Pardales and Belmonte (1989), who observed that the proportion of total dry matter partitioned to the tubers of bushy cultivars of sweet potato was greater than that in spreading types at all stages of growth.

Although the variety 'Solomon' did not perform well, due to its susceptibility to root-knot nematode, it is an excellent sweet potato, well liked for its cooking qualities. This variety will be included in further evaluations. In general, future yield trials will be conducted on these same varieties to confirm the stability of the tuber yields over several growing seasons.

One of the main objectives of the Root and Tuber Crops Programme of the Department of Agriculture is to identify sweet potato varieties with high and stable yields, in addition to good quality and resistance to pest and diseases. Varieties showing different responses under varying agronomic and environmental conditions make selection difficult. Further studies are required to identify varieties with more yield potential and to increase yield under improved agronomic practices.

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Internet Resources:

Noling, J.W. Nematode Management in Sweet Potatoes (including Boniatos)
http://edis.ifas.ufl.edu/NG030

Report on the Inter-Centre Review of Root and Tuber Crops Research in the CGIAR
http://www.fao.org/Wairdocs/TAC/X5791E/x5791e0q.htm#introduction