

## ON-FARM EVALUATION OF SWEETPOTATO VARIETIES IN ZANZIBAR

H.H. SALEH, Z. O. THABIT and A.H. ALI

Root and Tuber Crops Improvement Programme, Commission of Research and Extension,  
P. O. Box 159, Zanzibar

### ABSTRACT

On-farm evaluation of new crop varieties is crucial for speedy adoption of the materials by farmers. In Zanzibar, many experiments on sweetpotato (*Ipomea batatas*) have been conducted, but mostly on-station, hence, farmers' participation was limited. To improve farmers' adoption of new technologies including acceptance of new high yielding varieties, and for purposes of making recommendation to farmers based on their knowledge, skills and experience, on-farm experiments for testing of six improved sweetpotato varieties was done for two seasons in the Islands of Pemba and Unguja. Eight on-farm sites were involved and participation was highly encouraged. In order to involve many farmers as possible, Farmer Field Schools (FFS) and Farmers Research Groups were used in evaluation of the varieties. The criteria used by farmers to assess the materials included: plant establishment, drought resistance, disease and pest resistance, yield performance, dry matter content and cooking qualities. The seven varieties possess attributes desirable to the farmers. Therefore, all the varieties will be recommended to farmers.

*Key Words:* Farmer Field Schools, *Ipomea batatas*, Pemba

### RÉSUMÉ

Évaluation sur ferme de nouvelles variétés est cruciale pour accélérer l'adoption des matériaux par les fermiers. A Zanzibar, plusieurs expériences sur des patates douces (*Ipomea batatas*) étaient conduites, mais spécialement sur station, par conséquent, la participation était limitée. Pour améliorer l'adoption des nouvelles technologies, y compris des nouvelles variétés à haut rendement, par les fermiers; proposer des recommandations aux fermiers sur base de leurs connaissances, skills et expériences, des expériences sur fermes pour tester six variétés améliorées de la patate douce étaient faites pour deux saisons dans les îles de Pemba et Unguja. Huit fermes étaient impliquées et la participation était encourageante. Pour impliquer le plus grand nombre possible des fermiers des écoles de terrain de fermiers et des groupes de recherche des fermiers, étaient initiés dans l'évaluation des variétés. Les critères utilisés par les fermiers pour évaluer les matériaux: l'établissement des plantes, la résistance à la sécheresse, résistance aux maladies et pestes, rendement, le contenu en matière sèche et la qualité de la cuisson. Les sept variétés possèdent les attributs désirés par le fermiers. Par conséquent, toutes les variétés seront recommandées aux fermiers.

*Mots Clés:* Ecoles de terrain des fermiers, *Ipomea batatas*, Pemba

### INTRODUCTION

Agriculture accounts for 34.6% of the GDP in Zanzibar. It employs almost 80% of the total population of the Islands.

About 60% of the total cultivated land is planted to food crops, cassava (*Manihot esculenta*) and sweetpotato being the main root crops grown. Sweetpotato plays an important role as a food crop in Zanzibar. It has of late assumed a

cash crop status in some areas of the Islands. Though ranked fourth after rice, cassava and banana, sweetpotato is a food security crop. During drought periods, many low income families use it instead of bread and it also features prominently in the food recipes for breaking the fast (futari) during the holly month of Ramadan.

Sweetpotato like other root and tuber crops is a heavy feeder. It yields poorly in marginal land, therefore, farmers in some sweetpotato producing areas use urca to improve production of the crop.

Generally, the yield of sweetpotato in Zanzibar is low. Previous studies (COSCA, 1995; KAP Survey, 1994) reported that the average yield was as low as 5–8 t ha<sup>-1</sup>. However, a recent baseline study revealed average yield of some varieties were as high as 13–15 t ha<sup>-1</sup> on-farm (Saleh *et al.*, 2001).

Among the important constraints reported to cause low sweetpotato yield in Zanzibar are lack of capital for sweetpotato production, poor soils because of continuous cropping, poor quality vines and growing genetically low producing and disease and pest susceptible varieties (Op cit, 2001). There is need to research on improved varieties that will be acceptable to farmers. A trial was, therefore, conducted to evaluate with farmers participation the performance of introduced varieties, and select those that meet farmers' growing conditions and eating qualities.

## MATERIALS AND METHODS

The trial was conducted for two rainy seasons (2000/2001 and 2001/2002) in 8 sites using seven varieties. The sites included three in Pemba and five in Unguja. Five of the varieties (TIB-4, Salyboro, Zapallo, Tainung 65 and W-151) were introductions from CIP, two were local (SPN/O and Shangazi). The five CIP varieties are orange-fleshed. They were selected by farmers from 10 introductions planted on-station.

A randomised complete block design (RCBD) was used. Each site was treated as a replication. Each variety was planted on three ridges 10 m long. The plants were spaced 0.3 m within and 1 m by 1 m between the ridges. Trial management was using farmer normal practice of sweetpotato cultivation.

Four farmer field schools (FFS), two Farmer Research Groups (FRG), one prison camp (Magereza) and individual farmer were involved in the experiment. Farmers participated in all activities, from the site selection to the evaluation of the trial.

The vines were sourced from healthy and young mother stocks. Shoot tip cuttings, 25–30 cm long, were used. At each site, soil samples were taken before planting for laboratory analysis. The following data were taken by the researchers: plant establishment, root yield, number of roots per plot, number of marketable and non-marketable roots per plot, weight of marketable and non-marketable root and dry matter content.

Farmers assessed the varieties in the field using a scale of 1–5 (where 1 = very bad and 5 = very good) for resistance to diseases and pests, drought tolerance, time to maturity, root shape, root size, general root appearance, flesh colour of roots.

The roots were then boiled and farmers assessed each variety for appearance, taste, flavour, starchiness, fibrousness and general acceptability. The evaluation was done using a scale of 1–3 (where 1 = very good and 3 very bad). During the assessment, the varieties were given numbers instead of their actual names to reduce biasness in ranking of popular varieties. For each attribute the majority score was taken for each variety.

The data were statistically analysed using MSTAT-C and the statistical package for social scientists (SPSS) statistical software.

## RESULTS AND DISCUSSION

**Soil nutrient status.** Soil sample analysis results are presented in Table 1. In general, soil fertility status in experimental sites were not a factor to influence the performance on the sweetpotato production and, therefore, no significant interaction among the sites and varieties.

Upenja site lies within the semi-coral rag zone (with soils mixed with coral stones). Fujoni FFS site situated in the rice valleys of the sandy belt of northern part of Unguja Island. The rest of the zones lie between the belts of plantation area and multi-storey crop patterns.

TABLE 1. Soil properties across eight experiments sites

Site	Soil type	Sample depth (cm)	pH (H <sub>2</sub> O 1:2.5)	Total N <sup>1</sup> (%)	P <sup>2</sup> (mg kg <sup>-1</sup> )	K <sup>3</sup> (meq K <sub>2</sub> O 100g <sup>-1</sup> )	Na <sup>3</sup> (meq/100g)
Mitakawani	Sandy clay loamy	0-30	6.1	0.145	4	0.041	0.111
Junguni	Silt loamy	0-30	7.2	0.100	23*	0.060	0.135
Fujoni	Sandy clay	0-30	6.4	0.084	3	0.064	0.489*
Kinumoshi prison camp	Clay loamy	0-30	5.7	0.334*	4	0.136	0.156
Kizimbani	Sandy loamy	0-30	5.6	0.145	6	0.248**	0.052
Upenja	Silt loamy	0-30	7.7	0.282*	45**	0.117	0.058
Matangatuani	Clay loamy	0-30	5.3	0.084	45**	0.120	0.100
Kiuyu	Sandy clay	0-30	6.4	0.066	27*	0.180*	0.207

1. Total Nitrogen (N%) was determined by Semi Micro Kjeldahl method using Block Digester

2. Available P(P<sub>2</sub>O<sub>5</sub>) by Spectrometer from Bray & Kurtz 1 extraction

3. Exchangeable potassium (K<sub>2</sub>O) and sodium were analysed by Atomic Absorption Spectrophotometer using NH<sub>4</sub>O AC

\*Nearly adequate for the crop

**Farmers' field assessment.** The performance (mean score for all characteristics) of varieties across sites and the overall rank for each is presented in Table 2. In general, SPN/O was the most preferred variety, followed by the orange-fleshed varieties W-151 and Zapallo. Salyboro was the least preferred. The local control (Shangazi) was ranked poorly.

This result proves that farmers can evaluate and select their preferred varieties according to their indigenous knowledge, skills and experiences.

The performance of the varieties for different agronomic traits across sites is presented in Table 3. Significant differences ( $P < 0.05$ ) were observed among varieties in terms of field establishment (Table 3). Varieties SPN/O and Zapallo had the highest establishment of 98 and 97%, respectively, whereas variety Salyboro had the lowest (81%).

Varities differed significantly ( $P < 0.05$ ) in the number of marketable roots (Table 3) SPN/O had the largest number (23) whereas Salyboro and Tainung 65 the lowest (12).

No significant differences were detected between varieties for marketable root weight. The range among varieties was 3 - 7 kg plot<sup>-1</sup> (Table 3). All varieties had dry matter contents not less than 30%. However, varieties Shangazi (local check), SPN/O, Salyboro and TIB-4 had the highest dry matter contents. The differences between varieties were significant (Table 3).

Significant ( $P < 0.05$ ) differences existed between sites for number of marketable and non-marketable roots, and dry matter content (Table 4). No significant differences were detected among sites for marketable root weight.

Plant establishment was lowest at Upenja FRG (85%) and highest at Kiuyu FRG (96%). The case of Upenja was not surprising because this site is dominated by poor soils (coral rag) and moisture stress is a common phenomenon. Farmers rated variety Zapallo the best among the seven varieties at this site. Zapallo also proved the best performer under water logging conditions, which happened at Donge Muwanda (this site was abandoned) due to floods. All the other varieties perished. Furthermore, Zapallo was highly liked by farmers because its leaves (narrow) resembles those of a popular local variety grown for leaves, which are used as vegetable (mtoriro).

In general, five varieties (TIB-4, W-151, Zapallo

TABLE 2. Performance of sweetpotato varieties for all characteristics evaluated in the farmers field across eight sites

Variety	Sites								Mean	Rank
	Mitakawani FFS	Junguni	Fujoni	Prison camp Kinumosh	Kizimbani	Upenja	Matangatuani	Kiuyu		
TIB-4	3.73	3.34	3.64	3.30	3.09	3.45	3.36	3.54	3.43	4
Salyboro	3.18	2.90	3.18	2.50	2.90	3.09	2.55	3.00	2.91	7
Zapallo	3.73	3.55	3.81	3.36	3.27	3.36	3.63	3.72	3.55	3
Tainung 65	2.54	3.27	3.45	2.63	2.81	3.45	3.36	3.37	3.11	5
W-151	3.90	3.82	3.63	3.27	3.63	3.73	3.81	3.72	3.69	2
SPN/O	4.00	3.72	3.81	4.00	3.73	4.00	3.81	3.73	3.85	1
Shangazi (control)	2.7	3.18	3.09	3.00	3.18	3.00	3.27	3.27	2.96	6

varietal ranking was 1-5, where: 1 = very bad; 2 = bad; 3 = moderate; 4 = good; 5 = very good

and SPN/O and Tainung 65) were rated good across the sites. Two of them (Salyboro and the local check-Shangazi) were rated moderate (Table 5).

Although all the cooking qualities were rated good for all the varieties across sites, the varieties were outstanding in that they were not fibrous and tasted sweet (Table 6). Farmers in Zanzibar prefer varieties which are fibreless and sweet tasting (Saleh and Mohammed, 2001). Ranks for individual varieties for all the cooking characteristics at all the sites are presented in Table 5.

## ACKNOWLEDGEMENT

We are grateful to CIP/SARRNET and the Zanzibar Government for the financial support on this mini project.

## REFERENCES

- Ali, F.H., Salim, S.A., Rashid, F.S. and Hilal, S.M. 1996. Collaborative Study of Cassava in Africa (COSCA) survey results, Zanzibar Island. Root and Tuber Improvement Programme, Ministry of Agriculture, Livestock and Natural Resources, Zanzibar, Tanzania.
- Ali, F.H., Khatib, A.I. and Fom, M.A. 1995. Survey of Knowledge, Attitude and Practices (KAP) of five food crops and poultry production for Strategic Extension Campaign in Zanzibar, Tanzania.
- Mbwana, M.W. 1999. Crop Statistics in Zanzibar, with special reference to Cassava and Sweetpotato. Root and Tuber Improvement Programme, Zanzibar (MANREC), Tanzania.
- Nxumalo, M.H. and Edje, O.T. 1998. Farmers Participation in the selection of sweetpotato cultivars for on-farm trials. Paper presented in the SARRNET scientific workshop in Harare, Zimbabwe, 1998.
- Saleh, H.H. 2002. The adaptive research: Progress and Constraints, the case of Zanzibar. Paper presented at the Curriculum workshop held at Kizimbani Agricultural Training Institute, Zanzibar, 2002.
- Saleh, H.H. and Mohammed, S.O. 2001. The baseline study of cassava and sweetpotato in Tanzania (Zanzibar zone).

TABLE 3. Performance (per plot) of seven sweetpotato varieties across eight sites evaluated over two seasons (2000/01, 2001/02)

Variety/ clone	Establi- shment (%)	Plants with storage roots	Marketable roots	Non- marketable roots	Marketable roots (kg/plot)	Non-marketable roots (kg/plot)	Dry matter content (%)
TIB – 4	89.50	8.88	15.50	8.38	4.48 (14.9)*	0.62 (2.0)	34.88
Salyboro	80.94	7.88	12.38	4.63	3.33 (11.0)	0.52 (1.7)	35.51
Zapallo	97.38	8.63	13.75	3.87	4.32 (14.4)	0.35 (1.2)	30.13
Tainung 65	75.88	7.25	12.50	6.63	7.08 (23.5)	0.46 (1.5)	30.14
W.151	92.05	8.38	16.13	6.25	4.65 (15.5)	0.61 (2.0)	31.14
SPN/O	97.75	8.70	23.38	8.75	6.72 (22.3)	0.85 (2.8)	36.16
Shangazi	92.75	8.47	22.00	5.57	5.52 (18.3)	0.55 (1.85)	36.51
Mean	89.40	8.30	16.52	6.29	5.16	0.56	33.49
LSD (0.05)	10.39	1.21	3.21	NS**	NS	NS	4.88
CV (%)	8.88	14.45	42.63	69.42	96.93	77.7	11.14

\* values presented in parenthesis represent  $t \text{ ha}^{-1}$ 

\*\*NS = Not statistically significant

TABLE 4. Site performance for several agronomic characteristics of seven sweetpotato varieties evaluated for two seasons (2000/01, 2001/02)

Site	Establi- shment (%)	Plants with storage roots/plot	Marketable roots/plot	Non- marketable roots/plot	Marketable roots (kg/plot)	Non- marketable roots(kg/plot)	Dry matter content (%)
Mitaka. FFS	86.93	7.00	13.14	4.71	3.06	0.50	36.99
Upinja FRG	84.94	9.14	10.71	5.29	3.80	0.30	31.11
Kiuyu FRG	96.14	8.86	16.43	4.57	8.62	0.14	31.90
Fujoni FFS	91.71	9.14	15.00	5.85	5.30	0.95	33.97
Kizimbani	90.29	6.71	16.43	10.29	4.44	0.76	29.67
Kinumoshi	92.58	9.57	17.00	9.00	5.23	1.06	33.57
Junguni FFS	86.29	8.86	18.50	5.28	3.97	0.35	31.66
Matangatuani	86.82	8.43	24.80	5.57	6.78	0.24	34.09
Mean	89.46	8.46	16.50	6.32	5.15	0.53	32.57
LSD (0.05)	9.38	1.45	8.33	5.04	NS	0.52	4.412
CV(%)							

TABLE 5. Scores of seven sweetpotato varieties for seven cooking characteristics evaluated across eight sites for two seasons (2000/01, 2001/02)

Site	Mean score (1-3) for combined attributes per variety						
	Varieties						
	TIB-4	Salyboro	Zapallo	Tainung	W-151	SPN/O	Shangazi
Mitakawani	1.00	1.50	1.17	1.50	1.00	1.70	2.00
Upinja	1.00	1.50	1.33	1.17	1.17	1.33	1.33
Kiuyu	1.00	2.00	1.50	1.00	1.00	1.67	2.16
Fujoni	1.67	1.50	1.33	1.67	1.60	1.00	1.67
Kizimbani	1.00	1.66	1.67	1.33	1.17	1.33	1.50
Kinumoshi	1.17	1.67	1.00	1.67	1.17	1.00	1.67
Junguni	1.00	1.83	1.00	1.50	1.00	1.17	1.83
Mat/tuani	1.17	1.67	1.17	1.33	1.00	1.17	1.33
Overall mean	1.12	1.66	1.27	1.39	1.13	1.29	1.68
Overall rank	1	6	3	5	2	4	7

The subjective ranking score was 1-3 where as 1 =good, 2 moderate and 3 = poor

TABLE 6. Scores of six sweetpotato cooking characteristics for seven varieties evaluated across eight sites for two seasons (2000/01, 2001/02)

Sites	Attribute (score 1-3)						
	Appearance	Taste	Flavour	Starch	Fibrousness	Gen.acc	Mean Rank
Mitakawani	1.57	1.14	1.42	1.42	1.14	1.28	1.33 5
Upinja FFS	1.28	1.00	1.57	1.51	1.00	1.14	1.26 1
Kiuyu	1.57	1.42	1.42	1.28	1.14	1.57	1.40 8
Fujoni FFS	1.42	1.28	1.14	1.42	1.14	1.28	1.28 3
Kizimbani	1.20	1.28	1.42	1.42	1.00	1.28	1.30 4
Kinumoshi	1.42	1.00	1.57	1.57	1.14	1.42	1.33 5
Junguni	1.57	1.42	1.28	1.28	1.14	1.28	1.33 5
Mat/tuani	1.28	1.28	1.42	1.42	1.00	1.42	1.26 1
Mean	1.44	1.22	1.38	1.45	1.08	1.33	
Rank	5	2	4	6	1	3	

Ranking score 1-3 (1=good, 2=moderate, 3= poor)