

ON-FARM TESTING OF SELECTED CASSAVA CLONES

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ABSTRACT

Many local cassava (*Manihot esculenta* Crantz) varieties grown in Zanzibar are sweet and acceptable to farmers, but are prone to common virus diseases and pests. Unfortunately, these are low yielders. Most of the introduced varieties were not accepted by farmers. In order to enhance the acceptance of new high yielding new materials (five local bred breeding lines ZNZ/98/010, ZNZ/98/036, ZNZ/98/084, ZNZ/98/043 and ZNZ/98/034) were tested on-farm at UYT stage at 7 sites against Boma (local best) and a long time introduced variety, H.46106/27, a participatory evaluation trial was conducted. Farmers preferred clones ZNZ/98/036, ZNZ/98/034 and ZNZ/98/084 due to sweetness, disease resistance, root yields and dry matter content.

Key Words: Diseases, *Manihot esculenta*, pests

RÉSUMÉ

Plusieurs variétés locales de manioc (*Manihot esculenta* Crantz) plantées au Zanzibar sont sucrées et acceptables pour les fermiers. Cependant, elles sont sujettes aux virus et pestes. Malheureusement, elles ont un faible rendement. Toutes les variétés introduites n'étaient pas acceptées par les fermiers. Pour augmenter les chances d'acceptation des nouvelles variétés au rendement élevé, de nouveaux matériaux (cinq variétés locales ZNZ/98/010, ZNZ/98/036, ZNZ/98/084, ZNZ/98/043 et ZNZ/98/034) étaient testées sur ferme au stage UYT sur sept sites contre Boma (meilleur variété locale) et une variété longtemps introduite, H46106/27, utilisant une évaluation participative des essais. Les fermiers ont préféré les clones ZNZ/98/036, ZNZ/98/034 et ZNZ/98/084 à cause de la concentration en sucre, la résistance aux maladies, les rendements des racines, et le contenu en matière sèche.

Mots Clés: Maladies, *Manihot esculenta*, pestes

INTRODUCTION

Cassava (*Manihot esculenta*) is a major food crop in Zanzibar. It is grown mainly for the roots which are consumed in fresh form after boiling, roasted in coconut milk, or consumed in processed form. Cassava is ranked second among the staple food crops in Zanzibar though by acreage occupies the largest area under food crops (Ali *et al.*, 1996). It is estimated that more than 18,000 ha of cassava are grown annually and almost every rural household of Zanzibar is involved (Ali *et al.*, 1996).

Cassava is usually grown as a monocrop or intercropped with other food crops (Saleh *et al.*, 2001). Cassava intercrops often include; sweetpotato (*Ipomea batatas*), banana (*Musa* spp.), cowpeas (*Vigna unguiculata*), maize (*Zea mays* L.) and papaya (Wirth *et al.*, 1998; Op cit, 2001).

Zanzibar farmers grow a large number of varieties mainly sweet but they are genetically low yielding and are susceptible to diseases and pests. The most common diseases are cassava mosaic diseases (CMD) and cassava brown streak

disease (CBSD). White flies, mealy bugs and green mites are the common pests of cassava (Saleh, 2000).

Up to 46 varieties of cassava are estimated to be grown in Unguja Island alone (Fowler, 1997). Six of these are improved lines and two originated from Tanzania Mainland, including the famous Amani bred variety H.46106/27. Of all the varieties, Boma is the most common in Unguja.

Because of the diseases, pests and use of local low yielding varieties, root yield in Zanzibar is very low. Cassava yields have been reported to be 10–15 t ha⁻¹ in the plantation zones, but lower in the coral rag zones (COSCA, 1996). However, the 2001 baseline study revealed that cassava yield under good management ranges from 17–19 t ha⁻¹.

The objective of the trial was to evaluate improved clones of cassava under farmers conditions for resistance to pests and diseases, yield and other characteristics preferred by farmers.

MATERIALS AND METHODS

On-farm trials were set up at seven sites, four in Unguja and three in Pemba in Zanzibar. Unguja sites were Jendele and Mitakawani (Central District), Kizimbani (West District), and Upenja (North B District). For Pemba, the sites were Junguni (Wete District), Matangatuani (Micheweni District) and Mbuzini (Chake Chake District).

The varieties were selected from the Advanced Yield Trials (AYT) at Kizimbani and Matangatuani Research Stations (ZNZ/98/010, ZNZ/98/034, ZNZ/98/036, ZNZ/98/043 and ZNZ/98/084). Also included was one improved variety that originated from the former breeding station at Amani (H.46106/27) which is among the best performing introduced variety in Zanzibar, and the local (check) Boma, which is the most preferred local variety of cassava in Zanzibar (Benesi *et al.*, 1998). In Pemba, the local control was Kibiriti mweusi variety instead of Boma.

In Unguja the two Farmer Field Schools (FFS), and two Farmer Research Groups (FRG) were involved in evaluation, while in Pemba two FFS's and an individual farmer were involved.

A randomised complete block design was used

in the trials. Each site was treated as a replicate, thus, four replications were in Unguja and three in Pemba. Plot size slightly varied depending on farmers land availability. However, the average plot size was 10 m x 7 m.

Before planting, soil samples were taken from each site for nutrient analysis. Planting was done on ridges spaced 1 m apart, while space between plants was also 1 m. The trial was planted for two seasons (2000/01, 2001/02).

Data collected during the experiments included disease and pests scores. A scale of 1–5 was used, Where 1 = no apparent disease/pest symptoms and 5 = very severe symptoms. Disease and pest scoring was done at 3, 6, 9 and 12 months after planting (MAP).

Harvesting was done 12 MAP. At harvest, the total weight of roots (both marketable and non-marketable) was measured from ten plants in each plot. Dry matter was determined by taking 200 g medium sized roots, sliced and oven-dried at about 100°C for 2 days.

Farmers were asked to chew the dried slices and score them for taste using a scale of 1–5; where 1 = very sweet and 5 = very bitter.

Hydrocyanic acid content was determined by qualitative analysis using 0.1N silver nitrate (AgNO₃).

Data were statistically analysed using MSTAT-C statistical software.

RESULTS AND DISCUSSION

Results of soil analysis are presented in Table 1. Generally, the nutrient status across all the sites was good for good growth and yield of cassava.

Data on plant height are presented in Table 2. Varieties differed significantly ($P < 0.05$) in plant height across all the sites. At Mitakawani, plants tended to be taller irrespective of varieties than at the other sites. This could be attributed to the higher rainfall amount at this site than at the other sites.

Mean CMD disease scores across sites are summarised in Table 3. CMD severity was higher at Kizimbani, Upenja and Mitakawani than at the other sites. The most severity CMD affected varieties were the Amani hybrid H.46106/27, with a score of 2.5 at Mitakawani, and the local variety Boma with a score of 2.3 at Kizimbani

(Table 3). Varieties which had maximum severity scores of 4 - 5 included: Local Boma and Kibiriti. These varieties are genetically very susceptible to CMD (Saleh, 2000).

Cassava green mites incidence and severity was insignificant (data not shown).

The number of roots per plant data are presented in Table 4. There were significant ($P < 0.05$) differences among the clones/varieties with clone ZNZ/98/010 recording the highest number (9.5) at Junguni.

Total fresh root yields for the seven varieties across sites are given in Table 5. Significant ($P < 0.05$) differences were detected in yielding among varieties at all the sites. Variety ZNZ/98/084 gave the highest mean root yield across sites ($3.9 \text{ kg plant}^{-1}$). However, the highest mean yield

($8.0 \text{ kg plant}^{-1}$) was recorded from the same variety ZNZ/98/084 at Mbuzini (Table 5). Site differences in yield of varieties existed; Matangatuani was the best site overall ($4.9 \text{ kg plant}^{-1}$).

Dry matter (DM) and HCN content are presented in Tables 6 and 7, respectively. Varieties differed significantly in DM yield at all the sites. Differences between sites were also noted. In general variety ZNZ/98/084 had the highest DM (40.2%) across sites. However, all the varieties had high DMC ($>30\%$) at all the sites. All varieties had very low HCN levels (less than $5 \text{ mg } 100 \text{ g}^{-1}$ fresh weight) at all the sites. Clone ZNZ/98/036 had the lowest HCN content. The highest HCN content ($4.0 \text{ mg } 100 \text{ g}^{-1}$) was recorded from the Amani hybrid (H.46106/27) at Upenja. Significant differences were also detected across sites for

TABLE 1. Soil properties across seven sites used in the evaluation of the cassava varieties

Sites	Soil nutrient				
	Soil type	pH (H ₂ O)	Total N (%)	Avail. P (mg kg ⁻¹)	K K ₂ O/100g soil
Upenja	Silt loamy	7.7	0.282*	45	0.117
Jendele	Silt clay loamy	6.7	0.334**	4	0.136
Kizimbani	Sandy loamy	5.6	0.145	6	0.248
Matangatuani	Clay loamy	5.3	0.084	45	0.120
Junguni	Silt loamy	7.2	0.100	23	0.060
Mbuzini	Sandy clay	5.5	0.070	5	0.30
Mitakawani	Sandy clay loamy	6.1	0.145	4	0.041

N.B: Total Nitrogen (%) was determined by Semi Micro Kjeldah method using Block Digestor
Available P by Spectrometer (Bray and Kurtz 1 extraction)
Available Potassium (K₂O) was analysed by Atomic Absorption Spectro-photometer (AAS)

TABLE 2. Plant height for seven cassava clones evaluated at seven sites of Zanzibar, for two seasons (2000/01, 2001/02)

Clone no.	Sites/plant height (cm)							Mean
	Mitakawani	Upenja	Jendele	Kizimbani	Matangatuani	Junguni	Mbuzini	
ZNZ/98/010	315.8	146.8	143.0	163.6	134.1	137.0	136.9	168.2
ZNZ/98/084	332.1	166.5	173.0	202.1	142.8	137.3	139.7	184.8
ZNZ/98/034	264.0	168.3	172.1	184.5	135.2	133.7	141.1	171.2
ZNZ/98/036	289.9	123.3	164.9	168.8	156.8	140.2	135.2	168.4
ZNZ/98/043	243.0	105.9	182.4	174.0	156.2	137.2	148.9	163.9
Local check	317.3	125.3	156.2	214.8	166.8	142.6	142.9	180.8
H.46106/27	220.0	147.8	122.0	160.5	142.7	139.0	159.8	155.9
Mean	283.1	140.5	159.0	181.2	147.8	138.1	143.5	
LSD 0.05	15.1	9.25	9.80	11.2	8.6	7.4	7.8	

TABLE 3. CMD severity scores of seven cassava varieties evaluated across seven sites for two seasons (2000/01, 2001/02)

Clone no.	Sites							Mean
	Diseases score in scale (1-5)							
	Mitakawani	Upenja	Jendele	Kizimbani	Matangatuani	Junguni	Mbuzini	
ZNZ/98/010	1.00	1.25	1.02	1.2	1.05	1.05	1.15	1.10
ZNZ/98/084	1.15	1.25	1.45	1.27	1.10	1.10	1.05	1.19
ZNZ/98/034	1.15	1.30	1.15	1.50	1.10	1.10	1.15	1.20
ZNZ/98/036	1.00	1.30	1.15	1.20	1.15	1.15	1.05	1.14
ZNZ/98/043	1.00	1.10	1.25	1.35	1.25	1.35	1.30	1.22
Local check	1.77	1.50	1.17	2.35	1.70	1.40	1.15	1.57
H.46106/27	2.55	2.10	1.87	1.50	1.75	1.45	1.20	1.70
Mean	1.37	1.40	1.29	1.48	1.30	1.30	1.57	
LSD (0.05)	0.41	0.31	0.40	0.50	0.41	NS	NS	

Note: Control variety Boma for Unguja, Kibiriti for Pemba
Average severity of infected plants based on 1-5 classes 1 as no apparent symptoms 5: severe mosaic. The scoring was at 3, 6, 9 and 12 MAP

TABLE 4. Number of roots per plant for seven cassava clones evaluated across 7 sites of Zanzibar for two seasons (2000/01, 2001/02)

Clone no.	Sites/roots							Mean
	Mitakawani	Upenja	Jendele	Kizimbani	Matangatuani	Junguni	Mbuzini	
ZNZ/98/010	4.0	5.0	4.5	3.5	8.5	8.5	9.5	6.2
ZNZ/98/084	5.5	5.0	6.5	4.5	8.5	8.5	8.5	6.7
ZNZ/98/034	5.5	6.0	6.5	4.0	6.0	6.5	6.5	5.8
ZNZ/98/036	5.0	7.0	6.0	5.0	5.5	6.5	7.0	6.0
ZNZ/98/043	5.0	5.5	5.5	6.0	7.5	6.5	7.0	6.1
Local check	6.5	5.5	5.5	5.0	8.5	7.5	7.0	6.5
H.46106/27	4.5	5.5	4.5	5.0	4.5	4.5	5.0	4.7
Mean	5.1	5.6	5.5	4.7	7.0	6.9	7.2	
LSD 0.05	0.9	1.0	0.8	0.7	0.5	1.3	1.5	

TABLE 5. Yield performance (kg plant^{-1}) for the cassava clones evaluated across 7 sites of Zanzibar for two seasons (2000/01, 2001/02)

Cassava Clone no.	Sites							Mean
	Mitakawani	Upenja	Jendele	Kizimbani	Matangatuani	Junguni	Mbuzini	
ZNZ/98/010	3.2	3.2	2.7	1.6	4.6	2.9	3.7	3.2
ZNZ/98/084	2.5	2.3	1.7	1.8	7.0	4.5	8.0	3.9
ZNZ/98/034	3.2	1.7	2.2	1.5	3.4	5.1	3.0	2.8
ZNZ/98/036	4.0	3.5	1.0	1.9	4.7	4.5	3.2	3.4
ZNZ/98/043	1.5	1.5	1.9	1.5	6.0	5.2	5.3	3.3
Local check	3.0	3.5	2.2	2.0	5.0	3.0	4.5	3.3
H.46106/27	1.5	1.7	2.5	2.3	4.0	3.0	3.0	2.5
Mean	2.7	2.4	2.0	1.8	4.9	4.0	4.4	
LSD (0.05)	0.4	0.6	1.0	0.4	0.9	0.6	0.7	

HCN content. Varieties had highest HCN contents at Upenja (2.58 mg 100 g⁻¹ of fresh weight)

Sensory evaluation scores are presented in Table 8. Significant differences were detected between varieties at all the sites. In general, variety ZNZ/98/036 had the lowest score across the sites, indicating that it was the sweetest variety. H46106/27 had the highest score, implying that it was relatively bitter.

Sites effect was also significant ($P < 0.05$). Varieties scored the lowest (sweet) at Mbuzini, whereas at Upenja they scored highest (bitter). When the HCN content data were regressed on the taste data, a very strong and highly significant association was detected ($r = 0.94$). This implies that farmers in Zanzibar could detect high HCN levels in cassava by taste.

TABLE 6. Dry matter weight (DM) content (%) for seven cassava clones/varieties evaluated at 7 sites for two seasons (2000/01, 2001/02)

Clone no.	Sites/DMY (%)							Mean
	Mitakawani	Upenja	Jendele	Kizimbani	Matangatuani	Junguni	Mbuzini	
ZNZ/98/010	37.5	38.2	37.3	38.1	38.8	39.8	33.7	38.4
ZNZ/98/084	38.4	40.2	37.3	40.5	38.6	37.2	39.2	39.0
ZNZ/98/034	36.0	37.8	34.3	37.7	36.7	34.6	34.5	35.9
ZNZ/98/036	39.8	35.8	33.9	37.9	39.6	39.0	37.4	37.6
ZNZ/98/043	32.0	33.7	39.0	37.1	39.0	34.6	39.1	36.6
Local check	38.0	32.0	38.2	39.3	36.0	37.9	36.2	36.8
H.46106/27	39.6	38.6	38.9	34.9	39.9	39.7	39.1	38.6
Mean	37.6	36.6	37.0	37.9	38.3	37.5	37.7	
LSD (0.05)	5.5	6.0	6.1	NS	NS	NS	5.7	

NS = Not significant at $P < 5\%$

TABLE 7. Hydrocyanide (HCN) content (mg 100 g⁻¹ fresh weight) for seven cassava clones/varieties evaluated at seven sites for two seasons (2000/01, 2001/02)

Clone	Sites							Mean
	Mitakawani	Upenja	Jendele	Kizimbani	Matangatuani	Junguni	Mbuzini	
ZNZ/98/010	1.30	2.45	1.25	1.30	1.30	1.25	1.30	1.45
ZNZ/98/084	2.60	2.60	1.28	1.30	1.30	1.30	1.30	1.66
ZNZ/98/034	1.30	2.60	1.30	1.30	1.40	1.25	1.30	1.40
ZNZ/98/036	1.30	2.65	1.25	1.30	1.50	1.25	1.20	1.49
ZNZ2/98/043	2.60	2.55	2.55	2.60	1.30	1.30	1.35	2.03
Local check	1.30	1.30	1.30	1.30	1.70	1.30	1.80	1.42
H.46106/27	2.50	4.00	2.60	2.60	1.90	2.55	1.85	2.57
Mean	1.80	2.58	1.65	1.67	1.40	1.45	1.44	
LSD (0.05)	0.51	0.41	0.30	0.35	NS	0.47	NS	

NS = Statistically not significant

TABLE 8. Farmers assessment on taste of the roots for seven cassava varieties tested at 7 sites for two seasons (2000/01, 2001/02)

Clone no.	Sites							Mean
	Mitakawani	Upenja	Jendele	Kizimbani	Matangatuani	Junguni	Mbuzini	
ZNZ/98/010	2.0	5.0	2.0	2.0	4.0	3.5	2.0	2.9
ZNZ/98/084	4.0	5.0	2.0	2.0	2.0	5.0	3.0	3.2
ZNZ/98/034	1.0	4.5	1.0	1.0	1.0	2.0	2.0	1.8
ZNZ/98/036	1.5	5.0	2.0	2.0	2.0	2.0	2.0	2.4
ZNZ2/98/043	2.5	4.5	3.0	3.0	1.5	2.0	2.0	2.6
Local check	2.0	2.0	1.5	1.5	2.0	2.0	2.0	1.8
H.46106/27	4.0	3.0	4.0	4.5	2.0	2.0	2.0	3.1
Mean	2.4	4.1	2.2	2.3	2.1	2.6	NS	
LSD (0.05)	0.4	0.5	0.6	0.6	0.8	1.0	2.0	

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