

## PARTICIPATORY EVALUATION OF IMPROVED SWEETPOTATO VARIETIES IN EASTERN TANZANIA

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### ABSTRACT

Sweetpotato (*Ipomoea batatas* L.) is among the important subsistence food crops in eastern Tanzania. Sweetpotato is regarded as a food security crop since it bridges a hunger gap when cereals are still in the field. Recently, the crop has been commercialised and is a cash earner. On-farm trials were established in three villages in three districts of Coast and Dar-es-salaam regions. The villages are Pangani (Kibaha), Chanika (Ilala) and Matimbwa (Bagamoyo). Seven varieties were evaluated including 5 officially released varieties Jitihada, Vumilia, Mavuno, Sinia and Simama. Two local improved varieties, Carrot-C (orange-fleshed) and Ukerewe, were also included. The released varieties, with exception of Simama, were tested in the Lake zone of Tanzania only, prior to their release. Participatory variety evaluation involving researchers, extensionists and farmers was adopted in two consecutive seasons. Formal evaluation by researchers proved that a purple skinned and cream fleshed (with orange pigments) variety Ukerewe has generally high establishment, partial resistance to sweetpotato mosaic virus disease and sweetpotato weevils (*Cylas* spp.). Farmers' assessment revealed the variety to be most preferred by producers and traders. Its purple skin colour increases its market value. Root yield, marketability, resistance to drought, pests and diseases were the main criteria used by farmers in the selection of sweetpotato varieties.

*Key Words:* *Ipomea batatas*, mosaic virus, orange fleshed, weevil

### RÉSUMÉ

La patate douce (*Ipomea batatas* L.) est un important aliment de subsistance dans l'Est de la Tanzanie. Elle est vue comme l'aliment assurant la sécurité alimentaire quand les céréales sont encore dans les champs. Récemment, la plante a été commercialisée et devenue une source de revenu. Des expériences sur ferme étaient établies dans trois villages de trois districts de la cote et de Dar-es-Salaam. Ces villages sont Pangani (Kibaha), Chanika (Ilala) et Matimbwa (Bagamoyo). Sept variétés étaient évaluées dont cinq officiellement larguées: Jitihada, Vumilia, Mavuno, Sinia et Simama. Deux variétés locales améliorées, carrot-C (orange graissé) et Ukereme étaient aussi incluses. Les variétés larguées, à l'exception de Simama, étaient testées dans la zone du lac Tanganyika avant leur largage. Une évaluation participative des variétés impliquant les chercheurs, des agents de terrain et des fermiers était adoptée pour deux saisons consécutives. Une évaluation, formelle par les chercheurs montra que les variétés à peau violette et crème graissée (avec des pigments orangés) a généralement un haut niveau d'établissement, une résistance partielle au virus mosaïque et des charançons de la patate douce (*Cylas* spp.). L'évaluation des fermiers a révélé que la variété est préférée par les producteurs et les vendeurs. La couleur violette de sa peau augmente sa valeur commerciale. Le rendement des racines, la possibilité d'être commercialisé, sa résistance au déficit en eau, les pestes et les maladies étaient les critères utilisés par les fermiers dans la sélection des variétés de la patate douce.

*Mots Clés:* *Ipomea batatas*, virus mosaïque, orange graissé, charançon

## INTRODUCTION

Sweetpotato (*Ipomoea batatas* L.) is an important subsistence crop grown in almost all agro-ecological zones of Tanzania (Kapinga *et al.*, 1995; Minde *et al.*, 1995). The crop has a short growing season and so, can avoid long dry seasons (Jana, 1982; Kapinga *et al.*, 1995).

In eastern Tanzania, sweetpotato is considered as a household food security crop, surpassing those of maize (*Zea mays*) and rice (*Oryza sativa*) (Minde *et al.*, 1995). The crop is primarily grown for home consumption, although in some areas of the eastern zone, the crop has gained commercial value and it is produced for cash in both rural and peri-urban areas.

Most sweetpotato varieties grown by farmers are low yielders due to many factors. These include pests and diseases, low yielding character inherent to the genotypes and poor adaptation to environmental conditions (Onwueme and Charles, 1994). In the eastern zone, sweetpotato mean yields at farm level are 2.0 t ha<sup>-1</sup> (FAO, 1992; MAFS, 2002). Normally, sweetpotato marketability (price) is determined by the root skin and flesh colour. Purple skin with orange or yellow flesh fetches twice as much as the price of cream or white skinned with white or cream flesh (Mtunda *et al.*, 2001)

In sweetpotato breeding programmes, major parameters considered in the selection of new sweetpotato varieties include variety resistance to pests and diseases, high root yield potential, adaptability to a wider range of environments and other desirable agronomic characteristics. This results in exclusion of some attributes that farmers consider in the selection of new varieties.

Varieties react differently in terms of changes in the environment. Under research conditions, a controlled environment is created, which may sometimes differ from the actual field condition in on-farm. Participatory evaluation of the improved varieties is therefore, imperative. The objective of this study was to evaluate the acceptability of improved sweetpotato varieties by farmers, through assessing the performance of the tested varieties under farmers' condition and investigating the criteria used by farmers in the selection of sweetpotato varieties.

## MATERIALS AND METHODS

Trials were conducted on-farm in three villages Pangani (Kibaha), Chanika (Ilala) and Matimbwa (Bagamoyo). The villages are among potential areas for sweetpotato production in the Coast and Dar-es-salaam regions. Six to thirteen farmers per village (site) were involved in the first and second seasons, respectively.

Seven sweetpotato varieties were evaluated. These were, Sinia, Jitihada, Vumilia, Mavuno, Simama, Ukerewe and Carrot-C (orange fleshed) were evaluated. These varieties were tested against locally adapted varieties in each village, i.e., Majani mapana (Pangani), Pananzala (Chanika) and Mbutu (Matimbwa).

The trials were laid out in a randomised complete block design, where each farmer represented a replicate. Plot size was 4 m x 6 m. Each row consisted of 20 plants spaced 0.3 m apart. Farmers were responsible for all field activities, including land clearing, ridging, planting, weeding and harvesting. All activities were done under the supervision of the researcher and extension worker within the village.

The same seven varieties were evaluated in a uniform yield trial established on-station. Obtained results were used as a base for comparison of the varieties performance in the two management systems.

**Data collection and analysis.** Data were collected using CIP guidelines. It included sprouting rate, virus incidence (percentage), sweetpotato weevil infestation levels (Table 4), yield components (number and weight of roots, dry matter content). The data were subjected to analysis of variance and means separated using least significant differences (LSD) at 0.5 probability level.

**Farmers' assessment.** Groups of farmers from each site were invited for participatory selection of the varieties. Assessment was done for shoot, root and post-harvest qualities. Criteria used by farmers in the selection of varieties were also identified. The criteria were mentioned at random and finally preference ranking was developed (Fig. 1).

Farmers' opinions on individual clones were

computed into frequencies and the scores on each criterion were compared. Higher frequencies indicated that the criterion/variety had higher acceptance.

## RESULTS AND DISCUSSION

**Sprouting rate and reaction to virus diseases of the evaluated varieties.** Sprouting was generally high in all locations (Table 2). Variety Ukerewe had the highest sprouting percentage across locations (98% in the second season of 2002) and being second (85.2%) in 2001. Kibaha on-station had highest sprouting percentage in all years (88.57 and 100.0), compared to on-farm trials.

This was probably due to controlled conditions on-station. Sprouting was lowest at Chanika (78.53 and 86.0%).

Virus infection was evaluated using infection symptoms (Table 3). Mild virus symptoms on many plants and some stunted plants (Class 3) were observed on varieties Vumilia, Sinia and some farmers varieties. Varieties Ukerewe, Jitihada, Mavuno, Simama, and Carrot-C exhibited mild virus disease symptoms on a few plants (class 2), indicating to have some resistance to virus infection.

Though they expressed virus symptoms, varieties Jitihada, Mavuno, Simama, Ukerewe seem to be tolerant to sweetpotato virus diseases.

TABLE 1. Root characteristics of the sweetpotato varieties evaluated in eastern Tanzania

Variety	Storage root colour			
	Predominant skin colour	Secondary skin colour	Predominant flesh colour	Secondary flesh colour
Simama	Cream	-	Cream	Yellow
Vumilia	White	-	White	Purple
Mavuno	Cream	-	Cream	-
Jitihada	Cream	-	Cream	-
Sinia	Purple	-	Yellow	-
Ukerewe	Purple	-	Cream	Orange
Carrot-C	Cream	-	Orange	-

TABLE 2. Sprouting (%) of the evaluated varieties of sweet potato in the eastern zone, Tanzania, 2001-2002

Variety	Percent sprouting									
	2001					2002				
	Kibaha	Pangani	Matimbwa	Chanika	Mean	Kibaha	Pangani	Matimbwa	Chanika	Mean
Jitihada	91.3	86.1	75.7	79.0	83.0	100.0	98.0	76.0	51.0	81.3
Vumilia	91.6	82.0	84.3	77.2	83.8	100.0	91.0	82.0	94.0	91.8
Mavuno	66.9	72.3	77.0	79.0	73.8	100.0	94.0	93.0	84.0	92.8
Simama	95.7	97.9	79.7	79.2	88.1	100.0	98.0	93.0	94.0	96.3
Sinia	88.8	86.1	80.0	80.0	83.7	-	-	-	-	-
Ukerewe	93.8	92.8	76.3	78.0	85.2	100.0	95.0	99.0	98.0	98.0
Carrot-C	91.9	85.0	79.3	79.4	83.9	100.0	84.0	98.0	90.0	93.0
Farmers variety	-	86.5	79.7	76.4	80.9	-	77.5	100.0	91.0	89.5
Mean	88.57	86.09	79.00	78.53		100.0	91.07	91.57	86.00	
CV (%)	8.53					0				
LSD (0.05)	0.796					ns				

ns = not significant at 5%

**Sweetpotato weevil (*Cylas* spp.) infestation levels.** The results on sweetpotato weevil evaluation in both years/seasons are summarized in Table 4. All varieties had a mean scores of 1.0 to 2.0; implying that weevil infestation was very low. Only variety Jitihada had a mean score of above 2.0 at Chanika (2001) and 2.07 at Kibaha (2002). However, there were no significant ( $P>0.05$ ) differences among varieties.

**Root yield and dry matter content.** Root yield was determined on the basis of size and weight of the storage roots. Larger (marketable) roots were separated from small (unmarketable) roots. There were significant differences among varieties in terms of number of roots. Variety Mavuno and Ukerewe had more larger roots compared to other varieties (Table 5). The high number of large roots is a good indicator for high yields. In the first season (2001), variety Ukerewe had moderate yields across location ( $10.6 \text{ t ha}^{-1}$ ). This yield, however, was above the yield in farmers fields  $2.0 \text{ t ha}^{-1}$  (MAFS, 2002). In the second season, Ukerewe ranked the second with 4.78 tonnes per hectare as root yield. Mean yields in the second season were generally low, ranging from 1.60 to 5.68 tonnes per hectare, compared to the first season ( $4.15$  to  $24.6 \text{ t ha}^{-1}$ ) (Table 6). The difference was attributed to poor rainfall distribution over the season. In 2002, about 422.6 was received in April (planting stage) and a sudden drop of 22.9,

15.0 and 23.3 mm in the following months of May, June, July (Fig. 2).

Variety Ukerewe had significantly ( $P<0.05$ ) higher dry matter content (41.4) than the rest of the varieties. Dry matter content is one of the selection criteria farmers use in the selection of sweetpotato varieties (Table 6).

**Farmers' criteria for selection of sweetpotato varieties in Eastern zone, Tanzania.** Similar criteria were used by farmers in all sites in the selection of sweetpotato varieties. Sixty-six farmers were involved in this exercise. Criteria mentioned randomly, included marketability that consisted many factors such as shape, size, skin and flesh colour of the storage root. Other criteria included resistance to prevalent pests and diseases, longer shelf-life of the roots, high root yield potential, early maturity, sweetness and ability to resist drought.

Preference ranking revealed resistance to pests and diseases, root yield potential, ability to resist drought and marketability to be very important. Maturity period, root sweetness and shelf-life period were considered to be less important (Fig. 3).

Farmers participated in the assessment of shoot characteristics (canopy and leaf size, resistance to diseases, and suitability for intercropping), root characteristics (size, shape, number of roots per plant, skin and flesh colour), and post-harvest

TABLE 3. Virus incidence (percentages) on sweet potato varieties used in evaluation trials in eastern Tanzania, 2001-2002

Variety	Virus incidence (%)							
	2001				2002			
	Kibaha	Pangani	Matimbwa	Chanika	Kibaha	Pangani	Matimbwa	Chanika
Jitihada	2 (75)	2 (100)	2 (100)	2 (85.7)	2 (75)	2 (100)	2 (100)	2 (80)
Vumilia	2 (75)	3 (66.7)	3 (50)	3 (71.4)	2 (100)	2 (63.6)	3 (66.6)	3 (55.5)
Mavuno	2 (100)	2 (66.7)	2 (75)	2 (57.1)	2 (100)	2 (81.8)	2 (100)	2 (100)
Simama	2 (100)	2 (66.7)	2 (100)	2 (71.4)	2 (100)	2 (75)	2 (100)	2 (100)
Sinia	2 (100)	3 (66.7)	3 (100)	3 (71.4)	-	-	-	-
Ukerewe	2 (100)	2 (66.7)	2 (100)	2 (57.1)	2 (75)	2 (100)	2 (100)	2 (100)
Carrot-C	2 (100)	2 (66.7)	2 (75)	2 (100)	2 (50)	2 (84.6)	2 (100)	2 (88.8)
Farmers variety	-	2 (50)	2 (100)	3 (50)	-	2 (81.8)	2 (100)	2 (88.8)

Rating: 1=no symptoms, 2=mild symptoms on a few plants, 3=mild symptoms on many plants, some stunted, 4=mild symptoms on many plants, stunting of many plants, 5= most plants stunted. Values in brackets represent .....

qualities (appearance, sweetness, mealy-ness, acceptance) of the evaluated varieties. Varieties Ukerewe, Simama and dominant farmers' varieties in each site revealed to have general acceptance by the farmers as compared to the rest of the varieties.

## CONCLUSIONS

In the eastern zone of Tanzania (lowland warm sub-humid areas), the two sweetpotato varieties Ukerewe and Simama (SPN/O - a regional released variety) have high yields as well as acceptability

TABLE 4. Sweet potato weevil (*Cylas* spp.) infestation levels in uniform yield trial (Kibaha) and on-farm trials in the Eastern zone, Tanzania (2001 - 2002)

Variety/clone	Sweet potato weevil rating							
	2001				2002			
	Kibaha	Pangani	Matimbwa	Chanika	Kibaha	Pangani	Matimbwa	Chanika
Simama	1.19	1.36	1.18	1.64	1.49	1.56	1.06	1.41
Vumilia	1.21	1.20	1.03	1.24	1.80	1.30	1.00	1.08
Mavuno	1.11	1.20	1.53	1.33	1.53	1.57	1.12	1.25
Jitihada	1.22	1.64	1.18	2.28	2.07	1.87	1.21	1.52
Carrot-C	1.27	1.26	1.14	1.35	1.47	1.30	1.08	1.23
Sinia	1.07	1.30	1.05	1.13	-	-	-	-
Ukerewe	1.08	1.08	1.19	1.50	1.11	1.58	1.05	1.20
Farmer variety	1.01	1.06	1.16	1.47	-	1.27	1.04	1.47
Mean	1.153	1.262	1.181	1.492	1.557	1.493	1.078	1.309
CV (%)	16.39	16.82	18.40	29.65	47.99	20.05	10.24	26.47
LSD (0.05)	0.279ns	0.372ns	0.383ns	0.650	1.140	0.285	0.099	0.351ns

Rating: 1 =no damage, 2=1 to 25% root surface damaged, 3=26 to 50% root surface damaged, 4=51 to75% root surface damaged, 5=76 to100 % root surface damaged. NS = not significant at 5%

TABLE 5. Number of roots of sweet potato varieties evaluated on-farm in eastern Tanzania

Varieties	Site/number of small (unmarketable) roots					Site/number of large (marketable) roots				
	Kibaha	Pangani	Matimbwa	Chanika	Mean	Kibaha	Pangani	Matimbwa	Chanika	Mean
Simama	79.8	56.3	48.6bc	3.8b	47.13	31.0b	30.0a	17.9bcd	59.6abc	34.63
Vumilia	61.5	64.0	26.8c	0.8c	38.28	28.5b	23.0a	11.9d	29.9c	23.33
Mavuno	70.3	60.9	68.6ab	3.9ab	50.93	42.5a	23.9a	30.0a	77.9a	43.58
Jitihada	60.3	72.6	40.6c	4.3ab	29.59	50.5a	27.4a	32.3a	38.8bc	37.25
Ukerewe	95.3	72.1	75.4a	3.0bc	61.45	36.3ab	29.1a	25.9abc	68.3ab	39.90
Carrot-C	57.8	45.3	47.4bc	0.7c	37.80	10.8c	9.0b	15.6cd	48.7abc	21.03
Farmers variety	-	43.9	46.4bc	6.5a	32.27	-	21.8ab	28.6ab	54.3abc	34.90
Mean	70.79	59.29	50.53	3.30		33.25	23.46	23.16	53.91	
CV (%)	27.71	34.32	26.76	29.7		28.66	28.26	30.84	25.42	
Significance (0.05)	ns	ns	***	***		**	*	***	*	

TABLE 6. Yield and dry matter (%) of sweet potato varieties evaluated on-station and on-farm in the eastern zone, Tanzania (2001 and 2002)

Variety	Dry matter content (%)	Fresh root yield (t ha <sup>-1</sup> )									
		Site/2001					Site/2002				
		Kibaha	Pangani	Matimbwa	Chanika	Mean	Kibaha	Pangani	Matimbwa	Chanika	Mean
Jitihada	33.1	12.3	21.5	37.9	26.7	24.60	8.5	4.4	7.9	1.9	5.68
Vumilia	31.5	9.4	5.9	26.1	15.1	14.13	5.1	4.7	2.3	1.1	3.30
Mavuno	28.4	1.6	4.9	30.0	19.4	13.60	6.2	3.6	5.5	3.6	4.73
Simama	34.1	7.7	14.2	16.9	17.9	14.18	6.4	5.4	3.4	2.6	4.45
Sinia	-	5.1	4.2	1.5	5.8	4.15	-	-	-	-	-
Ukerewe	41.4	10.6	7.2	16.5	8.5	10.60	6.9	4.7	4.8	2.7	4.78
Carrot-C	35.5	8.8	3.7	11.5	7.1	7.78	1.9	0.9	2.1	1.5	1.60
Farmers variety	-	6.3	11.3	16.0	11.1	11.10	-	3.5	6.0	2.7	3.05
Mean	34.0	7.68	9.11	19.55	13.95		5.8	3.9	4.6	2.3	
CV (%)	4.20	33.44	35.15	36.69	49.23		29.13	32.01	31.07	29.53	
LSD (0.05)	***	7.141	8.941*	18.274*	6.318***		**	**	**	**	

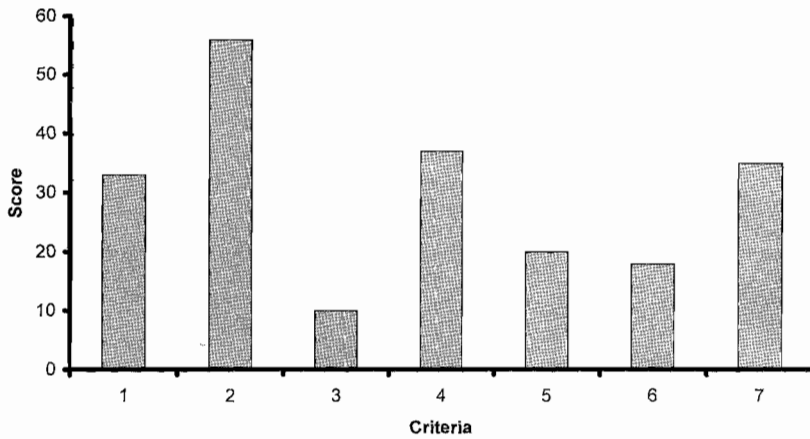


Figure 1. Criteria used by farmers in the selection of sweetpotato varieties in the eastern zone, Tanzania (N=66).

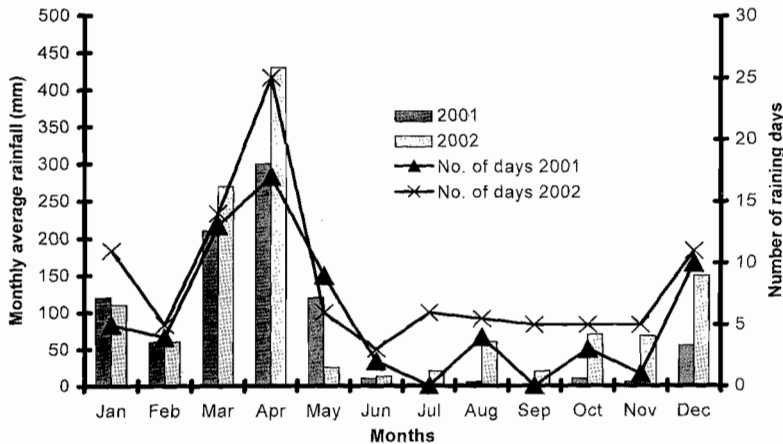


Figure 2. Amount of rainfall received 2001 and 2002, Kibaha, Tanzania.

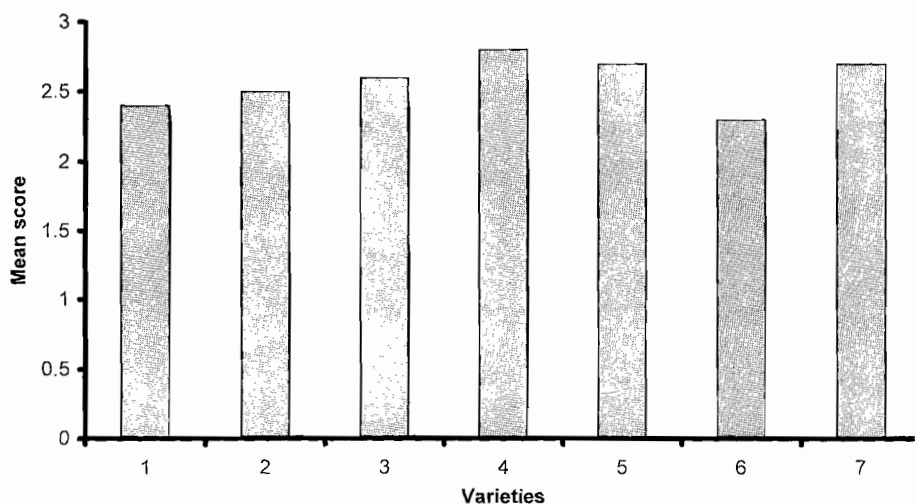


Figure 3. Mean virus infestation scores of sweetpotato varieties evaluated on-farm in the Eastern zone, Tanzania (N=66).

among more than other previously released varieties (Jitihada, Mavuno, Vumilia and Sinia).

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