

SWEETPOTATO CHARACTERIZATION IN NIGERIA

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INTRODUCTION



- ❑ Nigeria is now second largest producer of sweetpotato with 3.49million tonnes (FAO 2009), but per capita annual consumption is approximately 22.3 kg.
 - ❑ Despite its high agronomic potential, ease of production and ability to produce relatively good yields even on marginal soils, sweetpotato is considered as a minor crop in the country.
 - ❑ Increased production of the crop is desired, particularly as more emphasis is gradually being placed on agriculture.
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Introduction continued

- ❑ Local varieties cannot meet the demand of end-users for different utilization purposes.
 - ❑ Average tuber yields of 5t/ha are recorded
 - ❑ Crop variety is the main variable in the system that farmers often manipulate to raise yields
 - ❑ Sweetpotato varieties that are higher yielding than the available local clones need to be identified and released after a good multiplication programme.
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Problems associated with sweetpotato production in Nigeria

- 1. Varieties being cultivated by farmers are of unknown origin and give low yields.**
 - 2. No organized supply of good quality planting material.**
 - 3. Utilization of the crop is limited to pockets, hence no widespread cultivation.**
 - 4. Consumers bias and misconceptions about the crop, e.g. some claim it causes diabetes.**
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OBJECTIVES

- ☐ **Assess the sweetpotato systems in Nigeria**
 - ☐ **Characterize assembled sweetpotato clones under Ibadan conditions**
 - ☐ **Document distinguishing traits for better identification to aid sequential selection of clones that suit consumer preferences.**
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MATERIALS AND METHODS

The study was conducted as one survey and three experiments:

- ❑ Investigation I: Survey on Sweetpotato production, marketing and utilization systems in Nigeria
 - ❑ Investigation II: Characterization of sweetpotato genotypes in a tropical environment (Ibadan)
 - ❑ Investigation III: Evaluation of selected sweetpotato clones in different agroecological zones of Nigeria
 - ❑ Investigation IV: Uniform yield trials of sweetpotato clones in different agroecological zones of Nigeria
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Investigation I: Survey on Sweetpotato production, marketing and utilization systems in Nigeria

Objective: to assess sweetpotato production, utilization and marketing as an update of knowledge.

Study areas: Oyo, Kwara, Abia, Ebonyi, Rivers and Bayelsa States and three Local Government Areas (LGAs) per State

Focus Group Discussions with ten male and ten female farmers/
LGA/State

- to obtain information on problems encountered in production and marketing,
- as well as common utilization forms of the crop.

The major sweetpotato market in each LGA was used as a population.

- *Survey period:* October 2005 (Abia), November 2005 (Ebonyi), March 2006 (Oyo), April 2006 (Kwara), May 2006 (Bayelsa) and June 2006 (Rivers).

Investigation II: Characterization of sweetpotato clones in a tropical environment (Ibadan)

Objective: to characterize many clones and identify traits to aid sequential selection of clones that suit consumer preferences.

Experimental site: field located at Parry Road, University of Ibadan, Oyo State

- longitude 3°45 ' E; latitude 7°30 ' N; elevation of 210 m above mean sea level; bimodal rainfall distribution and mean annual rainfall of 1250 mm.

Experimental design: randomized complete block with two replications

- May to September 2006 (characterization and preliminary evaluation)
- March to September 2007 (further characterization and preliminary evaluation)

Table 1: Number of sweetpotato clones from different sources within and outside Nigeria assembled at Ibadan and characterized from 2006-2008

Collection source	No. of clones
Abia State	3
Cross River State	1
Rivers State	2
Bayelsa State	24
University of Ibadan	9
Kwara State	1
Oyo State	2
Ebonyi State	5
Kaduna State	1
IITA, Ibadan	11
CIP Kenya	59
DR Congo	2
Japan	2
Tanzania	2
Uganda	1
Total	125

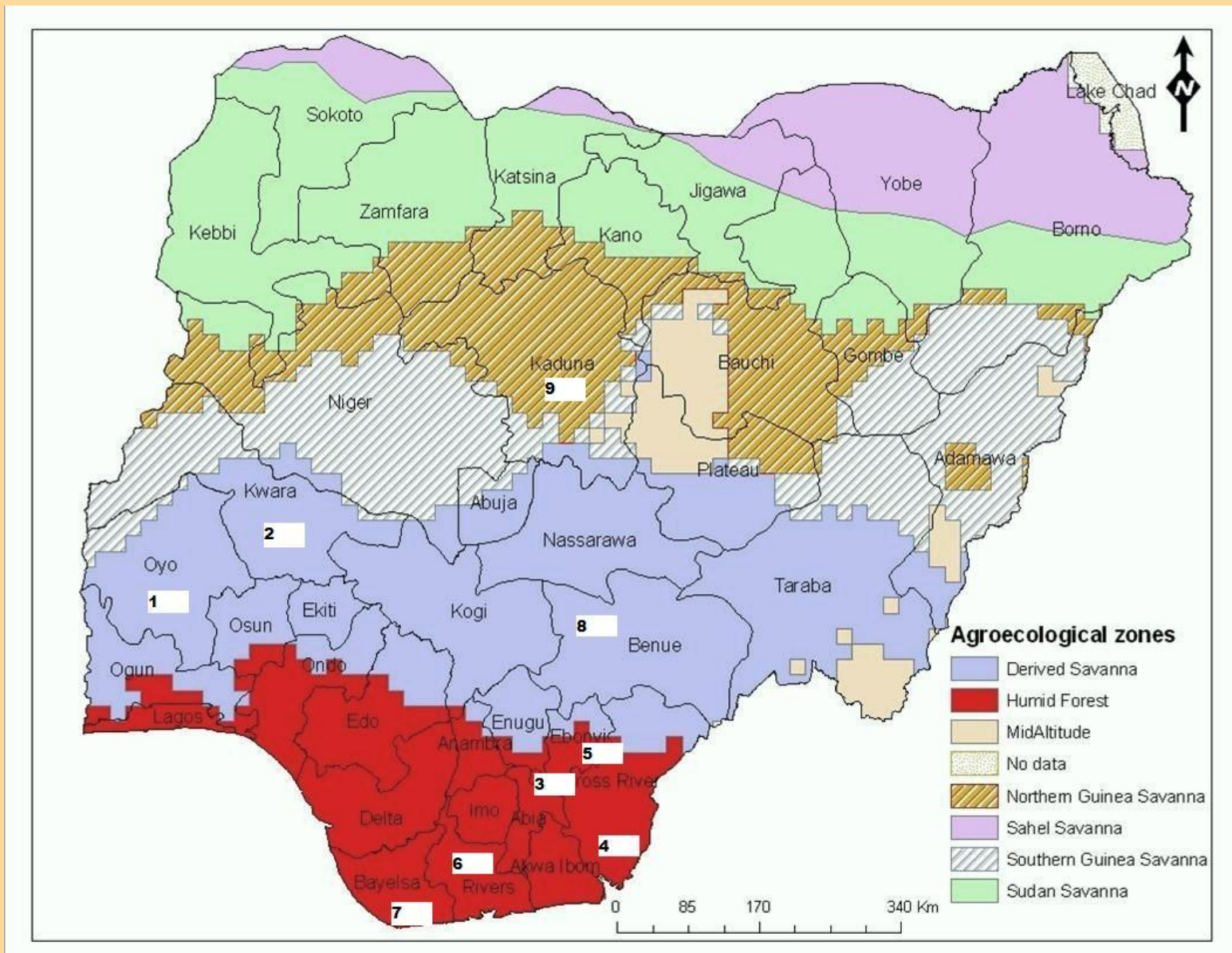


Figure 1: Locations for sweetpotato germplasm collection in Nigeria from October 2005 to May 2006

Field layout: A total of 125 sweetpotato clones

- single row plots measuring 2.1 m x 1 m to give seven plants
- during the second season, double row plots measuring 2.1 m x 2 m were used, giving 14 plants

Data collection: Characterization of the leaves, vines, tuberous roots and inflorescences was done using the CIP Protocol. Border plants were disregarded for both seasons

Statistical analysis: Multidimensional Analysis (MDA) of key traits to suit producer and consumer preferences was done in order to select clones for further evaluation in three agroecological zones of Nigeria.

Investigation III: Evaluation of promising sweetpotato clones in different agroecological zones of Nigeria

Objective: to evaluate 40 clones selected from the initial collection of 125.

Experimental sites: trials were carried out in Ibadan, Oyo State (Derived Savannah) and Umudike, Abia State (Humid Forest) and Kuru, Plateau State (Mid Altitude Zone) from July 2007 to January 2008.

Experimental design: randomized complete block design with two replications

Field layout:

- ❑ each plot was 4.5 m x 1 m (4.5 m²)
- ❑ plant spacing of 1 m x 0.3 m gave 15 plants per plot.
- ❑ length of vine cuttings planted was 25 cm.

Plot maintenance:

- ☐ manual weeding using hoes and cutlasses four, and eight weeks after planting
- ☐ re-heaping of ridges when necessary
- ☐ clearing of brush at borders of experimental areas every two weeks.
- ☐ no application of fertilizer or pesticides.

Data collection: was on whole plant, and tuber variables

Statistical analysis: Multidimensional Analysis (MDA) to select top white, yellow and orange-fleshed sweetpotato clones for further trials in the locations.

Investigation IV: Assessment of tuber yields of elite sweetpotato clones in different agroecological zones of Nigeria

Objective: to assess tuber yield of 15 sweetpotato clones selected for different end-uses

Experimental sites: Ibadan, Oyo State; Umudike, Abia State and Kuru, Plateau State

Experimental design: randomized complete block design with two replications per site in three sites

Field layout: Plot size was 5.1 m x 5 m, with five rows of 17 plants each, giving 85 plants/plot for each clone.

- plant spacing was 30 cm between plants and 1.0 m between rows.
 - 15 varieties (5 white-, 5 yellow- and 5 orange-fleshed), including two local checks (one white- and one yellow-fleshed variety) were used.
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Data collected includes: survival rate, fresh tuber yield, and marketable tuber yield

□ marketable tubers were taken to be $\geq 80\text{g}$ and free from insect, disease or rot damage.

Statistical analysis: Plotting of mean tuber yields and coefficients of variation (CV %) across locations

Table 2: Characteristics assessed, period and year of assessment for 125 sweetpotato clones from 2006-2008 at Ibadan

Characteristics assessed	Period of assessment	Year assessed
<i>Above ground</i>		
Leaf (mature leaf shape; size)	12 WAP	2006 and 2007
Shoot (immature shoot colour, vine tip hairiness)	12 WAP	2006 and 2007
Vine (vine colour; length; plant type)	12 WAP	2006 and 2007
Flowering		2006 and 2007
SPVD and Sweetpotato weevil	12 WAP	2006; 2007 and 2008
Survival rate	16 WAP	2006; 2007 and 2008
Plantable 25cm cutting supply	8 WAP	2006; 2007 and 2008
<i>Below ground</i>		
Tuber skin colour	at harvest 4 MAP	2006 and 2007
Tuber flesh colour	at harvest 4 MAP	2006 and 2007
Number of tubers/plant	at harvest 4 MAP	2006; 2007 and 2008
Fresh tuber weight	at harvest 4 MAP	2006; 2007 and 2008
Tuber length/breadth ratio	at harvest 4 MAP	2006 and 2007
Tuber shape	at harvest 4 MAP	2006 and 2007
Ease of harvesting	at harvest 4 MAP	2006 and 2007
<i>Sensory/quality evaluation</i>		
Boiled tuber consistency	after harvest	2007 and 2008
Boiled tuber texture	after harvest	2007 and 2008
Boiled tuber sweetness	after harvest	2007 and 2008
Boiled tuber acceptability	after harvest	2007 and 2008
Tuber rot score	4 WAH	2006 and 2007
Keeping quality	4 WAH	2006 and 2007

Forms of sweetpotato utilization based on survey in six States of Nigeria

- 1: boiling and eating with stew/palm oil;**
- 2: slicing and frying;**
- 3: roasting;**
- 4: boiling and eating as snack;**
- 5: boiling and pounding alone or with boiled yam/garri for eating with soup;**
- 6: cooking alone or with another crop to make pottage;**
- 7: slicing and sun-drying for milling into flour;**
- 8: feeding of vines and leaves to livestock;**
- 9: small tuberous roots as livestock feed;**
- 10: made into fufu like cassava;**
- 11: fresh leaves and young shoots consumed as vegetable.**



Plate 1: The four main sweetpotato varieties found in Nigeria:
(a and b) Cream skin, yellow-fleshed type
(c and d) Purple-red skin, white-fleshed type; and



A



B

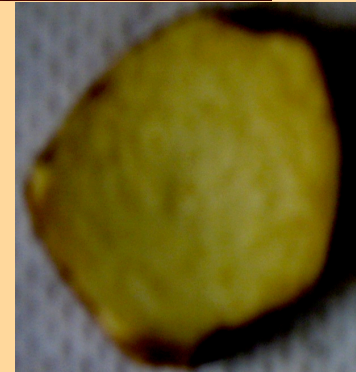


Plate 2: The two main sweetpotato tuber types found in Nigeria:
(a) Purple-red skin, white-fleshed type; and
(b) Cream skin, yellow-fleshed type

Table 3: Preferred characteristics of sweetpotato varieties by producers, marketers and consumers during focus group discussions in six States from October 2005 to June 2006

Characteristic	Reason
<i>1. Sweetpotato producers</i>	
Ability to spread fast and suppress weeds	Weeds are suppressed thus reduces the need for weed control
Disease and insect tolerance	Plants grow better and there is more tuberous root yield
Tolerance to water-logging	High amount of rainfall in some areas often leads to water-logging
Potential to be grown in all seasons	Rainy season sometimes unpredictable and the need to provide food and income year-round
High yielding	Leads to increased income with minimal inputs
Early maturing	To free land for other crops, or second crop of sweetpotato
<i>2. Sweetpotato marketers</i>	
Large tuber size	Preference of consumers
Good tuber shape (elliptical shape)	Makes produce more attractive for consumers to buy
Marketability (free from blemishes)	More sales means more income
Outer skin colour of tubers	Consumers are used to cream and purple-red skinned types
Tubers with hard-to-bruise skin	Handling and transport is usually rough and consumers reject bruised tubers
Good storability	Storing in times of glut and selling later gives more profit
<i>3. Sweetpotato consumers</i>	
Less- sweet or non-sweet taste	Only children and a few adults enjoy the very sweet types
High root firmness when boiled	Soft texture of boiled tubers is unappetizing
Little or no discolouration after boiling	Makes it more appealing
Low fibre content	Easier to chew and swallow when boiled

Table 4: Selected characteristics of 125 sweetpotato clones assessed at Ibadan from May to November 2006 and March to September 2007

Characteristic	No. of clones	Characteristic	No. of clones
<i>1. Plant type</i>		<i>5. Tuber shape</i>	
Erect (< 75cm)	14	Round	4
Semi-erect (75–150cm)	35	Round elliptic	28
Spreading (151–250cm)	44	Elliptic	28
Extremely spreading (> 250cm)	32	Ovate	20
<i>2. Mature leaf shape</i>		Obovate	27
Reniform	6	Long oblong	2
Cordate	36	Long elliptic	10
Triangular	41	Long irregular or curved	6
Hastate	1	<i>6. Tuber skin colour</i>	
Toothed	14	Cream	35
Slightly lobed	7	Yellow	7
Moderately lobed	7	Orange	23
Deeply lobed	12	Brownish Orange	5
Very deeply lobed	1	Pink	31
<i>3. Mature leaf size</i>		Red	5
Small (< 8cm)	51	Purple Red	16
Medium (8–16cm)	70	Dark Purple	3
Large (>16cm)	4	<i>7. Tuber flesh colour</i>	
<i>4. Flowering</i>		White	37
Produces flowers	18	Yellow	61
Does not flower	107	Orange	27

Table 5: Morphologically similar clones among 125 assessed at Ibadan in 2006 and 2007

Group Name	No.	Group members	Distinct characteristics
Yenaka	2	Yenaka I; Yenaka II	Medium-sized, moderately lobed leaves (5 lobes); mostly purple vines; moderate spreading ability
Shaba	8	Shaba, Ex Igbariam; Kayode; Odhiolugboji; Yibama II; ABK 4; Ishiayi; Zarama Market I	Medium-sized, triangular toothed leaves; high spreading ability; immature leaves usually have purple pigmentation
TIS 87/0087 (I)	5	TIS 870087; Yibama I; Kalama Pink; Zarama Market II; Umu I	Medium-sized, cordate leaves with green vines
AK Wide	3	AK Wide; Zarama Nyambiri II; Famgbe II	Medium-sized, wide toothed leaves (5 teeth); thick green vines
Zarama Epie (W)	3	Zarama Epie; Imiringi; Ogu I	Small-sized, deeply lobed leaves (5 lobes) with purple margins; viny, extremely spreading growth habit
Famgbe I	10	Famgbe I; Ishiayi Red; Kalama Red; Anyamabele-Okordia; Akinima; Zarama Nyambiri I; Otuasega I; Zarama Nyambiri III; Kaiama; Kalama White; Sagbama I;	Cordate leaves with vines sometimes purple and sometimes green
Arrowtip	3	Arrowtip; 440170; Sagbama II	Small-sized leaves shaped like an arrow-tip; viny, extremely spreading growth habit
Abakaliki	2	Benue; ABK 2	Medium-sized, toothed leaves (3 teeth) with purple veins on lower leaf surface; first 3 immature leaves have purple veins
TIS 8164 (I)	2	TIS 8164; Ogoja	Medium-sized, wide toothed leaves (5 teeth); thick pale green vines; semi-erect to slightly spreading growth habit

Table 6: Variability in tuber traits of 125 sweetpotato clones assessed at Ibadan in 2007

Variable	Min.	Max.	Mean	Std	CV (%)
Number of tubers/plant	1	13.17	3.38	2.28	67.56
Tuber weight/plant (g)	7	1696.6	328.21	325.57	99.2
Weevil damage score	1	5	1.94	1.38	71.18
Large tuber length/breadth ratio	0.62	7.6	2.52	1.32	52.49
Medium tuber length/breadth ratio	2.5	18.5	2.1	1.04	49.43
Ease of harvesting large tubers	1	4	2.27	0.82	35.96
Ease of harvesting medium tubers	1	4	2.38	0.8	33.66
Boiled tuberous root consistency	1	9	4.26	2.02	47.45
Boiled tuberous root texture	1	9	4.18	2.36	56.41
Boiled tuberous root sweetness	1	6	3.16	1.41	44.65
Boiled tuberous root appearance	1	5	2.86	2.96	103.69
Tuberous root rot score 4WAH	1	5	2.78	1.48	53.33

4 WAH: 4 weeks after harvesting



**Plate 3: Sweetpotato fields 2 MAP at: a) Umudike, Abia State (Humid Forest);
b) Ibadan, Oyo State (Derived Savannah); and c) Kuru, Plateau State (Mid Altitude)**

Table 7: Selection indices and ranks for ten orange-fleshed sweetpotato clones evaluated in 2007 at Kuru, Ibadan and Umudike

Clone	TY	YSI	EHl	TAI	KQI	PCI	SRI	WRI	SSI	Rank
199024.2	4.38	0.42	0.50	8.00	2.50	0.68	0.50	1.00	5.41	1
A-067	2.33	0.96	0.33	7.00	1.25	0.49	0.50	1.00	2.93	2
440034	2.87	0.66	0.29	9.00	1.00	0.36	0.50	1.00	2.47	3
199034.1	3.07	0.88	0.42	9.00	1.67	0.31	0.33	1.00	1.55	4
440141	2.94	0.42	0.33	9.00	1.67	0.29	0.20	0.20	1.37	5
440041	7.51	0.18	0.50	5.00	5.00	0.54	0.20	0.50	0.98	6
SPK 004	0.59	0.20	0.33	8.00	2.50	0.29	0.50	0.33	0.55	7
440140	1.47	0.21	0.50	5.00	5.00	0.45	0.20	0.20	0.22	8
440001	1.59	0.26	1.00	7.50	1.00	0.28	0.20	0.25	0.16	9
440293	4.30	0.41	0.33	3.00	2.50	0.28	0.25	0.20	0.15	10

TY = mean tuber yield; YSI = yield stability index; EHl = Ease of harvest index;
TAI = Taste acceptability index; KQI = Keeping quality index; PCI = Plantable cuttings index; SRI= survival rate index; WRI= sweetpotato weevil resistance index; and SSI = Selection suitability index

Table 8: Selection indices and ranks for fifteen yellow-fleshed sweetpotato clones evaluated in 2007 at Kuru, Ibadan and Umudike

Clone	Mean AY	YSI	EHl	TAI	KAI	PCI	SRI	WRI	SSI	Rank
CIP Tanzania	0.73	0.40	0.50	8.00	2.50	0.79	1.00	1.00	9.64	1
Barth	1.36	0.33	0.33	9.00	1.67	0.47	1.00	1.00	5.96	2
A-012	1.85	0.33	0.50	8.00	1.67	0.32	1.00	1.00	3.94	3
Shaba	3.68	0.21	0.33	8.50	1.25	0.29	1.00	0.50	2.04	4
440215	3.53	0.37	1.00	9.00	1.25	0.33	0.50	0.50	1.25	5
ABK 1	2.74	0.29	0.50	6.00	1.67	1.00	0.25	0.25	0.70	6
Famgbe I	1.89	0.28	0.33	8.00	1.25	0.47	0.33	0.25	0.46	7
NASPOT 1	2.59	0.47	0.33	7.50	1.25	0.52	0.25	0.25	0.40	8
TIS 4400-2	1.49	0.35	1.00	9.00	1.25	0.43	0.25	0.25	0.35	9
Ogu I	1.22	0.37	0.75	8.00	1.25	0.27	0.25	0.33	0.26	10
TIS 80/0140	1.34	0.29	0.42	8.00	1.25	0.46	0.20	0.25	0.26	11
TIS 70357	0.38	0.34	0.33	8.00	5.00	0.31	0.25	0.20	0.22	12
440102	0.76	0.26	0.50	7.50	1.25	0.37	0.20	0.20	0.15	13
CIP Wagaboliga	0.28	0.29	0.50	8.00	1.25	0.23	0.25	0.25	0.15	14
GR 3 25	1.78	0.19	0.50	7.00	1.00	0.26	0.20	0.25	0.14	15

TY = mean tuber yield; YSI = yield stability index; EHI = Ease of harvest index;
TAI = Taste acceptability index; KQI = Keeping quality index; PCI = Plantable cuttings index; SRI= survival rate index; WRI= sweetpotato weevil resistance index; and SSI = Selection suitability index

Table 9: Selection indices and ranks for fifteen white-fleshed sweetpotato clones evaluated in 2007 at Kuru, Ibadan and Umudike

Clone	Mean AY	YSI	EHl	TAI	KAI	PCI	SRI	WRI	SSI	Rank
TIS 87/0087*	3.78	0.65	0.50	8.00	1.25	0.33	1.00	1.00	4.67	1
A-089	1.59	0.28	0.33	7.00	1.67	0.41	1.00	1.00	4.44	2
Arrowtip	2.94	0.78	0.33	8.00	1.67	0.22	1.00	1.00	2.96	3
Benue	1.36	0.40	0.42	8.00	1.67	0.40	1.00	0.50	2.40	4
TIS 8441	3.75	0.42	0.33	9.00	1.67	0.25	1.00	0.50	1.91	5
AK Wide	1.00	0.28	0.50	9.00	1.67	0.90	0.33	0.25	0.93	6
TIS 8250	1.10	0.31	0.50	4.00	0.00	0.29	1.00	0.50	0.86	7
TIS 8164	3.64	0.52	0.42	8.00	1.67	0.82	0.25	0.25	0.73	8
TIS 2532	3.07	1.00	0.50	8.00	2.50	0.33	0.50	0.25	0.62	9
ABK 2	1.76	0.20	0.42	9.00	0.00	0.38	0.25	0.33	0.36	10
420005	2.01	0.20	0.42	9.00	1.25	0.57	0.20	0.20	0.29	11
AOB 25	0.84	0.22	0.50	8.50	0.00	0.47	0.20	0.25	0.24	12
18801.2	1.20	0.26	0.33	5.00	1.67	0.25	0.20	0.25	0.11	13
440170	2.83	0.28	0.50	3.00	1.00	0.38	0.20	0.20	0.11	14
440112	1.24	0.23	0.33	5.00	1.67	0.28	0.20	0.20	0.09	15

TY = mean tuber yield; YSI = yield stability index; EHI = Ease of harvest index;
TAI = Taste acceptability index; KQI = Keeping quality index; PCI = Plantable cuttings index; SRI= survival rate index; WRI= sweetpotato weevil resistance index; and SSI = Selection suitability index

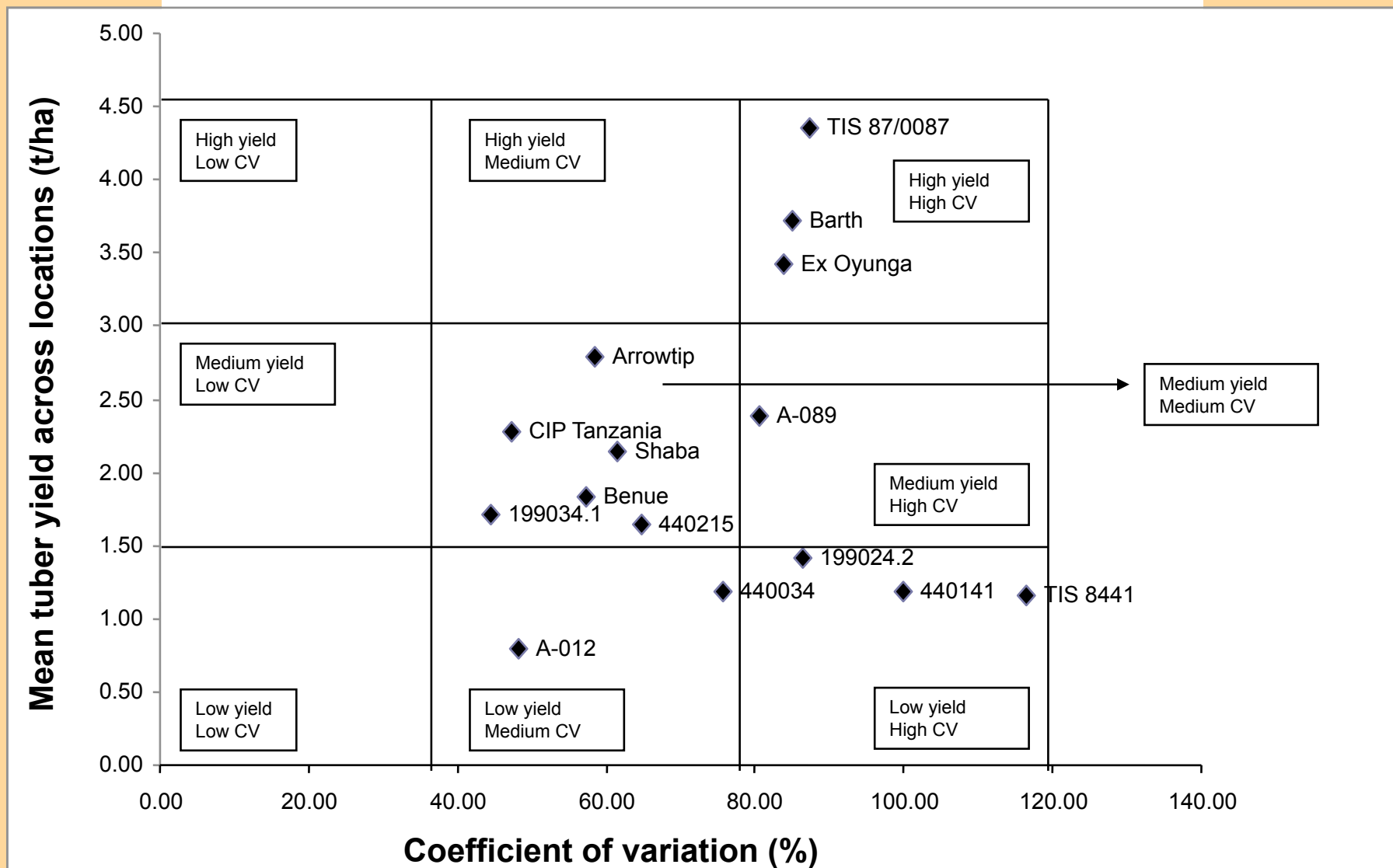


Figure 2: Mean tuber yield and coefficients of variation for 15 sweetpotato clones evaluated at Kuru, Ibadan and Umudike in 2008/2009 cropping season



SUMMARY AND CONCLUSIONS

Red skin, white-fleshed and cream skin, yellow-fleshed sweetpotato varieties are the most commonly grown, marketed and consumed types.

Sweetpotato tubers are mainly eaten in fresh form with little or no processing in the survey areas.

Stakeholders (producers, marketers and consumers) have selection preferences and these must be considered in any meaningful selection scheme.

- producers prefer varieties that are disease and pest tolerant/resistant, with ability to spread fast, suppress weeds, and be grown in all seasons;
 - marketers prefer those with large, healthy and elliptical-shaped tubers;
 - consumers prefer tubers that are less sweet with firm texture when boiled.
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SUMMARY AND CONCLUSIONS

Characterization, evaluation and sequential selection of a collection of 125 sweetpotato clones gave fifteen elite clones which meet different end-uses

Vine cuttings of the 15 elite clones have been multiplied and disseminated to farmers in Oyo State for on-farm trials.

Five clones with relatively stable yield across agroecological zones were:

Arrowtip; CIP Tanzania; Shaba; Benue and 199034.1

THANK YOU



FOR YOUR ATTENTION
