Evaluation of Stability Performance of Orange-fleshed Sweetpotato Clones in East African Regional Trials

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Outline

- Introduction
  Vitamin A Deficiency (VAD) Status
- Conduct of Orange-fleshed Sweetpotato (OFSP) Regional Trial in 7 East African Countries, 2004-2006
- Materials and Methods
- Results and Implications

Micronutrient Malnutrition

- Primarily Due to Diets Poor in Bioavailable Vitamins and Minerals
- Widespread, Very Serious Problem in Developing Countries
- Fe, Zn, and Vitamin A Deficiencies Affect >3.5 Billion People

Underlying Cause of Micronutrient Malnutrition

- Poor Quality Diets
- High Intake of Food Staples
- Low Consumption of:
  a) Animal and Fish Products
  b) Plant Sources Rich in Bioavailable Minerals & Vitamins

Status of Vit A Deficiency

- 3 Mill Pre-school Age Children Visible Eye Damage
- 250,000 – 500,000 Go Blind Annually, 2/3 Die After 1 Month (167,000 – 333,000)
- Vit A Essential For Immune Function

Consumption of OFSP High in Provitamin A Improves Body Stores of Vitamin A, Reduces Risk of VAD (Clinical Trial, 4-8 Year Old Children, S. Africa)

Van Jaarsveld et al. ß-carotene-rich orange-fleshed sweet potato improves the vitamin A status of primary school children assessed with the modified-relative-dose-response test. *Am J Clin Nutr* 2005; 81: 1080-1087.

Biofortification of Staple Food Crops

- Increased Interest
- To Complement Sustainable Approaches to Alleviate Micronutrient Deficiencies
- Biofortification is Development of Micronutrient-dense StapleCrops Using Best Traditional Breeding and Modern Biotechnology Practices

Regional Effort to Improve Consumption of OFSP to Alleviate VAD in SSA

- PRAPACE, CIP, NARS
- Elite Sweetpotato Clones Undergo Rigorous Testing Before Official Release
- GxE Trial Reported Here
- Objective: Evaluating Quality of Data Generated by Participating Countries
- Preparation For Regional Collaborative Biofortication Research Effort to Improve ß-carotene Content in Sweetpotato

Materials and Methods

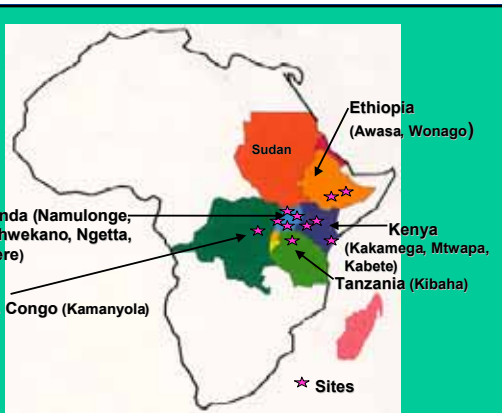
1) 20 Clones (2 Pathogen-tested OFSP Invitro Plantlets/Clone) Sent From CIP, Lima, Peru to CIP, Muguga (Kenya), and Namulonge (Uganda) Nov 2002
2) Material Micropropagated in Tissue Culture Labs and Screenhouses at Mugaga and Namulonge 2003

Materials and Methods

- In Uganda the 20 OFSP Clones Evaluated For Adaptation
- Trials Planted June/July 2004
- 7 Promising Clones Evaluated in E. African OFSP Regional Trial

Trial Sites in Uganda

Mini-vine Cuttings of 7 OFSP Promising Clones in Uganda Sent From Muguga Quarantine Station, Kenya to 7 Collaborating Countries, 2005. Each Country Multiplied the Clones, Including Common Check (SPK004) For Trial



GxE Sites For OFSP E. African Regional Trial

G x E Sites Regional Trial

- Selection of Sites Based on Altitude, Agroclimatic Conditions, and Food Systems
- Clone Selection Based on Vine Availability
- Vine Tip Cuttings, 30 cm Long
- Each Clone 4 Ridges, 0.3 m between plants (1 m x 6 m) [33,300 Plants/ha]
- RCBD, 3 Reps
- Standard Data Collection: Establishment, Vigour, SPVD, Root Traits at Harvest
- Middle 2 Rows Harvested 4-6 Months After Planting

GxE Regional OFSP Trial, Data Collection and Analysis

- Complete Data Set For Total Root Yield of 8 Clones
- 11 Out of 18 Sites in 5 Out of 7 Countries
- Analyses (SAS):
- ANOVA
- Regression (b, deviation)
- AMMI
- Tai

Table 1. Estimates of stability parameters for storage root yield of 8 OFSP clones in 11 sites, 2004/2005

CIP code	Clone name or pedigree	Root yield t/ha	Regression estimates[1] b^3	S_d^4	Tai stability test[2] α^5	Signi ficance	λ^6	Signi ficance
199004.2	CC89.147. 4 x OP	14.5	0.76151	78.78	-0.1021	NS	5.12875	*
199005.11	CHGU 1.002 x OP	18.8	1.70016	44.52	0.61903	*	2.69174	*
199015.13	LM92.032 x OP	13.5	0.09465	27.14	-0.8457	*	2.23443	*
199024.1	SR91.109 x OP	15.0	1.66328	75.98	0.95833	*	4.18079	*
199026.1	SR92.095. 8 x OP	17.8	0.33779	54.59	-0.5305	NS	4.02522	*
199027.3	SR92.095. 10 x OP	12.0	-0.09801	54.37	-0.8468	*	4.15429	*
199034.1	SR95.628 x OP	15.3	1.76968	41.13	0.61511	*	3.94999	*
-	SPK004 (Kakamega)	12.0	0.68353	74.80	-0.0087	NS	5.16209	*

Significant at P<0.05 (*); NS is not significant. [1]Eberhart and Russel stability criteria; b = 1.0 and S_d = 0 at 5% probability. [2]Tai stability criteria; α = 0; and λ = 1.0 at 5% probability. [3]Regression coefficient of the i-th clone. [4]Deviation from regression of the i-th clone on the environmental indices. [5]Linear response of the i-th clone to the environmental effects. [6]Deviation from the linear response to the magnitude of the error variance

ANOVA of additive main effect and multiplicative interaction (AMMI) model for total root yield (tha^{-1}) of 8 sweetpotato clones in 11 locations with three replications each in the regional trial in 2004/2005.

Source	df	Sum of squares	Mean squares	F-value	Probability
Total	263	32529.3	32529.3		
Treatment	109	27590.6	253.12	7.89	<00001
Blocks (Env't)	32	17335.9	541.75	51.73	<0.0001
Genotype (G)	7	1514.5	216.36	6.7464	<0.0001
G x E	70	9021.2	128.87	4.0186	<0.0001
IPCA[a]1	16	4620.6	288.79	9.005	<0.0001
IPCA2	14	2567	183.36	5.7174	<0.0001
IPCA3	12	1601.3	133.44	4.1609	<0.0001
Residual	28	232.4	8.3	1.0263	0.4104
Error	154	4938.8	32.07		

a = Interactive principal component axis (IPCA) 1, 2, and 3.

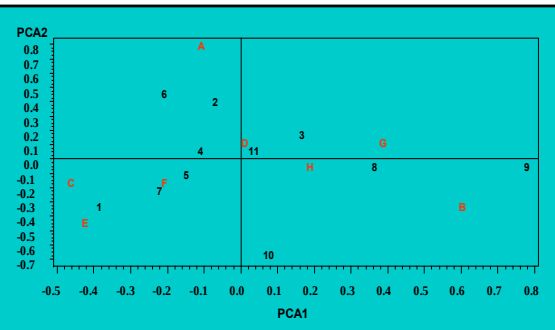


Fig 1. Biplot of principal component analysis (pca) axis 2 vs. axis 1 for mean root yield for eight sweetpotato clones grown in 2004/2005 in eleven environments (locations). Clone codes: A) 199004.2, B) 199005.1, C) 199015.13, D) 199024.1, E) 199026.1, F) 199027.3, G) 199034.1, H) SPK004 ("Kakamega"), Location names: 1) Kakamega, 2) Kabete, 3) Mtwapa (Kenya), 4) Kamanyola (DR. Congo), 5) Kibaha (Tanzani), 6) Awaasa, 7) Wonago (Ethiopia), 8) Namulonge, 9) Kachwekano, 10) Ngetta, 11) Serere (Uganda).

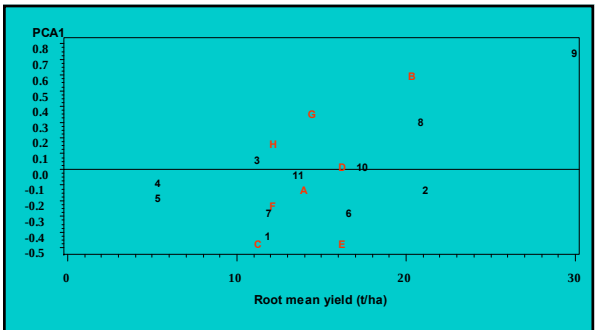


Fig 2. Biplot of principal components analysis (PCA) axis 1 vs. mean root yield for eight sweetpotao clones grown in 2004/2005 in 11 environments (locations). Clone codes: A) 199004.2, B) 199005.1, C) 199015.13, D) 199024.1, E) 199026.1, F) 199027.3, G) 199034.1, H) SPK004 ("Kakamega"). Location names: 1) Kakamega, 2) Kabete, 3) Mtwapa (Kenya), 4) Kamanyola (DR. Congo), 5) Kibaha (Tanzani), 6) Awaasa, 7) Wonago (Ethiopia), 8) Namulonge, 9) Kachwekano, 10) Ngetta, 11) Serere (Uganda).

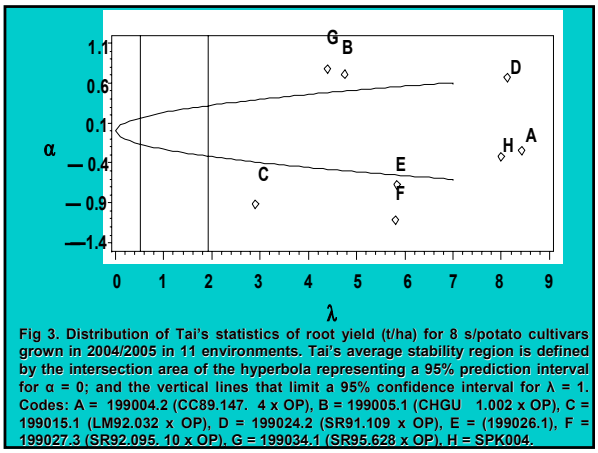
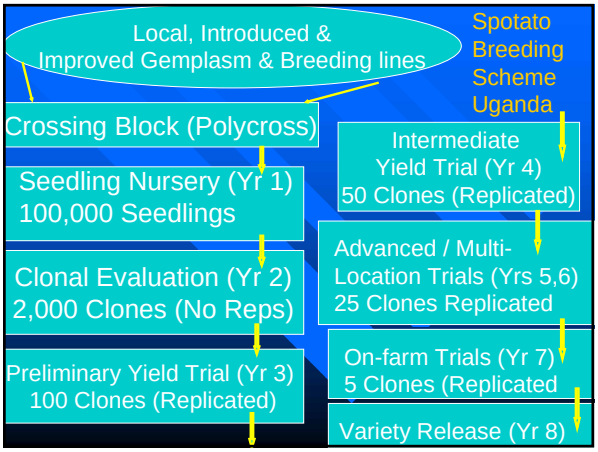


Fig 3. Distribution of Tai's statistics of root yield (t/ha) for 8 s/potato cultivars grown in 2004/2005 in 11 environments. Tai's average stability region is defined by the intersection area of the hyperbola representing a 95% prediction interval for α = 0; and the vertical lines that limit a 95% confidence interval for λ = 1. Codes: A = 199004.2 (CC89.147. 4 x OP), B = 199005.1 (CHGU 1.002 x OP), C = 199015.1 (LM92.032 x OP), D = 199024.2 (SR91.109 x OP), E = (199026.1), F = 199027.3 (SR92.095. 10 x OP), G = 199034.1 (SR95.628 x OP), H = SPK004.



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