Sweetpotato breeding at the East and Central Africa Sweetpotato Support Platform

R. Mwanga, C. Wasonga, G. Ssemakula, J. Kreuze, J. Low, T. Zum Felde & W. Grüneberg

The 14th Sweetpotato Breeders Meeting, Colline Hotel, Mukono, Uganda, June 2-5, 2015

SWEETPOTATO ACTION FOR SECURITY AND HEALTH IN AFRICA

Outline of presentation

- Background on Breeding Component Objective in SASHA 2
- Breeding at the East and Central Support Platform
- Main breeding activities

Breeding Component Objective: Breed new populations with new methods and varietal development

SASHA
Sweetpotato Action for Security and Health in Africa

- Generate a radically **expanded range of sweetpotato varieties** that combine different quality traits with significant improvements in yielding ability
- Generate by **population improvement** new populations for major needs of users:
  - Sweetpotato virus disease (SPVD) resistance (East Africa)
  - Drought tolerance (Southern Africa)
  - Non-sweet sweetpotato (West Aftica)
  - **Incorporate important traits** e.g. high beta-carotene content, dual purpose types for animal feed

Objective 1, Breeding, E. & C. Africa

Specific Objectives

- **1.1 Continue to improve sweetpotato population development in SSA through validation of improved breeding methods, linked with participatory varietal selection at national level (**Proof of concept for Accelerated breeding scheme & Heterosis)
  - Validate the new breeding approaches (in Uganda and Mozambique), strengthening SSA breeding capacity
  - Emphasis on efficient population improvement using conventional and new molecular tools for breeding

Breeding in East & C. Africa, specific objectives

- **1.2 To breed for key biotic constraints in Africa.**

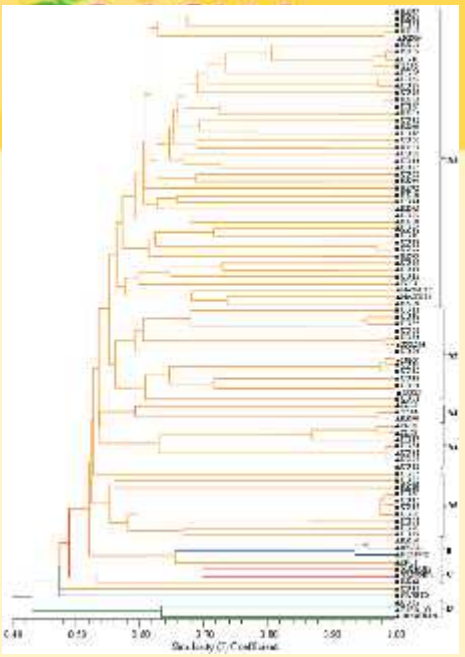
Population development based in Uganda aims to achieve high frequencies of resistance to sweetpotato virus disease (SPVD) (2 to 20%) in new varieties for the low to mid-altitudes. Seek to:

1.1.2. Continue population improvement for virus resistance with 130 parents in two genepools, to ensure true seed supply for NARS partners in high SPVD pressure zones

1.2.2. Incorporate virus resistance into breeding populations

1.2.3. Exploit heterosis in two virus-resistant pools using a small number of parents

Population Development – support platforms



- Two distinct genepools
- (Population Uganda A and Pop Ug B; molecular markers (18 SSR markers)
- Controlled crossing (inter- and intra-gene-pool) for population improvement
- NIRS: quality traits (beta-carotene, protein, starch Fe, Zn, fructose, glucose, sucrose)

Crossing

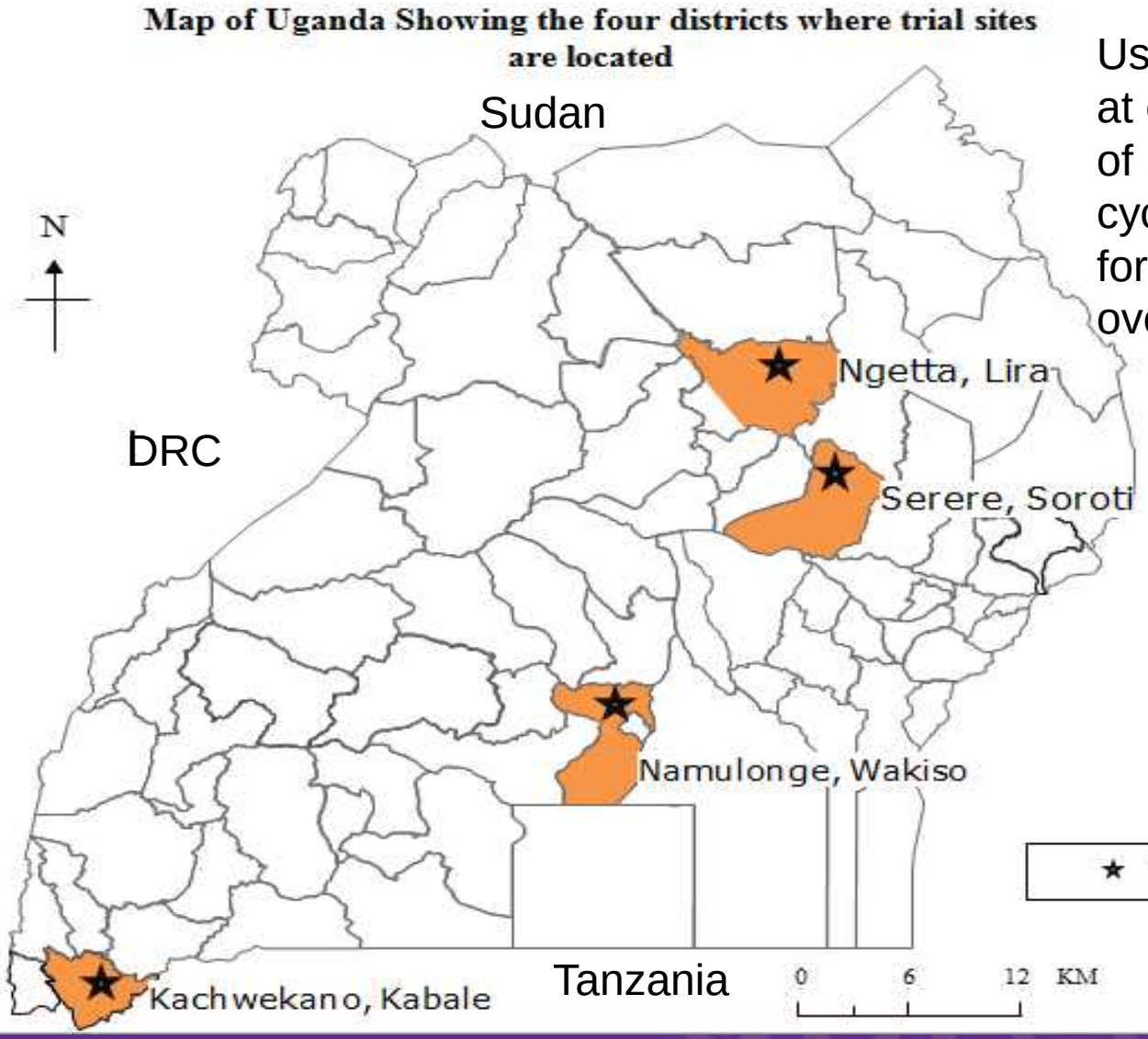
Pop Ug A

Pop Ug B

Accelerated breeding

Multiply new breeding lines in screenhouses, glasshouses, irrigated fields

Accelerated Breeding/ Used by NARS



Use more sites at earlier stages of breeding cycle, substitute for fewer sites over seasons

Sweetpotato Virus Disease (SPVD) Causes Significant Yield Losses (50->90%)

SASHA
Sweetpotato Action for Security and Health in Africa

Christopher A. Clark

Jeffrey A. Davis

Jorge A. Abad

Wilmer J. Cuellar

Segundo Fuentes

Jan F. Kreuze

Richard William Gibson

Settumba B. Mukasa

Arthur K. Tugume

Fred Donati Tairo

Jari P. T. Valkonen

Clark et al. 2012: Plant Disease

Discrimination of resistant and tolerant clones using real-time PCR (Ct = cycle threshold)

Virus accumulation in promising clones

Accession code	Root yield (t/ha)	[1]SPVD (3 seasons)	Mean scores (3 reps, May-Aug 2012)			SPFMV [2](1/ΔCt)	SPCSV (1/ΔCt)
			SPVD	Alternaria			
4.3	5.1	5.3	2.3	3.0		0.556	1.011
17.3	6.1	3.0	2.0	2.7		0.053	0.067
21.4	16.2	3.3	2.0	2.7	Tolerant	0.144	0.463
23.11	19.9	2.3	2.7	3.7		0.273	0.162
24.7	5.4	2.7	1.0	1.3	Resistant	0.053	0.053
29.3	7.0	5.3	4.0	2.7		0.052	0.349
NSP11	17.4	2.7	2.3	2.0	Resistant	0.113	0.064
Mean	10.7	4.1	3.1	2.9	-Ve Control	0.052	0.062
$LSD_{0.05}$	4.9	2.0	1.8	1.9			
CV (%)	27.3	29.8	35.1	39.6			

[1]SPVD = sweetpotato virus disease; SPFMV = *Sweet potato feathery mottle virus*; SPCSV = *Sweet potato chlorotic stunt virus*. [2]ΔCt = Delta Ct = Ct gene test – Ct endogenous control.

Generation of breeding populations in 2014

Specific cross	No. of seed
Within Pop Uganda A	10,063
Within Pop Uganda B	11,241
Pop Uganda A x Pop Ug B	8,474
Total	29,778
Open pollinated seed	
Pop Ug A	697,339
Pop Ug B	605,654

Seed sent to other programs:
Kenya 28,000
Uganda: 107,000
Mozambique: 5,400

NIRS Analysis Request to Support Platform, CIP-Uganda, (Ethiopia, April 2015)

Sample ID	Protein (%)	b-carotene (mg/100g) DW	Fe	Zn	starch (%)	Fructose (%)	Glucose (%)	Sucrose (%)
AM-1	3.7	9.2	1.3	0.5	58.0	4.5	6.1	12.6
AM-25	5.1	42.9	1.3	0.3	45.8	6.7	9.1	23.6
A-1	7.5	23.5	2.0	0.9	60.4	3.1	3.5	6.8
A-24	5.4	25.1	1.6	0.6	55.7	4.5	5.2	11.0
A-25	4.0	6.9	1.4	0.6	46.2	7.1	9.3	16.5
D1	11.7	21.0	2.8	1.6	57.6	2.8	3.5	2.6
D24-1	8.4	13.9	2.2	1.3	64.0	2.1	3.3	0.9
H-1	9.4	40.4	2.3	1.1	54.0	1.4	2.5	14.7
H-25	7.1	23.6	2.1	1.2	49.1	3.8	4.3	13.7
K-1	3.5	16.8	1.3	0.6	66.7	3.0	3.6	3.1
K-25	2.9	6.6	1.1	0.5	60.7	4.5	5.1	8.7
W1	8.8	22.4	2.5	1.4	61.7	2.0	3.4	0.6
W24	9.8	30.4	2.8	1.3	55.4	3.5	4.8	5.0

Total No. of Samples: 140, Period of analysis: April 2015, Fekadu-Ethiopia, SP-Beta-carotene

Backstopping national programs

Shumbusha, D., J. Ndirigwe, et al. 2014. 'RW11-1860', 'RW11-2419', 'RW11-2560', 'RW11-2910', and 'RW11-4923' Sweetpotato. HortScience 49(10): 1349-1352.

Several visits- cordinated/breeding protocols, Proposal writing, Training on CloneSelector,
On-station and on-farm trials, Variety release, Publishing

Status of AGRA Grants: Sweetpotato

Country (9)	Name of scientist leading the project	Yr awarded AGRA breeding grant		Year awarded AGRA seed systems grant
		1st grant	2nd grant	
Tanzania	Evarina Lukonge	Oct-2009	Submitted renewal	na
Rwanda	Jean Ndirigwe	Mar-2010	na	na
	Lydie Kankundiye	na	na	Jul-2014
Uganda	Gorrettie Ssemakula	Jun-2014	na	na
Kenya	Laura Shali	Jun-2007	Jan-2011	na
	Joyce Malinga	na	na	May-2014
Mozambique	Jose Ricardo	Jul-2012	na	Jul-2012
Zambia	Martin Chiona	2010	Submitted renewal, Oct 2014	na
Malawi	Felistus Chipungu	2011	2014	2014
Burkina Faso	Some Koussao	Aug-14	na	Na
Nigeria	Solomon Afuape	2010	na	Na

Graduate Students on Sweetpotato Supported by AGRA (2014)

	Student	Country	Degreee	Center	Status
1	Benjamin Kivuva	Kenya	PhD	ACCI	Completed
2	Godfrey Sseruwu	Uganda	PhD	ACCI	Completed
3	Some Koussau	Burkin Faso	PhD	WACCI	Completed
4	Vivian Oduro	Ghana	PhD	WACCI	Completed
5	Jebbeh Samba	Sierra Leone	MSc	WACCI	Completed
6	Ernest Baafi	Ghana	PhD	WACCI	Completed
7	Jose Ricardo	Mozambique	MSc	ACCI	Completed
8	Victor Amankwaah	Ghana	MSc	WACCI	Completed
9	Placide Rukundo	Rwanda	PhD	ACCI	On-going
10	Damien Shumbusha	Rwanda	PhD	ACCI	On-going
11	Stephen Ngailo	Tanzania	PhD	ACCI	On-going
12	Fekadu Gurmu	Ethiopia	PhD	ACCI	On-going
13	Solomon Afuape	Nigeria	PhD	WACCI	On-going

Annual Meeting/training

- Change venue since 2009
  - 1st yr: Uganda
  - 2nd yr: Mozambique
  - 3rd yr: Ghent University
  - 4th yr: Rwanda
  - 5th yr: Malawi
  - 6th yr Uganda
- Update Methods & Software