Sweetpotato Breeding in Ghana in Partnership with the Sweetpotato for Profit and Health Inititiative

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Summary

Sweetpotato is increasingly important in African agriculture for combating food insecurity and malnutrition, particularly vitamin A deficiency. The Sweetpotato for Profit and Health Initiative (SPHI) aims to reposition sweetpotato in African food economies, and improve the lives of 10 million families by 2020. The SPHI works through diverse research and development partnerships and seeks to ensure that women and children benefit from its efforts. The Sweetpotato Action for Security and Health in Africa (SASHA) project (under the SPHI) supports pre-breeding and capacity-building efforts through regional Sweetpotato Support Platforms (SSPs) in Uganda, Mozambique and Ghana. From these SSPs, national and sub-regional partners work together breeding for adaptation and quality attributes, selecting and disseminating superior cultivars, and maintaining pathogen-tested germplasm for international distribution. The SSP for West Africa was established at the CSIR-Crops Research Institute (CRI) in Kumasi, Ghana, in 2010, and is working to develop less sweet genotypes for use in staple foods of West Africa and processed products. Parental germplasm has been selected for population improvement through recurrent selection, based on quality attributes (largely through literature review) including sugar profile, taste, dry matter content, and on local adaptation. Selection sites and partners have been identified in 3 regions of Ghana, the Central, Volta and Upper East Regions, where sweetpotato is important, and which vary in agro-ecology. Selecting genotypes in important production zones allows for strong research-extension linkages and enables a client-oriented breeding effort. Although the CRI in Kumasi is not in an important production region, sweetpotato virus disease pressure is high and allows for resistance screening. Initial trials were conducted to implement an accelerated sweetpotato breeding program by evaluating across 3 locations during the first clonal evaluation, which permits early identification of stable genotypes. Evaluation of large numbers of genotypes for the recurrent selection effort will be facilitated through the use of near infrared reflectance spectroscopy to measure sugars, starch and carotenoids. Tissue culture and screenhouse facilities at the CSIR-Crops Research Institute have enabled assembly of a collection of elite sweetpotato genotypes and disease-free planting material for use in breeding and for international distribution.

Sweetpotato Support Platforms (SSPs)


Figure 1


Figure 2

Under SASHA, CIP sweetpotato breeders work with national program partners in 14 countries from SSPs in Uganda, Mozambique and Ghana (fig 1). Priority traits for population improvement vary by platform (fig 2), with southern Africa emphasizing drought tolerance, East Africa emphasizing resistance to sweetpotato virus disease, and West Africa prioritizing the development of less sweet (*un*sweetpotato) types to meet local taste and utilization preferences. Selection for orange flesh color to help combat vitamin A deficiency is important in all sites. Population improvement by SASHA is tightly linked to variety development by national program partners, supported by the Alliance for a Green Revolution in Africa and others. In addition to breeding, the SSPs facilitate regional stakeholder input to their activities through meetings held twice yearly with partners including representatives of NGOs, farmer organizations, and the private sector (fig 3).

Figure 3. Participants at the second meeting of the Sweetpotato Support Platform for West Africa held at the University of Cape Coast, Ghana, 23 to 25 November 2010

Breeding in Ghana

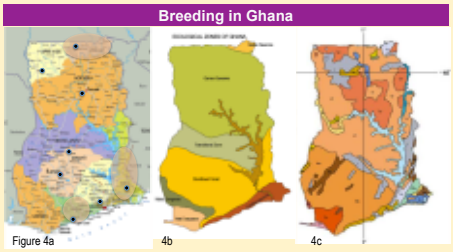
Figure 4a 4b 4c

Primary selection sites in Ghana are located in production zones where sweetpotato is important (black dots in shaded zones, fig. 4a), and cover a range of edaphoclimatic zones (figs 4b and 4c). Table 1 presents the role of sweetpotato in the farming system, the type of sweetpotato preferred, and agroecologies at the principal selection sites in Ghana.

Table 1. Principal selection sites in Ghana and their characteristics

Region	Agroecological zone	Role of sweetpotato	Preferred type of sweetpotato
Ashanti	Forest	Insignificant	Not preferred
Central	Coastal Savanna	Commercial	Yellow skin, yellow flesh
Volta	Coastal Savanna	Commercial/Food security	Red skin, white flesh
Upper East	Guinea/Sudan Savanna	Food security/less commercial	Skin color less important, OFSP exist

Vivian Oduro (fig 5a) interviews farmers in the Central Region on their taste preferences. Farmers are important partners in the selection process, which must also include food scientists and other value chain players. Here Eric Owusu Mensa explores farmers preferences during a harvest in the Central Region fig 5b). Farmers in Upper East Region already grow orange fleshed varieties, which are used for breeding (figs 5c and 5d).


Figure 5a 5b Figure 5c 5d

Near Infrared Reflectance Spectroscopy (NIRS) helps with the rapid analysis of samples for selection. Figs 6a and 6b show NIRS and freeze dryer at Crops Research Institute, Kumasi.


Figure 6a 6b

An accelerated breeding scheme is used in Ghana (Table 2). Selection efficiency is increased by evaluating at more than one location from the initial clonal selection stage. Selected clones may continue to varietal selection or be incorporated in crossing block for recurrent selection. This approach significantly shortens time needed to develop new varieties. Two separate breeding populations are under development, one in Lima, Peru, to enable the exploitation of heterosis.

Table 2. Accelerated sweetpotato breeding scheme used in Ghana

Year 1	Crossing block (50 parents)					
Year 2	Seedling nursery (~240 families, 5000 genotypes)					
	OT - Kumasi (virus + proximity)			OT – Tono (key production area)		
	~250 clones selected with top selections going for recombination					
Year 3	PT – UE	PT – CR	PT – VR	PT - AR		
	~25 clones selected					
Year 4	AT + OFT	AT + OFT	AT + OFT	AT + OFT	AT + OFT	AT + OFT
	Decentralized testing and multiplication					
Year 5	Official release					

OT – Observational Trial (1-plant plots, no reps)
PT – Preliminary Trial (>10-plant plots, 2 reps)
AT – Advanced Trial (75 plants, 2 reps); OFT – On-Farm Trial
UE – Upper East, CR – Central Region, VR – Volta Region, AR – Asante Region

Germplasm from diverse sources has been gathered to constitute the Ghanaian *un*sweetpotato breeding populations, and for direct use in variety selection (Table 3). We expect that drought tolerant and virus resistant germplasm from the SSPs for East Africa and Southern Africa will prove valuable, as these are important constraints in West Africa too. Genotypes lacking β-amylase activity are among those from USA and Japan, and will be included in breeding efforts.

Table 3. Accelerated sweetpotato breeding scheme used in Ghana

Source	Type	Number
CIP- Lima (from IITA)	Clones	128
CIP – Kenya (Global)	Clones (In vitro/In vivo)	87 / 92
NARO/CIP-Uganda	Seed	192,600 (20 OP families)
IIAM/CIP-Mozambique	Seed	20,000 (28 OP families)
Ghana – CRI/PGRRI	Seed/Clones	9 released / ~ 50 farmers varieties / seed from CRI crossing blocks
USA	Clones (In vitro), seed	21 clones + 5150 (40 fam.)
Japan	Seed	400 (4 families)

Considerable complementarity of efforts by partners is required to effectively utilize resources of individual projects and partners in support of the overall breeding program efforts to serve farmers and others in Ghana.

Table 4. Trials and farmer field fora conducted by partners in Ghana in 2011

Region	Location	Hybrid	Multiply	OT	PT	AT	OFT
Ashanti	Fumesua	1 1	1	1	1	1	
Ahsanti	Ejura				1	1	
G. Accra	Pokuase				1	1	6
Volta	Ohawu		1		1	1	10
Northern	Nyanpkala					1	
Upper East	Navrongo		1	1			3
Central	Komenda				1	1	10 2
	Total	**2**	**3**	**2**	**5**	**6**	**26+5**

Orange = SASHA supported, Black = WAAPP supported, Blue = RTIMP supported

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