Sweetpotato Breeding Under the Sweetpotato for Profit and Health Initiative

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Summary

Sweetpotato is playing an increasingly important role in African agriculture, combating food insecurity and undernourishment, 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. 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), of the SPHI, supports significant pre-breeding and capacity-building efforts from regional Sweetpotato Support Platforms (SSPs) in Uganda, Mozambique and Ghana. From these locations, CIP breeders work with national and regional partners. Pre-breeding (population improvement) efforts at each location focus on key attributes of regional importance and use recurrent selection and an accelerated sweetpotato breeding (ASPB) approach to advance populations rapidly. ASPB involves early evaluation of clones and families across environments, and is also used by partners for selecting new varieties. High dry matter and provitamin A content are a priority at each of the SSPs, with specific emphasis in southern Africa on drought tolerance, in eastern Africa on resistance to sweetpotato virus disease (SPVD), and in West Africa on non-sweet types. Near infrared spectroscopy is used at each SSP for rapid analysis of quality attributes. The relative efficiencies of controlled versus polycross methods and the use of heterosis are also being systematically assessed. Breeding efforts at SSPs are backstopped by germplasm and expertise from CIP headquarters and elsewhere. It is anticipated that outputs from each SSP may be useful to other SSPs and national programs. Capacity building and breeding efforts in each region are undertaken in close collaboration with national programs and within regional structures, such as ASARECA, and with support from various sources, including AGRA.

The SPHI and SASHA

Vision: Repositioning sweetpotato in African food economies, particularly in expanding urban markets, to reduce child malnutrition and improve smallholder incomes.

SPHI is a multi-partner, multi-donor initiative that seeks to reduce child undernutrition and improve smallholder incomes in 10 million African families by 2020 through the effective production and expanded use of sweetpotato.

SASHA is a 5 year project led by the International Potato Center that will develop the essential capacities, products and methods to reposition sweetpotato in the food economies of Sub-Saharan Africa (SSA).

SASHA places major emphasis on developing an integrated breeding system to significantly boost yields and, and explicitly address the preferences of resource-poor women and children, as both producers and consumers.

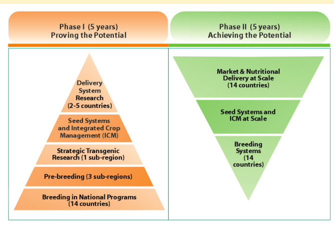

Figure 1. Two phases of the SPHI: Establishing the scientific base, and scaling up

SPHI is implemented with a growing array of partners, aligned with the framework of regional agricultural research and development structures including ASARECA, CORAF, and SADC.

Key partners in the breeding and variety dissemination effort of SPHI include: African and West African Centers for Crop Improvement (ACCI & WACCI), Agricultural Research Council, South Africa (ARC), Alliance for a Green Revolution in Africa (AGRA), Bill & Melinda Gates Foundation, Catholic Relief Services (CRS), Crops Research Institute (CRI) of the Council for Scientific and Industrial Research (CSIR), Ghana, Forum for Agricultural Research in Africa (FARA), Helen Keller International (HKI), Institute of Agricultural Research of Mozambique (IIAM), Irish Aid, Kenya Agricultural Research Institute (KARI), National Agricultural Research Organization (NARO), Uganda, Natural Resources Institute (NRI), United States Agency for International Development (USAID), West Africa Agricultural Productivity Program (WAAPP).

Sweetpotato Support Platforms

Support platforms in Uganda, Mozambique and Ghana provide

- Regional breeding services
  - Population improvement (pre-breeding) for key attributes
  - Near infrared spectroscopy (NIRS) laboratories for analysis of quality attributes
  - Virus cleanup for the safe movement of germplasm and to support seed systems
- Regional bases for
  - Capacity building related to plant breeding and seed systems
  - Collaborative varietal selection with national program partners
- Regional fora for partners and stakeholders to monitor SASHA progress and guide SPHI development through meetings held twice yearly

Figure 2. Three Sweetpotato Support Platforms provide regional breeding support services and regional fora for project guidance by partners and stakeholders

Table 1. Summary of Pre-Breeding and Population Improvement activities at Support Platforms under SASHA

Sub-region and Target	Outputs	Breeding Methodology
- Across Sub-Saharan Africa and potentially other regions of the world - Improved breeding methods available for sweetpotato breeders	- Critical hybridization capacity in controlled cross breeding determined in programs where these are superior to polycross - Magnitude of heterosis in applied breeding populations estimated - Protocol for the development of double-triploids established	- Controlled cross breeding used where it is useful - Exploitation of heterosis where two genetically distinct populations are available
Agroecology and Market Targets	**Trait Targets for Populations**	**Breeding Methodology**
- East and Central Africa: mid- to low-elevation - Fresh and processed markets and nutrition	- SPVD resistance - Beta carotene and zinc - High dry matter (consumer taste and processing)	- Accelerated breeding - Heterosis/hybrid breeding - Marker assisted selection
- Southern Africa drought prone areas - Nutrition/food security	- Drought tolerance - Vine survival - Weevil resistance - Beta carotene	- Accelerated breeding - Heterosis/hybrid breeding
- West Africa Savanna - Urban markets	- High dry matter/ starch (processing) - Non-sweet (processing) - SPVD resistance	- Accelerated breeding - Two genetically distinct populations available (African and American) to exploit heterosis in next phase

Building a Breeding Community of Practice

An important aspect of strengthening sweetpotato breeding in SSA is building a community of practice through short courses, regional workshops and postgraduate training. ACCI, WACCI and other universities are key partners in training a cohort of African sweetpotato breeders. A computer program, CloneSelector, helps with standardized data collection, analysis and management. A website, sweetpotatoknowledge.org, provides a place where all can share information and experiences.

Figure 3. Capacity building at various levels helps to build a community of practice. Breeders at the 2010 Speed Breeders workshop, Namulonge, Uganda (above); Technicians and extension collaborators at a collaborative CIP, Root and Tuber Improvement and Marketing Program (RTIMP) breeding trial harvest training exercise, Ejura, Ghana, September 2010 (below)

Advances in Sweetpotato Breeding

Accelerated Sweetpotato Breeding speeds up the selection process by evaluating genotypes across environments from the earliest stages of selection. In contrast to the "traditional" approach, which can take more than 10 years, new varieties can be developed in under 4 years, as recently demonstrated by the release of fifteen new cultivars in Mozambique. These were selected in trials conducted at 4 selection environments over less than 4 years.

The potential for **Exploiting heterosis** has not been assessed systematically in clonally propagated crops. Studies conducted at CIP in Peru demonstrate that there is great potential for utilizing heterosis in sweetpotato breeding. Work is underway to evaluate this under drought conditions in Mozambique with populations developed there.

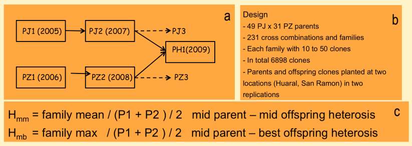

Figure 4. Explanation of experiment to evaluate heterosis:
(a) Development of two separate populations using recurrent selection;
(b) Recombination and population and evaluation of parents and progenies; (c) Two measures of heterosis.

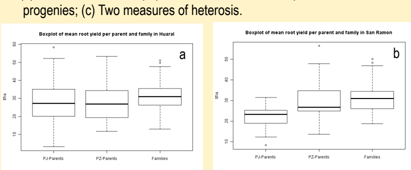

Figure 5. Mid-offspring root yields (N = 231) and parental root yields (NPJ=49, NPZ=31) by location Huaral (a) and San Ramon (b)

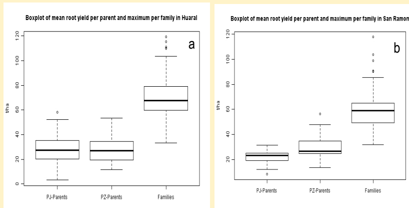

Figure 6. Best-offspring root yields (N = 231) and parental root yields (NPJ=49, NPZ=31) by location Huaral (a) and San Ramon (b)

Acknowledgement

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