SPHI

A TIME OF CELEBRATION!

Report of the 7th Annual Sweetpotato for Profit and Health Initiative (SPHI) Meeting held in Addis Ababa, Ethiopia, October 7-8, 2016

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Acronyms

ABS	Accelerated Breeding Scheme
AGRA	Alliance for a Green Revolution
APA	African Potato Association
AVCD	Accelerated Value Chain Development
BecA	Biosciences eastern and central Africa
BNFB	Building Nutritious Food Baskets
BMGF	Bill & Melinda Gates Foundation
CBO	Community Based Organizations
CHW	Community Health Worker
CIP	International Potato Center
CoPs	Communities of Practice
CRS	Catholic Relief Services
CSIR	Council for Scientific and Industrial Research
DVMs	Decentralized Vine Multipliers
EHFP	Enhanced Homestead Food Production
EIAR	Ethiopian Institute of Agricultural Research
FARA	Forum for Agricultural Research in Africa
FCI	Farm Concern International
FGDs	Focus Group Discussions
GAP	Good Agricultural Practices
GHS	Ghana Health Service
GMP	Good Manufacturing Practices
HCA	Hydroxycinnamic acid
HKI	Helen Keller International
IEC	Information, Education and Communication
IPM	Integrated Pest Management
INERA	Institut de l'Environnement et Recherches Agricoles
IYCF	Infant and Young Child Feeding
KEPHIS	Kenya Plant Health Inspectorate Service
MLE	Monitoring, Learning and Evaluation
MPU	Marketing, Processing and Utilization
MSU	Michigan State University
NCSU	North Carolina State University
NaCRRI	National Crops Resources Research Institute
NAFASO	Neema Agricole du Faso SA
NARI	National Agricultural Research Institute
NARS	National Agricultural Research Station
NCRI	National Crops Research Institute

NRCRI	National Root Crop Research Institute
NRI	National Resources Institute
ODK	Open Data Kit
OFSP	Orange-fleshed Sweetpotato
PAC	Project Advisory Committee
PPP	Public-Private Partnership
QDPM	Quality Declared Planting Material
QDS	Quality Declared Seed
RCT	Randomized controlled trials
RTB	Root and Tuber Crops
SBCC	Social and Behavior Change Communication
SARI	Southern Agricultural Research Institute
SASHA	Sweetpotato Action for Security and Health in Africa
SeFaMaCo	Seed-Farmer-Market-Consumer
SEM	Scanning Electron Microscopy
SETSAN	Secretariado Técnico de Segurança Alimentar e Nutricional
SHF	Small Holder Farmer
SNNPR	Southern Nations and Nationalities, and People's Region
SPHI	Sweetpotato for Profit and Health Initiative
SPVD	Sweetpotato virus disease
SSA	Sub-Saharan Africa
SSC	SPHI Steering Committee
SUSTAIN	Scaling Up Sweetpotato through Agriculture and Nutrition
SWOT	Strengths, Weaknesses, Opportunities and Threats
TARI	Tigray Agricultural Research Institute
TOR	Terms of Reference
UDS	University for Development Studies
USAID	United States Agency for International Development

Executive Summary

The 7th Annual Sweetpotato for Profit and Health Initiative (SPHI) Technical Meeting took place from 7-8 October 2016 in Addis Ababa, Ethiopia. The theme of this year's meeting was 'Celebrating the 2016 World Food Prize'. This theme honored four scientists - Dr. Howarth Bouis of HarvestPlus, and Drs. Jan Low, Maria Andrade and Robert Mwanga of the International Potato Center (CIP), who were awarded the Prize for their combined efforts in using biofortification of crops to improve the nutrition and health of millions of people. Over the years, the SPHI has continued to grow, and this is reflected in the composition of the 94 participants, who came from 17 sub-Saharan African countries, the United Kingdom, USA, Peru and Germany.

SESSION 1

Welcome remarks and introductions: The meeting was officially opened by **Dr. Fentahun Mengistu,** Director General of the Ethiopian Institute of Agricultural Research (EIAR). Dr. Mengistu emphasized his government's commitment to using modern tools and technologies to transform the agricultural system to benefit the livelihood of the Ethiopian people. **Dr. Nelson Ojijo** made the opening remarks on behalf of the Executive Director of the Forum for Agricultural Research in Africa (FARA), Dr. Yemi Akinbamijo, who is the co-leader of the SPHI. Ojijo led the SPHI meeting attendees in giving a standing ovation to the 2016 World Food Prize laureates and congratulated them for raising the profile of biofortification. He also presented the background and governance structure of the SPHI and current progress towards meeting the 2020 goal of 10 million households.

Jumpstarting OFSP in West Africa through diversified markets: Accelerating towards outcomes: **Erna Abidin, Souleimane Adekambi and Joseph Nchor** provided the background of the project, progress towards outcomes at midline, and the focus interventions for Year 3, which are based on the learning from the first two years of implementation. The three-year project aims to achieve sustainable and inclusive market-driven approaches for orange-fleshed sweetpotato (OFSP) to increase incomes, and improve health through consumption of vitamin A rich OFSP, especially in women and children in Ghana, Nigeria and Burkina Faso.

Integrating OFSP as part of Enhanced Homestead Food Production: **Mette Kinoti** of Helen Keller International (HKI) made a presentation about the Enhanced Homestead Food Production (EHFP) approach, which seeks to improve the nutritional status of children under five years of age, women of reproductive age, breastfeeding and pregnant women. It is implemented by HKI in Burkina Faso, Mozambique, Cote d'Ivoire, Tanzania, Nigeria and Senegal. She also presented the Nurturing Connections intervention that seeks to promote gender equality in decision making.

Scaling up biofortified crops through a food basket approach in Nigeria and Tanzania: Hidden hunger is severe in rural poor households in vulnerable populations in Africa and affects most women. Biofortification has been proven to be a cost-effective, sustainable and culturally acceptable approach. There is, therefore, need to catalyze scaling up of proven biofortified innovations. **Hilda Munyua** presented the Building Nutritious Food Baskets (BNFB) project, which is being implemented in Tanzania and Nigeria and focuses on iron-rich beans, vitamin A cassava, sweetpotato and maize.

SESSION 2

Integrating nutrition in agricultural projects: Experiences from Ethiopia: **Wellington Jogo** presented the sweetpotato components of four agriculture-nutrition projects implemented in Southern Nations and Nationalities, and People's Region (SNNPR) and Tigray regions of Ethiopia. The goal of these projects is to contribute to improved food and nutrition security among vulnerable households with young children in target regions through increased production and consumption of micronutrient-rich sweetpotato and potato varieties as part of diversified diets. His presentation

addressed the factors considered at project planning, the implementation approach and success and challenges.

Integrating nutrition in agricultural projects: the influence of different socio-cultural and agro-ecological conditions in delivery: case of northern Mozambique: **Benjamin Rakotoarisoa** shared the experience gained in northern Mozambique by the Nutritious Sweetpotato for Niassa and Viable Sweetpotato Technologies in Africa (VISTA) projects, specifically with regard to an intervention exploring attitudes using focus groups and Trials for Improved Practices (TIPS). This intervention was implemented in Chimbunila, Central Lago and Northern Lago in Niassa Province.

Nutrition model of VISTA Tanzania project: going to scale with nutrition education: **Frederick Grant** spoke about the VISTA project, whose goal is to contribute to improved dietary diversity, food security, and incomes in Tanzania. He focused on the factors considered when going to scale and implementation progress of the main nutrition objective, which is to increase access to improved nutritional knowledge and practices and diversified use of OFSP by both female and male caregivers. Under this objective, the project targets to reach 17,500 households by 2017 and to ensure that equal numbers of women and men are included through community groups.

Integrating nutrition in different conditions in Kenya: **Penina Muoki** presented two projects that are being implemented in Kenya using the agriculture-nutrition-market approach for scaling up OFSP: These projects are (i) Accelerated Value Chain Development (AVCD) and (ii) Scaling Up Sweetpotato through Agriculture and Nutrition (SUSTAIN) project. The presentation focused on the nutrition component of the two projects.

SESSION 3

The SeFaMaCo Programme: **Worku Tsega** of Farm Concern International (FCI) presented a project titled Integrated Value Chain Development and Smallholder Farmer Commercialization of Banana and Sweetpotato for Tanzania, Uganda, and Ethiopia based on a seed-farmer-market-consumer model. The goal of the project, implemented by FCI, is to optimize profitability and productivity by catalyzing market oriented value chain- wide competitiveness and investments in banana and sweetpotato for increased household incomes.

Progress in Developing Shelf-Storable Puree and OFSP bread improvement: **Tawanda Muzhingi** of CIP and **Antonio Magnaghi** of Euro Ingredients Ltd. explained that the growing demand for innovative healthy foods has generated a new bread market worldwide. Therefore, their work is exploiting the existing potential to store orange-fleshed sweetpotato puree without refrigeration. Their research seeks to determine the effect of different preservative combinations and vacuum packing on quality of OFSP puree and baked products. They presented their findings to date and the next research steps.

Scaling Up Sweetpotato through Agriculture and Nutrition (SUSTAIN) - Lessons from going to scale: Achieving impact at scale is a key ambition and there is growing demand from countries globally to access OFSP. This panel discussion, moderated by **Simon Heck** of CIP, sought to address this by exploring the following questions: (i) how to scale up and what exactly; (ii) how to scale up well? (iii) how do we know that we are doing it well? The panel discussion was structured with two rounds of questions: (1) Progress made (approaches used, results, how M&E was used, adjustments made and why; (2) Lessons emerging (key elements of successful scaling up and what we need to improve for overall learning. The panelists were **Penina Muoki** (Kenya); **Kirimi Sindi** (Rwanda); **Roland Brouwer** (Mozambique); **Robert Ackatia-Armah** (for Malawi); **Julius Okello** (Impact Assessment, M&E).

SESSION 4

Postharvest challenges in sweetpotato: NRI partnership with CIP to support SASHA: **Andrew Westby** explained the role that NRI is playing to improve the utilization pathways for sweetpotato consumption and production to boost the economic viability of sweetpotato value addition and business activities; and to alleviate vitamin A deficiency through intake of processed products

containing OFSP. His presentation focused on NRI's inputs into the commercial scale storage, domestic scale storage and analytical support to develop regional capacity and appropriate protocols for analysis of roots and derived products at reasonable cost.

Discussion with two 2016 World Food Prize winners: How Mozambique led the way – a sisterhood story: **Jan Low** and **Maria Andrade** are two of the four recipients of the 2016 World Food Prize. In this panel discussion, moderated by **Margaret McEwan**, they shared their experiences introducing and promoting OFSP in Mozambique, their personal journeys and how the SPHI could benefit from the improved policy environment in the region, and from the UN Decade for Action on Nutrition 2016-2026.

SESSION 5

Lessons learned by HarvestPlus scaling up biofortified crops: HarvestPlus uses an integrated approach with seed systems, agronomy, nutrition and demand creation, marketing and product development. The goal is to reduce micronutrient malnutrition and improve dietary intakes of vitamin A and iron for 315,000 households in 25 districts in Uganda by 2016, a goal already achieved. In her presentation, **Anna-Marie Ball** from HarvestPlus shared the progress made towards ensuring a clean seed system, improved feeding practices, marketing, product development, advocacy and promotion and training of multipliers and inspectors to use protocols. She also gave examples of how HarvestPlus was using ICT to link farmers to vines and to respond to their information needs.

Panel: Technical innovations in pre-basic seed production – Burkina Faso, Ethiopia, Nigeria, Rwanda and Uganda: The production of pre-basic seed is expensive and efforts have been made to develop technical innovations to make seed more affordable for farmers. One of the challenges is to ensure sustainable production. This can be done by making it affordable so that it can be taken up by other stakeholders after the end of the SASHA project. **Felistus Chipungu** of CIP moderated a panel with **Benard Yada** (Uganda); **Some Koussao** (Burkina Faso); **Jude Njoku** (Nigeria); **Jean Ndirigwe** (Rwanda); and **Beyene Demtsu** (Ethiopia) to discuss the technical innovations in their countries.

Can RTB systems learn from each other? RTB crops have a challenge of accumulation of diseases leading to degeneration and relatively low multiplication rates. There have been many interventions but little systematic learning. This was the genesis of Graham Thiele's presentation. He emphasized the need to come up with instruments that help to compare the dissimilar information from the different crops, and presented a framework that includes: (i) stakeholder framework – seed security (ii) seed degeneration and (iii) Impact Network Analysis.

Progress in sweetpotato genomics and strengthening the *SpeedBreeders* community of practice: This presentation drew the attention of participants to up-stream applications of genomics for breeding. **Craig Yencho** explained the inception of the Genomic Tools for Sweetpotato (GT4SP) project in 2013, and the vision for marker-assisted breeding that had brought it about. He also described the partnership approach with SASHA concerning the annual technical meeting with breeders in Africa and the progress with regard to development of genomic resources, population development, phenotyping, data management and capacity building.

Panel: Institutionalizing business plans and revolving funds for pre-basic seed production: National Agricultural Research Institutes (NARIs) in 11 sub-Saharan Africa (SSA) countries are expanding their pre-basic sweetpotato seed production. Ten institutions have started to implement their business plans; of which six institutions earned revenue from the sale of seed, to start their revolving funds to ensure that pre-basic seed production is sustained. **Srini Rajendran**, CIP's agricultural economist who is working with NARIs to develop their business plans, gave introductory remarks. The panel discussion by **George Momanyi** and **Stella Ennin** was moderated by **Graham Thiele** and covered the following questions: (i) What products are already generating revenue and what strategies have you already implemented? (ii) How is the revenue being managed? (iii) What is the progress in implementing the business plans?

The way forward with the evil weevil: In most areas, especially dry ones, weevils are a major problem. In this panel, moderated by **Jan Low** of CIP, various approaches to address weevil control and resistance were discussed. **Jurgen Kroschel**, an entomologist, gave an introduction to weevil basics and spoke about pest management and attract-and-kill. **Bernard Yada**, talked about the conventional breeding approach to increase weevil resistance. **Marc Ghislain,** a biotechnologist, explained progress using transgenic approaches; **Chad Keyser**, an insect pathologist at Ag Biome could not make it to the meeting, and his presentation on screening for microbes for biological control was delivered by Marc Ghislain. The goal of the panel discussion was to explore what makes the best sense for small holders in terms of weevil management.

Panel: What was our progress in growing as a Community of Practice in Year 2? A community of practice is a group of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly. This definition reflects the fundamentally social nature of human learning. The purpose of the panel discussion was to expose all participants to the progress being made under the non-breeding Communities of Practice (CoP) groups i.e. the Seed Systems and Crop Management CoP; the Marketing, Processing and Utilization CoP; and the Monitoring, Learning and Evaluation CoP. The moderator was **Tawanda Muzhingi** of CIP, and the panelists were **Francis Amagloh** (UDS); **Jude Njoku** (NRCRI); **Richard Gibson** (NRI); **Julius Okello** (CIP); **Ibrahim Koara** (IDE); **Lukas Wanjohi** (CIP) and **Antonio Magnaghi** (EIL).

Closing remarks

The 7th annual SPHI meeting was officially closed by **Dr. Barbara Wells**, the Director General of CIP. She explained that biofortification has gained recognition and stated that it has taken a long time for OFSP to achieve the status it has today, where 2.8 million households or about 10 million people had been impacted. She urged participants to celebrate these accomplishments while strategizing to pick up momentum for the future.

1 Session one (Friday morning, 7th October)

1.1 Introduction

The 7th Annual Sweetpotato for Profit and Health Initiative (SPHI) took place from 7-8 October 2016 in Addis Ababa, Ethiopia. The theme of this year's meeting was 'Celebrating the 2016 World Food Prize'. This theme honored four scientists - Dr. Howarth Bouis of HarvestPlus, and Drs. Jan Low, Maria Andrade and Robert Mwanga of the International Potato Center (CIP), who were awarded the Prize for their combined efforts in using biofortification of crops to improve the nutrition and health of millions of people.

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Ojijo also presented the background and governance structure of the SPHI. The SPHI is a multi-partner, multi-donor initiative that seeks to reduce child malnutrition and improve smallholder incomes in 10 million African families by 2020 through the effective production and expanded use of sweetpotato. The SASHA project, which serves as the foundation for the broader initiative, is a 10-year project led by the International Potato Center (CIP) and over 26 partners to develop the essential capacities, products and methods to reposition sweetpotato in the food economies of SSA.

Over the years, the SPHI has continued to grow, and this is reflected in the composition of the 94 participants, who came from 17 sub-Saharan African countries, the United Kingdom, USA, Peru and Germany. Figure 1 shows the list of countries by proportion of representation.

Figure 1: Countries represented at the meeting

Participants presented and discussed progress in sweetpotato science and delivery along the entire sweetpotato value chain and showcased innovations and impact case studies in agriculture, nutrition and health innovations. Following the main meeting, the SPHI Steering Committee meeting was held on 9th October 2016. In addition, the Sweetpotato Action for Security and Health in Africa (SASHA) Project Advisory Committee held their annual meeting the afternoon of 8th October.

The following report documents the presentations and proceedings of all the sessions and side events. The presentations can also be downloaded from the Sweetpotato Knowledge Portal at the following link: http://www.sweetpotatoknowledge.org/topics/sweetpotato-for-profit-and-health-initiative-sphi/

Figure 2 illustrates the two phases of the SPHI. The first five-year phase (2010-2014) concentrated on proving the potential. It placed great emphasis on breeding and seed systems research and testing models of delivery of improved varieties to producers and consumers. The second five-year phase (2015-2019) focuses on achieving the potential, ensuring that effective seed systems are delivering improved planting material to 10 million SSA households.

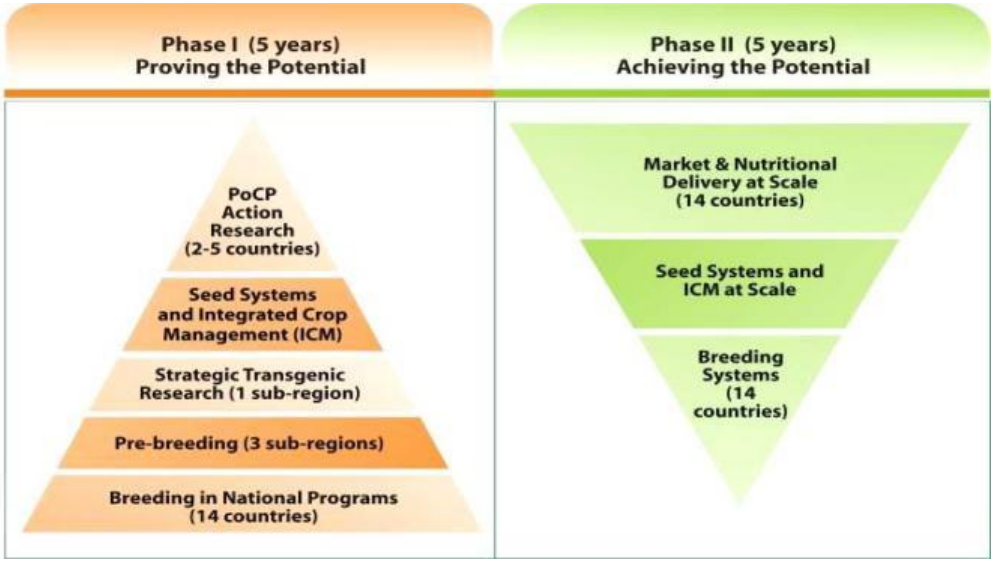


Figure 2: Areas of focus of the two phases of SPHI

The SASHA Project Advisory Committee and the SPHI Steering Committee hold their annual meetings at the end of the SPHI main meeting. The mandates and membership of these committees are presented in more detail in Annex 1.

The SPHI meeting preceded the 10th Triennial African Potato Association (APA) conference, and the 45th anniversary celebrations of the International Potato Center (CIP), which were held in the same city. To avoid duplication, scientific presentations, that traditionally take place at the SPHI, as well as the exhibition booths and poster presentations, were only presented at the APA conference.

Progress in reaching the 10 million target and advocacy strategies

To date, 2,894,730 households have been reached with improved varieties of sweetpotato (Figure 2).

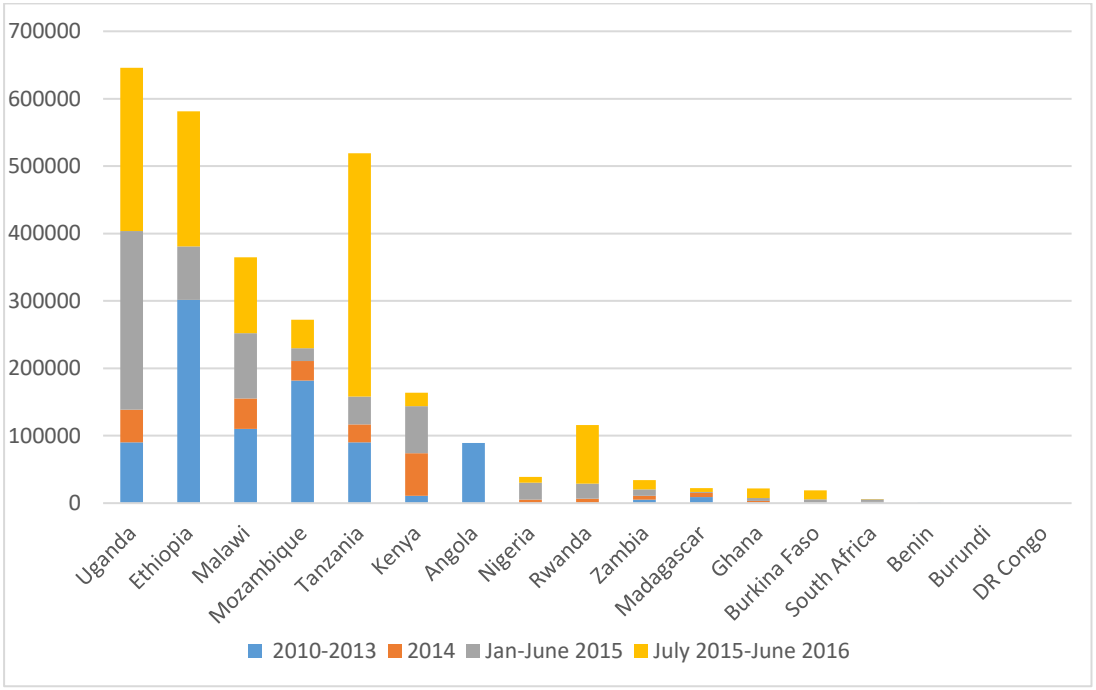


Figure 3: Number of households reached by country and by time period

1.2 Jumpstarting OFSP in West Africa through diversified market: Accelerating towards outcomes

By Erna Abidin (pictured), Souleimane Adekambi and Joseph Nchor

1.2.1 Introduction

This three-year pilot project funded by the Bill & Melinda Gates Foundation (BMGF) aims to achieve sustainable and inclusive market-driven approaches for orange-fleshed sweetpotato (OFSP) to increase incomes, and improve health through consumption of vitamin A rich OFSP, especially in women and children in Ghana, Nigeria, and Burkina Faso. This presentation provided the background of the project, progress towards outcomes at midline, and the focus interventions for Year 3, which are based on the learning from the first two years of implementation.

The project is pursuing the following outcomes, whose linkages are presented in Figure 4:

1. Formal and informal diversified OFSP market opportunities developed in pilot areas in Ghana, Nigeria, and Burkina Faso
2. Viable Quality Declared Planting Material (QDPM) seed system in target areas capable of expansion in response to increased demand
3. Households, including women and children, in target areas have increased vitamin A consumption from OFSP
4. Commercial sweetpotato planting material and OFSP producers, including women, increase income through participation in OFSP value chains

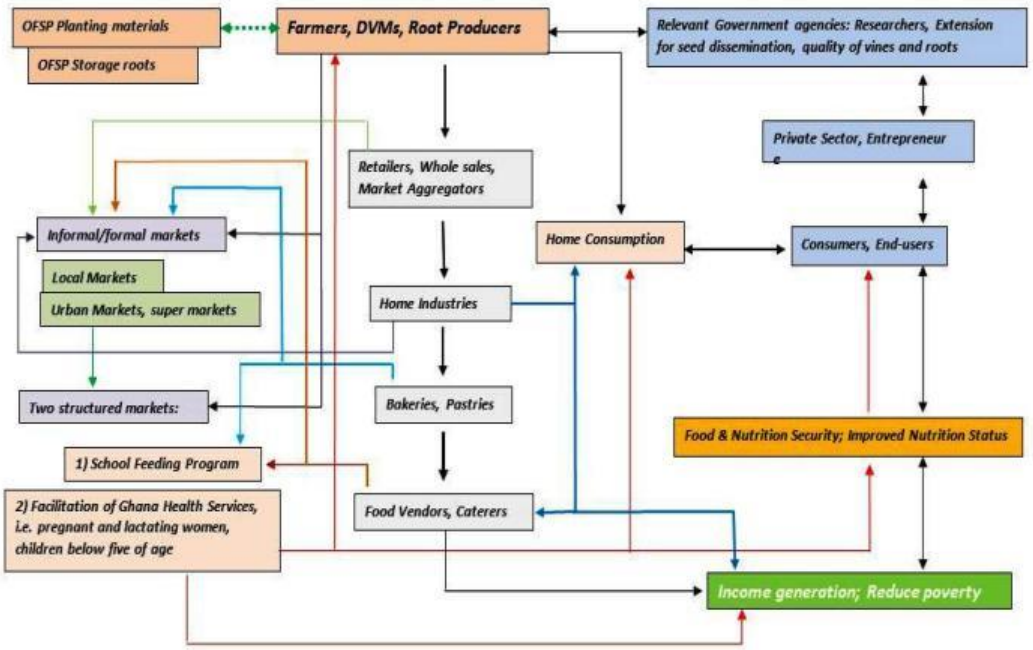


Figure 4: An integrated approach: public and private sector partnership to match into the four jumpstarting OFSP project outcomes

1.2.2 Progress and achievements

In the first and second year of the project, two elements were required, i.e. linkage of seed system, the breeding programme and elements that contributed to the functioning of the seed system. In the third year (1 April 2016 to 31 March 2017) the project will:

- Strengthen the seed system (QDPM) implementation (already on going)
- Expand and document formal and informal markets for fresh roots and processed products, i.e. bread (Ghana, Nigeria)
- Solidify M&E systems
- Solidify and expand partnerships to reach more than one million households by 2020
- Continue learning from the Ghana Health Service (GHS) intervention (willingness to pay)
- School feeding pilot project in Ghana

The MLE officer was replaced and the annual work plan was revised. The project monitoring, learning and evaluation plan was revised to include the people responsible for different elements. Open data toolkits have been deployed for use in the project, and training has already been undertaken. In the third year, data collection of market information will be done. Field visits are organized to validate and verify reported activities and adjust the implementation of project activities as required. Monthly reports using uniform templates are used to share progress.

Dry season production under irrigation (Ghana)

A midline survey was organized in Ghana and Burkina Faso. The respondents were selected from two regions in Ghana and five communities in Burkina Faso targeted by the project. Two categories of farmers were selected: direct beneficiaries (treated) and non-beneficiaries (control). According to the findings, information about OFSP is very high, 94% in Ghana and 95% in Burkina Faso. The main information sources are project partners in the two countries, but more so in Ghana (82%). Gross margin of vine production was investigated to find out if the business could be profitable. In Ghana, the total cost of production per acre was USD 65.83 (USD 162.75/ha), average vine plot size was 0.9 ha and gross margin was USD 243.49/ha. In Burkina Faso, the total cost of production per acre was USD 325.20 (USD 803.96/ha), average vine plot size was 0.52 ha and gross margin was USD 591.16/Ha.

By mid-2015, 17 elementary schools in Osun State, with over 8,000 pupils were receiving an OFSP meal once a week, while 1,910 students in 13 schools received OFSP bread once a week. In September 2016, 100 additional schools were included around the state, with the possibility of further increase. Overall, ten tons of OFSP are required to feed 41,216 students weekly.

GHS is trying to increase the consumption of OFSP through a well-developed theory of change that will ensure that women and children access roots and vines. In addition to establishing DVMs, training health facility staff on IYCF counseling and OFSP, cooking demos, sensitization and training on utilization and processing, a voucher system helps pregnant and lactating mothers get access vines.

1.2.3 Plans for the next six months

As this phase of the project draws to a close, the following activities have been planned:

- Conduct endline surveys of producers and DVMs
- Assess contribution of GHS to OFSP
- Analyse cost-benefits of OFSP incorporation into bread and contribution to OFSP root production
- A meeting of core implementation partners will be held in November 2016

1.2.4 Exit strategies

These are the possible strategies for OFSP expansion and scaling up in Ghana, Burkina Faso and Nigeria. All partners strongly preferred exit strategy Option two.

Option one: Do not exit and seek extension for Jumpstarting Phase 2 or other follow-up project.

Option two: Exit

- Determine the successes of the intervention that can be scaled out or scaled in; prepare some concept notes and seek a number of respected donors for funding activities through a project or two.
- Partners have their capacities to carry on through their own investment e.g.
  - In Burkina Faso: Neema Agricole du Faso SA (NAFASO) Seed Company now supplies QDPM to the Ministry of Agriculture and NGOs and the OFSP fresh market value chain now runs on his own. In Nigeria: school feeding continues to expand within Osun State and nationally. In Ghana: OFSP value continues to grow through bakeries, school feeding and GHS
- Services investment: value chain actors and partners continue on their own.

1.3 Integrating OFSP as part of Enhanced Homestead Food Production

By Mette Kinoti

The Enhanced Homestead Food Production (EHFP) approach, implemented by Helen Keller International (HKI), seeks to improve the nutritional status of children under five years of age, women of reproductive age, breastfeeding and pregnant women. The project is implemented in Burkina Faso, Mozambique, Cote d'Ivoire, Tanzania, Nigeria and Senegal. This presentation highlighted HKI's progress in OFSP delivery in Africa, the next steps, and perspectives and future plans.

1.3.1 The EHFP approach

The approach works through women groups. Education on nutrition is linked to improved production training. The project is set to end in 2016. In Mozambique, there is a new project focused mainly on OFSP and vine multiplication, while in Tanzania, Burkina Faso and Cote D'Ivoire, randomized controlled trials (RCT) are being carried out.

The approach has worked well to combine production and consumption. While adoption has increased, the taste of OFSP has been found to be more preferred by children than adults. The same challenges remain, e.g. access to land for female farmers to set up their model farms, late distribution of vines leading to late planting and to low or no yield, and damage by livestock. There is also limited documentation of adoption and spread of orange and white-fleshed sweetpotato varieties. More focus needs to be placed on raising local awareness, irrigated vine production to ensure timely availability of planting material, and improved documentation on adoption, yield, consumption and sale.

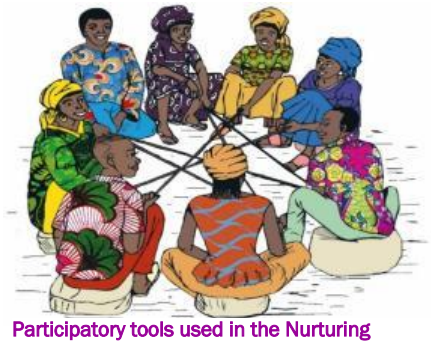
In 2016, the EHFP project distributed almost 9 million vines, reaching 25,922 direct beneficiaries and 178,555 indirect beneficiaries.

The next steps for EHFP are:

- Finalize the ongoing RCT in Tanzania and Burkina Faso. The first data set receive from Tanzania is good with regard to consumption and production. The one from Burkina Faso is not yet in.
- Integrate work within the neglected tropical diseases program, and to use OFSP vine distribution as an incentive for drug distributors.
- A new initiative is anticipated to begin in Cote D'Ivoire in 2017, and there is also potential for a new initiative in Tanzania.
- OFSP will be integrated in other programs.

1.3.2 Nurturing connections

This was a four-month series of participatory exercises, games, sketches and storytelling to facilitate conversations on gender equality, and enhance communication around food production and nutrition decisions, division of labor and resource allocation. The intervention worked with women, men and decision makers in the community, such as traditional birth attendants and mothers-in-law. This intervention is important because nutrition sensitive agriculture is not gender neutral.



Participatory tools used in the Nurturing Connections intervention

The decisions that influence consumption patterns are influenced by gender. Four months of weekly interactive sessions around gender issues were done within the three groups: women, husbands/partners, and community leaders, and in the fourth week, they all met. The research question was *whether the nutrition communication implementation has an effect on intra-household communication, decision making, community communications and support, purchasing authority views and gender equity.*

1.3.3 Results – decision making

The results of the study were as follows:

- Significantly larger shares of women report discussions within the past four weeks for six of the nine topics from baseline to endline in Nurturing Connections villages
- Significant impacts: living in a Nurturing Connections intervention village was associated with a comparative increase in women's roles in decision making and more joint decision making within livestock, childcare, spending, health and domestic work, but excluding agricultural decisions about the partner's and one's own plot

Future analysis, based on the available data sets will focus on nutrition and agricultural outcomes, men, mobility and land ownership and rights. There has definitely been progress in terms of communication and sharing of household tasks and decision making. However, the project has found no magic bullet that will address gender issues at the household level.

1.4 Scaling up biofortified crops through a food basket approach in Nigeria and Tanzania

By Hilda Munyua

Hidden hunger is severe in rural poor households in vulnerable populations in Africa. Most women of reproductive age, infants and young children suffer from deficiencies in vitamin A, iodine, iron, zinc and folate, leading to high mortality rates, birth defects, anemia, blindness, infertility, increased infections, reduced growth and mental development. The situation in Nigeria and Tanzania, the areas of intervention of the Building Nutritious Food Baskets (BNFB) project, is shown in the table below.

Table 1: State of micronutrient deficiencies in Nigeria and Tanzania

NIGERIA	TANZANIA
– 2.5 million children suffer acute malnutrition – Over one third of child deaths due to undernutrition – 30% of preschool aged children deficient in vitamin A – 49% of women of reproductive age are deficient in iron – 36% prevalence of under 5 stunting	– 2.4 million children malnourished – One third of children deficient in iron and vitamin A – 24% preschool children deficient in vitamin A – 40% women of reproductive age deficient in iron – 35% prevalence of under 5 stunting

There is need for comprehensive holistic approaches (multiple strategies) to reach different populations. Biofortification has been proven to be a cost-effective, sustainable and culturally acceptable approach. There is therefore need to catalyze scaling up of proven biofortified innovations. BNFB's work in Tanzania and Nigeria focuses on iron-rich beans, vitamin A cassava, orange-fleshed sweetpotato and vitamin A maize.

1.4.1 Project outcomes and approach

The goal of the BNFB project is to reduce hidden hunger, and the purpose is to demonstrate how scaling up of "multiple biofortified crops" can be achieved. Scaling up is dependent on supportive policy environment, strong institutional capacities and proven technologies. Therefore, the project expects to achieve the following outcomes:

(i) Improved supportive policy and investment environment for biofortification in the two countries through:

- Bringing together partners to ensure a coordinated and joint approach to advocacy: - policies, strategies, and plans developed and implemented (situation analysis + advocacy strategies – regional and national)
- Identifying and strengthening the capacity of advocates and champions for continued advocacy at regional and national levels
- Advocating for increased investments by public, private, NGO sectors and development partners
- Establishing multi-sectoral technical and policy platforms that actively promote evidence-based support for biofortification
- Improving global understanding of scaling up approaches

(ii) Strengthened institutional and community capabilities to produce and consume biofortified crops through:

- Strengthening capacities and competencies of investors and executing institutions (institutional strengthening + ToTs + step-down courses)
- Enhancing awareness of and increasing organizational action for biofortification among key stakeholder groups (producers, farmer organizations, marketers, processors)
- Mainstreaming biofortification in national nutrition programs and National Agricultural Research Stations (NARS) crop programs

1.4.2 Key targets

The key targets are:

- USD 10 million raised for biofortified crops programs in Nigeria and Tanzania
- Seven country and three regional policies/strategic plans developed and implemented that prioritize support to biofortification
- Five technical programs supporting or utilizing biofortification designed and implemented
- Twelve varieties of biofortified crops in the pipeline expedited for release
- At least 10,000 change agents with the capacity to design and implement gender sensitive projects
- Ultimately, 2.175 million households growing biofortified crops

1.4.3 Achievements to date

The project was launched in March 2016 and planning meetings held with key stakeholders. Biofortification was promoted at key regional and national conferences, events, fairs, shows and a number of advocacy engagements were carried out. A situation analysis study was commissioned to inform the advocacy strategies, and a range of advocacy and communication materials were developed.

Capacity building of project participants

Biofortification has been integrated in the draft Multi-Sectoral Action Plan for Prevention of Micronutrient Deficiencies in Tanzania, with funds being earmarked for investment in nutritious crops.

A rapid needs assessment was conducted, and gaps for training and learning materials identified. The capacity of five seed companies, 12 extensionists and 24 farmers was built in Tanzania. National seed agencies in Tanzania were also supported to self-organize and are now multiplying and conducting multi-location testing for large-scale production of seeds of biofortified crops, and special criteria for release of biofortified crops was initiated. BNFB engaged processors in Nigeria and Tanzania on the processing of nutritious foods.

A monitoring, learning and evaluation (MLE) plan was developed to facilitate systematic monitoring, data collection, reporting and evaluation. A workshop was held to facilitate internalization and ownership of the MLE plan.

1.4.4 Discussion of session one

Christiane Gebhardt: Was there a significant difference between treatment and control groups in terms of OFSP yields during the Jumpstarting project's midline survey?

Souleimane Adekambi: There is an informal sharing of OFSP vines between the groups we are working with and those we are not, and this could be the reason the difference is not large for both variables. OFSP was introduced in 2015, so those in the control group who produced OFSP in that year got vines directly from the DVMs.

Olapeju Phorbee: Who is supporting the school feeding program in Ghana?

Ted Carey: In Ghana, the school feeding program has had a problem of payment to the vendors, but it is sponsored by Ghana School Feeding Program.

Olapeju Phorbee: How does the voucher system work?

Joseph Nchor: The voucher system has been piloted to enable pregnant women access vines when they visit the health facilities on clinic days. They are registered and their coupons and vine dissemination forms are filled. They use these coupons to receive vines from DVMs. It is a subsidized intervention so the coupons are collected and sent to NGOs, who then pay the DVMs.

Mette Kinoti: The voucher system has different variants. For example, they could be given to community health workers (CHWs) who then give them to households that they provide nutrition and health education to.

Roland Brouwer: What do you mean by gross margins and why is the difference between Ghana and Burkina Faso so large?

Erna Abidin: The difference lies in pricing. In Burkina Faso, the market is mostly informal, while in Ghana, most OFSP producers are selling to bakeries where the prices for bread are controlled.

Francis Amagloh: In Ghana, iron deficiency is very high and OFSP alone is not sufficient. Can the BNFB be scaled up to Ghana and such countries?

Hilda Munyua: The project is being implemented in Nigeria and Tanzania, where we are demonstrating how the food basket approach can be scaled up. We aim to also advocate for more investment by governments in biofortification.

2 Session two (Friday morning, 7th October)

2.1 Integrating nutrition in agricultural projects: Experiences from Ethiopia

By Wellington Jogo

In Ethiopia, there are challenges of chronic food insecurity and malnutrition, and micronutrient deficiencies, such as vitamin A deficiency are highly prevalent especially among children under the age of five, and pregnant and lactating mothers. The National Nutrition Plans (2008-2015; 2016-2020) and the Ministry of Agriculture and Natural Resources Nutrition Sensitive Agriculture Strategic Plan (2015) recognize biofortification and food-based approaches (and especially OFSP) as strategies to address micronutrient deficiencies.

The goal of four agriculture-nutrition projects implemented in SNNPR and Tigray regions is to contribute to improved food and nutrition security among vulnerable households with young children in target regions through increased production, and consumption of micronutrient-rich sweetpotato and potato varieties as part of diversified diets. These projects are:

(i) Scaling out sweetpotato and potato-led interventions to improve nutrition and food security in Tigray and SNNPR, Ethiopia (Irish Aid-funded); Sites (SNNPR and Tigray)
(ii) Better Potato for Better Life (USAID-funded); Sites (Tigray, SNNPR, Oromia & Amhara)
(iii) SASHA project (BMGF-funded); Sites (SNNPR & Tigray)
(iv) Emergency Seed Project (USAID-funded); Sites (SNNPR)

2.1.1 Factors considered at project planning

When planning, the project considered a number of factors, which are outlined below:

- The project does not only address nutrition, but also food security and income, as this was considered a factor of increasing adoption by farmers.
- Farming systems and local diets are dominated by cereals, and sweetpotato and potato are not priority crops. Therefore, the project had to integrate OFSP into these cereal-based cropping systems and local diets. Processing had to integrate OFSP into local foods.
- Target households are selected in conjunction with bureaus of health and agriculture and NGOs to ensure that the most vulnerable households are included.
- Agriculture-nutrition interventions are multi-sectoral and require multi-sectoral coordination and partnership. Government structures have to be linked into for the sake of sustainability.
- Gender roles had to be considered, as women play a key role in sweetpotato production and household nutrition. Furthermore, women and children under five are the most vulnerable to malnutrition.
- Instead of running a separate school feeding program, it was considered more effective to use opportunities to complement similar initiatives that were implemented by other national and regional stakeholders.

2.1.2 Implementation approach

A partnership approach was adopted, in which regional research institutes, government departments, universities, NGOs and funding organizations play distinct but complementary roles.

OFSP is used as an entry point, but as part of a basket, because micronutrient deficiency cannot be addressed by only one crop. Existing government and community structures are used in nutrition promotion to ensure sustainability. Nutrition promotion is done through complementary behavior change approaches such as, cooking demonstrations, community nutrition sessions,

The Ashenda festival

radio, Information, Education and Communication (IEC) materials, the Ashenda Festival and other programs. Established OFSP school gardens and feeding and nutriton education are used to complement the traditional extension approach.

Some technologies that were piloted for ensuring farmers' access to clean planting material include Triple S, on-farm net tunnels and drip irrigation. These have been validated and can now be scaled up.

2.1.3 Successes and challenges

Successes: Farmer linkages to local OFSP root markets were established, and OFSP was successfully integrated into local diets in different forms. Quality Declared Seed (QDS) was ratified and institutionalized at national and regional government levels.There is increased interest in OFSP by other stakeholders, and a recognition of sweetpotato as a food security crop by other organizations e.g. GIZ and Concern International. It has been mainstreamed into the health and agriculture extension education package especially at *kebele* level in Tigray. Agriculture and health sectors are now collaborating with NGOs through their joint work in the project.

Challenges: Farmers in SNNPR were not able to conserve vines on the farm. Furthermore, the OFSP roots market was not well established, while at the same time, farmers, who produce at a small-scale, could not supply the market consistently. This is partly because the targeted farmers by the project are the most vulnerable households. As with other countries, government institutions face a few institutional challenges. The varietal traits of released OFSP varieties are not preferred by farmers because they have low dry matter content and are drought prone, as compared to the white-fleshed varieties. To address this, the project is working with the Southern Agricultural Research Institute (SARI) to introduce improved varieties.

2.2 Integrating nutrition in agricultural projects: the influence of different socio-cultural and agro-ecological conditions in delivery: The case of northern Mozambique

By Benjamin Rakotoarisoa

This presentation shared the experience gained in northern Mozambique by the Nutritious Sweetpotato for Niassa and Viable Sweetpotato Technologies in Africa (VISTA) projects, specifically with regard to an intevention led by the partner Anglican Diocese exploring attitudes using focus groups and Trials for Improved Practices (TIPS). This intervention was implemented in Chimbunila, Central Lago and Northern Lago districts of Niassa.

2.2.1 Understanding attitudes, myths, culture and barriers

The first step was to find out what the prevalent attitudes, myths, cultures and barriers were, and to craft messages that would address them. These are presented in the table below.

Table 2: Dealing with attitudes, myths, culture and barriers

	Issues	Messages
Attitudes	The most desirable attributes in food is health for young women and intelligence for men.	Explain to young women that OFSP will help their child's nutritional status, and help the child to be more healthy. Explain to men that OFSP will help their child's nutritional status, and help the child be more intelligent.
Myths	Food from factories, like fizzy drinks and drink powder are highly nutritious and worth spending scarse money on for the good of the children. Feeding a child too much would make their bellies grow.	Promote the value local foods; draw on local belief about God, and explain that God's foods are better than factory foods. Teach about why it is good for a child to eat many times a day.
Culture	Eating sweetpotato and porridge is not "sophisticated"— prefer drinking tea with bread.	Explain that sweetpotato and porridge is far more nutritious than bread and tea.
Barriers	OFSP is only a breakfast food.	Teach methods of preparing OFSP in different ways for different meals.

2.2.2 Approach

Lussanhando (Yao): old women in Chimbunila district

A group of 20 persons were involved in a demonstration of making porridge of OFSP with groundnuts, and legumes that people from around the community, including chiefs, sampled and highly appreciated. They promised to commit five minutes at every community meeting to teach about OFSP and nutrition. A nutrition fair was organized to demonstrate how one can eat well using products that are home-grown. During this period (February 2014 – November 2015), 1,610 men and 3,985 women were reached. Lessons from the first investigation and implementaion were used to draw a community nutrition framework for 2016, which involves multiple stakeholders.

The pathway for the Niassa Integrating Nutrition in Agriculture intervention is founded on a structure through which the intervention is cascaded from promoters to animators, then to counselors and finally to the end-users, who are households with children under the age of five. While quite similar to the pathway of the VISTA Mozambique, this intervention places a greater focus on partnership. The District Health Department disseminates nutrition messages at health centers during the antenatal checkups, and supports promoters and animators during trainings. The Anglican Diocese of Lichinga and Nampula implements the program in the rural areas of Sanga and Murrupula districts. Lúrio University provides internship opportunities to students. This partnership approach makes it possible to reach 21,800 households in six months.

Training covers the following topics:

1. Investing in the first 1,000 days, for health, growth and intelligence.
2. Three key food groups and why our body needs each – food diversification.
3. Healthy complementary feeding for young children – cooking demonstrations (recipes of enriched porridge using local food).
4. Taking advantage of OFSP – cooking demonstration (recipes made of OFSP).
5. Appropriate feeding frequency.
6. Evaluation and planning – graduation.

2.2.3 Conclusion

Many successes have been achieved, for example, all the farmers are using diversified foods contributing to body building, protection and energy, because of the training implemented in the community. The enriched porridge has proven to be popular among young children.

Nutrition must be practiced, not just talked about. None of the participants in the training had ever seen sweetpotato prepared as porridge for children, so during demonstrations, both men and women were involved in the cooking and they loved the enriched porridge.

2.3 Nutrition model of VISTA Tanzania project: Going to scale with nutrition education

By Frederick Grant

The VISTA project's goal is to contribute to improved dietary diversity, food security, and incomes in Tanzania through four main objectives: (i) increased production and consumption of OFSP varieties through an integrated agriculture-nutrition technology set (ii) access to improved nutritional knowledge and practices and diversified use of OFSP by both female and male caregivers; (iii) improved storage and marketing of fresh OFSP roots and (iv) improved evidence-based and policy support for OFSP production and utilization.

The main nutrition objective is to increase access to improved nutritional knowledge and practices and diversified use of OFSP by both female and male caregivers. Under this objective, the project targets to reach 17,500 households by 2017, and to ensure that equal numbers of women and men are included through community groups.

2.3.1 Planning phase

A number of factors had to be considered when going to scale. The first was that behavior change takes time, but it is possible to expedite the process if the messages are well crafted and transferred. It was important to ensure that the nutrition interventions rolled out in the districts would have the same content to avoid confusion among the change agents and the beneficiaries. Secondly, quality control was built into the project, e.g. through supervision and surveillance of collected data and indicators. Thirdly, it was important to gather knowledge on the OFSP varieties and other vitamin A sources that exist and are being consumed.

The main elements of the work plan were as follows:

- Formative research: rapid assessment of dietary practices.
- Identification of households with children under five and implementing partners, and development of work plans for each location.
- Nutrition education and counseling / Social Behavior Change Communication (SBCC), including adapting existing IEC materials, training implementing partners and holding regular monitoring.

2.3.2 Implementation phase

The core components of the project are

- Initial nutrition assessments on food consumption, OFSP availability and use at household level and OFSP pricing and procurement sources.
- Nutrition education, focussing on key messaging on Infant and Young Child Feeding (IYCF) and the 1,000-day approach.
- Nutrition counseling to provide skills and techiques for message transmission.
- Training of partners such as CHWs, CSOs, extension workers and local government.
- Targeting of direct and indirect beneficiaries.
- Project monitoring.
- Gender sensitivity.

2.3.3 Progress in implementation

Nutrition cards used for training in Tanzania

IEC materials and training manuals for implementers were developed and translated into Kiswahili. To increase coverage, VISTA partnered with Mwanzo Bora CSO and district nutrition extension departments.

One hundred and fifty-seven CHWs were trained to deliver nutrition counseling in IYCF support groups, and have formed community based groups of 15-20 members. Gender sensitive counselling has been implemented, as well as enhanced demonstrations of infant food preparations. The project activities have been integrated with other nutrition programs in the communities.

Monitoring tools were developed as part of the M&E framework. Examples of these tools are group profile form and group meeting attendance form for CHWs and supervision checklist for district nutritionists.

VISTA Tanzania has faced a number of challenges, such as low attendance in meetings and inefficient completion of monitoring tools by the CHWs. To address these challenges, the project will improve targeting, take advantage of meetings that men attend in the community and peer groups, and carry out targeted refresher trainings.

2.4 Integrating nutrition in different conditions in Kenya

By Penina Muoki

Two projects are being implemented in Kenya using the agriculture-nutrition-market approach for scaling up OFSP: These projects are: (i) Accelerated Value Chain Development (AVCD) and (ii) Scaling Up Sweetpotato through Agriculture and Nutrition (SUSTAIN). The anticipated outcomes are increased production of nutritious sweetpotato, improved nutrition knowledge and practices and increased availability of sweetpotato roots and farmer incomes.

In Western Kenya, the prevalence of VAD is 84% among children under five and 39% among women of reproductive age. Fifty percent of children do not get vitamin A supplementation. Exclusive breastfeeding is at 35.8% and stunting at 40%. Almost 50% of women get married before the age of 18, which calls for the need to focus nutrition messaging to appeal to a young female audience.

2.4.1 The focus on nutrition integration

The focus of the nutrition component is on the first 1000 days, which is the window of opportunity to reverse malnutrition. The interventions contribute to implementation of WHO/UNICEF recommendations for IYCF, and promote affordable balanced diet during pregnancy and adherence to ante and post-natal care.

Previously, the SUSTAIN project collaborated with PATH. Currently, activities are implemented in collaboration with the county government through the departments of nutrition and public health. This approach utilizes already existing structures, in which households are clustered into community units, with about 100 households being manned by a CHW.

Agriculture and nutrition links have been established through linking vine multipliers to health facilities. Vine beneficiaries are recruited at the health facility during ante- and post-natal consultation. So far, 760 CHWs have been trained and over 27,000 households have been reached with vines and nutrition education. Ninety health workers were trained on agriculture.

2.4.2 Approaches to integrate nutrition activities

A cooking demonstration in Western Kenya

Nutrition education: These are guided modules facilitated by a trained CHW. Training manuals (adapted from Mama SASHA) are provided by the project.

Nutrition counseling: This could take place either at the health facility or at the community. It is mainly conducted by a trained nutritionist and often facilitated by the project.

Community based cooking demonstrations: These are conducted by CHWs. Supervision is provided by either Ministry of Health or Ministry of Agriculture staff, and facilitated by the project.

Social and Behavior Change Communication: A knowledge, attitude and practice survey was carried out to document drivers and barriers to adoption of OFSP, and its inclusion in usual diets including infant feeding. The results are being used to come up with messages to achieve behavior change. A full time staff was hired to drive SBCC activities.

Monitoring progress and learning: Baseline survey results are being used to guide implementation. An elaborate monitoring plan was developed. Operational research and an annual survey are included into the project plans.

2.5 Discussion of session two

To start the discussion, the moderator, Robert Ackatia-Armah, highlighted the differences between nutrition-sensitive and nutrition-specific programs, and the importance of understanding the concepts and how they influence each other. He also spoke about the influence of gender on activities, perceptions and household dynamics, which in turn influences nutrition outcomes. Panellists responded to questions from the audience.

Margaret McEwan: Which behavior change strategies are most cost-effective?

SPHI participants pay attention to the discussion

Wellington Jogo: In Ethiopia, a behavior change strategy was developed and after a few years of implementation, it was evaluated to find out which approaches worked and their cost-effectiveness. We found out that cooking demonstrations worked best. To make them cost-effective, the NGOs that carried out the demonstrations now train women who can carry out smaller community-led demonstrations.

Frederick Grant: We chose to use community level activities because they are effective and more likely to be sustained.

Penina Muoki: In Kenya, the county governments are interested in publicity and they have access to media outlets, so they are usually keen to use local radio and television. This has the potential to reach many people in a cost-effective way.

Robert Ackatia-Armah: These strategies should all be brought together through a platform to ensure that they are sustained and that the health and nutrition sectors work better together.

Jan Low: What are your strategies for keeping CHWs motivated?

Frederick Grant: CHWs mostly do not want monetary reward, but they like to get trained, it means that they are appreciated. We ensure that the training quality is maintained.

Penina Muoki: CHWs are no longer on the government payroll in Kenya. Therefore, just as in Tanzania, training is a motivating factor. Also, when they achieve certain targets, we give them incentives.

Jan Low: In Mama SASHA, to get the outcomes, people had to actively participate throughout. You are all monitoring participation at community level. What are you doing to ensure that they fully participated?

Penina Muoki: In Kenya, we ensure that mothers or caregivers go through four months of training, after which they graduate. We have integrated many lessons from the Mama SASHA proof-of-concept.

Mette Kinoti: How are the promoters in the project in Mozambique motivated?

Benjamin Rakotoarisoa: In Northern Mozambique, we tried to work directly at the community level for six months. First, the animator had to be literate and willing to work as a volunteer. After the animator has shown their commitment, they receive an incentive such as a bicycle to travel to the community. Changing the perception and having people realize that the local foods are more cost-effective than purchased ones helped to get people to participate.

Olapeju Phorbee: Biofortification has more acceptance at community level than at the policy level, where vitamin A supplementation seems to be more preferred.

Wellington Jogo: The situation in Ethiopia is similar. The moment you go past the CHWs to the district level, agriculture-based interventions are considered to be the mandate of the Bureau of Agriculture. This is definitely a problem which needs to be further addressed to find some solutions.

Roland Brouwer: The recommendation about integrating OFSP in cereal-based systems has implications, especially as the project would be in drought prone areas as well. How do you address agronomic factors like soil fertility?

Wellington Jogo: Soil is an important factor; right now we are getting extremely varied sizes and quality of roots from the same plots, and we have yet to establish the cause of these differences. There is need to research and address this, especially as we target the market which wants consistent root size.

Jude Njoku: How did you train DVMs in Mozambique?

Benjamin Rakotoarisoa: We are working mainly with government partners, and DVMs are motivated according to the demand. The vines are being taken to other provinces and to the commercial market. OFSP is recognized and promoted by the government of Niassa.

Temesgen Bocher: How are you measuring the real impact on the ground i.e. are you monitoring the area under sweetpotato and OFSP?

Wellington Jogo: In Ethiopia, we do baseline and midterm surveys and area will be one of the variables in the endline survey.

Frederick Grant: This was one of the questions from USAID after submitting our report. We have a two-page form for M&E officers to document progress on specific indicators, including area under cultivation.

Sunette Laurie: In Ethiopia, which is cereal-based, if you bring in sweetpotato, are you suggesting that they replace teff or is it an addition? Wouldn't that just mean feeding people on more starch?

Wellington Jogo: We are not trying to replace teff with OFSP. Rather, we would like to integrate OFSP into local diets.

Ibrahim Koara: How do you determine and ensure availability of the preferred varieties for different stakeholders in Kenya?

Penina Muoki: These varieties were released based on suitability for the area of operation, but some varietal preferences in different levels of the value chain are being fed back to the project. This information is shared with the breeders.

Kwame Ogero: Has the government of Ethiopia made any direct investment in OFSP?

Wellington Jogo: The government recognizes OFSP in the policy document, but the implementation and investment is not sufficient. We need to do more advocacy to ensure the government is held accountable to its promises.

Oscar Ortiz: CIP is a research organization and that should be kept in mind. Comparative analysis is critical in this.

Graham Thiele: The four presentations explain four different models, yet they also have common elements such as CHWs. The first part of comparison should be an implementation protocol looking at what you said you would do, and if you did it. The second should look at how it was implemented, i.e. what is exactly the same and what was done differently. This will help to identify some strategies that work across the board.

Recommendations

Kirimi Sindi: We have been working on behavior change for a while and also carried out some baselines and evaluations. We should put this information together to identify the lessons we have learned. If we think we know what we are doing, we should influence partners to fund us to implement a common approach.

Maria Andrade: We have to integrate agriculture, nutrition, health and climate change.

Jude Njoku: Agronomic practices can help us to improve the micronutrient content of crops, for example, whether some of the fertilizers that are used could lead to nutrient retention and depletion.

Mette Kinoti: When we have a resource framework for multi-sectoral strategies, there should be indicators for nutrition-sensitive aspects.

3 Session three (Friday afternoon, 7th October)

3.1 The SeFaMaCo programme

By Worku Tsega

The Integrated Value Chain Development and Smallholder Farmer Commercialization of Banana and Sweetpotato for Tanzania, Uganda and Ethiopia is based on a seed-farmer-market-consumer (SeFaMaCo) model. The goal of the project, implemented by Farm Concern International (FCI), is to optimize profitability and productivity by catalyzing market-oriented value chain-wide competitiveness, and investments in banana and sweetpotato for increased household incomes.

3.1.1 Program outcomes

The SeFaMaCo programme aims to achieve the following outcomes:

(i) Enhanced strategic investments in commercial seed enterprises responsive to market-driven clean and quality sweetpotatoes purchased by Small Holder Farmer (SHF) – Seed Marketing Enterprise Development (SEMaD) Approach.
(ii) Commercialized SHF through the Commercial Village Model for increased productivity and yields of market preferred varieties of sweetpotato, strengthened farmer organizations for collective marketing, and inclusion of youth and women as value producers.
(iii) Increased market share of sweetpotato through enhanced value chain efficiency, market partnerships and competitiveness in informal traditional markets and schools as demand catalysts for other distribution channels.
(iv) Increased utilization of sweetpotato through positive image building, product diversification, nutrition education, and enhanced consumer preference in rural and urban areas.
(v) Enhanced learning networks strengthened through strategic alliances and partnerships based on an upgraded SeFaMaCo model.

SeFaMaCo focuses on partnership across the value chain nodes, and creates synergy for effectiveness and efficiency. It is currently being adopted for partnership with various stakeholders.

3.1.2 Progress updates

Seed multiplication farm in Serere, Uganda

The program targets 192,992 households and 1,026,894 beneficiaries in Uganda, Tanzania and Ethiopia. For sweetpotato, SeFaMaCo works with 525 sweetpotato seed entrepreneurs, and aims to reach USD 161 million in sales. To date, 965 commercial villages, with 59,113 women and 48,449 youth have been structured. There are 55,220 acres (22,336 ha) under sweetpotato, producing 428,953 metric tons (estimated 19.2 tons/ha).

At the seed level, 756,120,641 sweetpotato vines have been accessed by SHF, and 33 suppliers of inputs have been linked to farmers. The program engages 11 sweetpotato extension agents and 11 sweetpotato research officers. Already, 176,996 households have been impacted by the program.

At the market level, linkages have been established with 254 traditional sweetpotato informal wholesalers, and partnerships have been established with schools and institutions. Sweetpotato achieved cumulative total sales of USD 15 million in the second year of implementation.

3.1.3 Discussion

Kirimi Sindi: How did you measure the coverage and yield in your project?

In terms of the sales volume, we are linking SHF in commercial villages to informal markets and retailers in secondary towns and cities. We have trade facilitators working with the commercial villages and they provide regular updates, which are tracked and put in the system. These are real data collected from trade facilitators and entered into the database by the M&E officer.

Kirimi Sindi: How do you get enough planting material to get this number of acres and the tons?

The material comes from SARI, which is the national centre of excellence for root crops, we are able to get this material through the support of Dr. Fekadu Gurmu. Please note that this data refer to the three countries. All data are captured rigorously and regularly right from the field level, and it is aggregated by the M&E.

The local market has a limited capacity to pay for the product, while nearby secondary towns can absorb the product at a much better price. This is what is referred to as high value. It is not about what producers can produce, but what the market needs, and if they can meet those requirements, producers can move along the value chain to the high value market.

3.2 Progress in developing shelf-storable puree and OFSP bread improvement

By Tawanda Muzhingi (CIP) and Antonio Magnaghi (EIL, pictured)

The growing demand for innovative, healthy foods has generated a new bread market worldwide. The use of OFSP flour as a substitute for wheat flour is not cost-effective, while the use of OFSP in puree form is economically advantageous. The major bottleneck to expanding use of puree is the inconvenience associated with the preparation and storage.

3.2.1 OFSP puree storage practices

The Gold Standard for puree storage is aseptic processing using continuous flow microwave, Other common practices are canning, cold storage (freezing), using natural preservatives (natamycin and nisin) or chemical preservatives (sorbates and benzoates).

3.2.2 Development of shelf-storable OFSP puree

Puree production at Organi Ltd.

There is potential to store puree without refrigeration. On-going research seeks to determine the storage life of this puree, and in particular, the safety of the product as it ages; demonstrate and ensure the nutritional and bread quality attributes of stored OFSP puree; and determine the cost-effectiveness of shelf-storable puree production, transportation and storage.

One component of the OFSP puree storage studies seeks to determine the effect of different preservative combinations and vacuum packing on the quality of OFSP puree and baked products.

Hurdle technology is employed to ensure that pathogens in food products can be eliminated or controlled. Hurdle technology usually works by combining more than one approach. These approaches can be thought of as "hurdles" the pathogen has to overcome if it is to remain active in the food. The right combination of hurdles can ensure all pathogens are eliminated or rendered harmless in the final product. This means the food products will be safe for consumption, and their shelf-life will be extended.

OFSP puree samples treated with 0.5% potassium sorbate, 0.5% sodium benzoate and 1% citric acid with vacuum packing were stored at ambient conditions in a fresh root storage room at Organi Ltd, Ringa Kenya, and temperature was monitored and maintained at 15-23^{o}C. When stored for 12 weeks under these conditions, there was no fermentation (pH <4.2), and no significant change in beta-carotene content and color. The final product was found to be microbially sterile after baking, and with packaging costing USD 0.04 per kilogram, was cost-effective.

3.2.3 Shelf-storable OFSP puree bread trials

The stored puree was used in bread trials. The following hypotheses were tested:

Hypothesis 1: Stored and preservative treated OFSP puree makes bakery products with same quality as fresh OFSP puree.

Hypothesis 2: Potassium sorbate and sodium benzoate (chemical preservatives) have no effect on yeast activity and dough development

Data were collected on taste, color, texture, odor, bread volume and shelf-life. The findings show that chemical preservatives in shelf-storable puree increased the proofing/fermentation time of the dough for bread from one hour to five hours. Sorbates retard yeast activity and extend fermentation or proofing times of yeast leavened products. Dough conditioners will improve the dough development in the presence of sorbate.

3.2.4 High fiber OFSP puree for breadmaking

Unpeeled sweetpotato, which is high in fiber, is being tested for puree production and bread making. It has been found to increase the yield of OFSP puree production from uncooked roots from 70% to 95%. Unpeeled sweetpotato puree has the added advantage of being more nutritious by addition of fiber, antioxidants and minerals found in the skin. It also saves on labor and time hence reducing production cost, and improves waste management.

Bread made with puree from unpeeled OFSP roots was not different from bread made from peeled roots in terms of taste, color, and texture. The baking process of using unpeeled OFSP roots and peeled OFSP roots puree was the same.

3.2.5 Next steps

Research steps that are going on will focus on:

- Development of an optimized recipe for OFSP sorbate treated puree for bread applications.
- Optimization of the OFSP puree formulations for the volume/size of products.
- Shelf-life studies of OFSP bread versus standard white bread.
- Characterization of the functional ingredients and nutrition of OFSP puree bread.
- Promoting Good Manufacturing Practices (GMPs) and Good Agricultural Practices (GAPs).
- Providing feedback to research on OFSP varieties with regard to the shape, size and skin color that is preferable for puree production.

3.2.6 Discussion

Jim Lorenzen: The most expensive ingredient in bread is the time it takes for bread to rise.

Antonio Magnaghi: One has to consider the product being developed. One can retard production, and we also have some strategies in progress to speed up the process through a combination of ingredients that are currently not on the Kenyan market.

Julius Okello: Even if you save time by not peeling, I feel there would be a trade-off. First, it takes longer to wash, and the spots that are left on the peel could influence color. Further, wouldn't you let in some weevil infested roots?

Antonio Magnaghi: The tendency is that roots are cleaned before they are sold to processors, so at the processing unit, rinsing and sterilization takes a short time. The equipment in use screens the product before use so that bad batches can be removed. Sweetpotato starch works like the gums sold in the market, so they trap the moisture in the bread, and prevent bacterial growth. Water used is very important in bread preparation. Because sweetpotato traps water, the bread requires less addition of water and prevents bacterial growth.

3.3 Panel: Scaling Up Sweetpotato through Agriculture and Nutrition (SUSTAIN) - lessons from going to scale

Moderator: Simon Heck

Panellists: Penina Muoki (Kenya); Kirimi Sindi (Rwanda); Roland Brouwer (Mozambique); Robert Ackatia-Armah (for Malawi); Julius Okello (Impact Assessment, M&E)

3.3.1 Introduction

SUSTAIN panel discussion participants from left: Robert Ackatia-Armah, Roland Brouwer, Penina Muoki, Julius Okello and Kirimi Sindi

Achieving impact at scale is a key ambition and is in strong demand from countries globally. Technologies have been developed and delivery mechanisms piloted. There is no doubt about the existing commitment going to scale, and the 2016 World Food Prize is a manifestation of that commitment. However, the question is 'how'? Three years ago, the SUSTAIN project was designed to develop and assess such an approach to scale up OFSP seed systems, nutrition integration and commercial processing.

This panel discussion sought to address this topic by exploring the following guiding questions:

- How to scale up and what exactly?
- How to scale up well? (effectiveness, efficiency)
- How do we know that we are doing it well?

The panel discussion was structured with two rounds of questions: (1) Progress made (approaches used, results, how M&E was used, adjustments made and why; (2) Lessons emerging (key elements of successful scaling up and what we need to improve for overall learning).

3.3.2 Progress made

Kirimi Sindi: We start by developing the seed system and ensuring that clean planting material goes to DVMs (usually small-scale and medium-scale farmers), who multiply vines to distribute to farmers. One of the biggest bottlenecks is experienced in the seed systems. At the beginning, DVMs are not willing to give all the material required, so we have also worked with the national program and private sector multipliers to increase capacity. SUSTAIN also got directly involved in multiplication to ensure that sufficient material is available. Our M&E shows that we have moved people from five tons to 12 tons per hectare on average because of the use of disease-free planting material. Last year, in SUSTAIN alone, we had 38 DVMs who made about USD 40,000 from the sale of 4.7 million vines. The beneficiaries sold roots worth around USD 14,000. One of the large-scale processors consistently makes USD 35,000 USD per year. In value addition, we work at the lower levels where we train our farmers.

Due to our communications, people know very well about OFSP and the minister has declared that it should be available to every household that needs it. However, we realize that we have yet to achieve exactly what we want as sufficient planting material is still a bottleneck. Many people talk about market development. Our project focused on the most vulnerable and resource poor households, so when people say they cannot see OFSP in the market, we can confidently say that the beneficiaries ate them.

Penina Muoki: The components of SUSTAIN are the same across all four countries. In Kenya, we have focused on linking commercial root producers to processors. We find that it is a chicken and egg situation; when the demand is created, the supply cannot meet it, and vice versa. We have to build up processing to ensure that it is commensurate with the production. One challenge we have faced is the exit of a partner in the middle of the project. Experience has taught us that the transition to a new partner could make or break the project.

Roland Brouwer: In Mozambique, partnerships are very important. Seed systems is done by CIP, and we have partners to carry out nutrition education. Gender issues have been addressed after it was found that most of the money for DVMs went to female farmers; now 40% goes to male farmers. There is a discrepancy between diet diversity and OFSP production, i.e. those that grow it are not diversifying their diet because too much is being sold. This means our nutrition work will have to be changed. Social media platforms are helping us to share information.

Robert Ackatia-Armah: In Malawi, they looked at six varieties that were available for dissemination through the mother-baby trials. They also made OFSP available to go to scale by creating a commercially viable supply system. They worked through the government, commercial partners and NGOs. SUSTAIN had started working in selected areas, and as the Malawi office got more projects, they spread out to cover the whole country. For M&E, common tools were designed to be used across the four countries, but they had to be modified slightly to meet country-specific needs. Most of what is being done expands on the work by the Mama SASHA proof-of-concept project that was implemented in Western Kenya.

Julius Okello: SUSTAIN is very much about scaling up the proof-of-concept projects and it was critical to measure some key indicators, among them, the number of people reached. We quickly learned that we needed to measure both direct and indirect beneficiaries in a systematic way, and track them regularly. We came up with operational definitions of direct and indirect beneficiaries, and developed a methodology that can be applied to the scaling up effort.

SUSTAIN is implemented in five countries. Mozambique released 15 varieties for adoption at the end of 2015. They added seven more this year and now have 22 varieties. Malawi took it upon themselves to evaluate the six varieties through mother-baby trials. It is critical to evaluate how varieties perform in terms of yield in different countries. The M&E community agreed to use the crop cut method to estimate yield. This method is being piloted in Rwanda.

Simon Heck: Thank you for those initial comments and reflections. I now want to open up the discussion for question and comments from your own projects, and on how you approach some of these challenges.

Margaret McEwan: Policy enabling environment, institutional capacity and technologies – how are these being used in the scaling up effort?

Julius Okello: Michigan State University (MSU) is using a combination of scaling up strategies. They are treating delivery of good planting material as one of the bigger packages of technologies. It includes agronomy, market linkage and some training elements. These are different arms of a systematic RCT. They already did the baseline survey, but are yet to do the endline. When they do, we will get to know what combination of these strategies is most effective.

Robert Ackatia-Armah: At the end of this year, several partners that SUSTAIN was working with will be phased out. These partners have integrated the aspects they got from SUSTAIN into their training. This is definitely an example of sustaining capacities.

Penina Muoki: In Kenya, health and agriculture are devolved and we are represented in all nutrition and agriculture forums. Through trainings, we are getting the county governments involved.

Kirimi Sindi: It is important to work with institutions that can take the project forward. We ensure that policies are enacted at local and national level. In addition, even as we talk about technology or giving the vines, it comes as a package. If you give the vines alone, you do not get the results you want. At the national level, institutional partners such as CRS and USAID contractors have more resources, so we are acting as coordinators by finding out if they work with OFSP and what their demand is, so that we can work with DVMs to ensure that the materials are available.

Roland Brouwer: Towards the political end of capacity building, SUSTAIN is not the only project working in Mozambique, so together with other projects, we are working to contribute to scaling up of sweetpotato.

Craig Yencho: I would argue that there is one factor that has not been discussed - postharvest storage of sweetpotato.

Penina Muoki: In Kenya, We are lucky to be working in collaboration with the SASHA project on postharvest handling of sweetpotato. The intention is that within the AVCD project, we shall be able to scale up some of the outcomes from the SASHA project and establish at least two storage facilities in two counties. We understand that scaling up will not happen if we cannot have continued availability of sweetpotato, either for home consumption or to sustain the kind of enterprise we are initiating.

Kirimi Sindi: At the beginning of SUSTAIN, we started an experiment called 'zero energy storage unit' that we have worked on with Madjaliwa Nzamwita and Jean Ndirigwe from the national program. We have shown that we can store sweetpotato roots with zero energy using water and charcoal. Using clay blocks, we can store the sweetpotato for between four and six months. More work on storage is required.

Roland Brouwer: Storage is very important to ensure a constant supply of roots. In partnership with the SASHA project, we are developing a solar-heated storage facility with a South African partner first in one location, and later on we will build another one.

Kwame Ogero: In Rwanda, CIP got involved directly so as to meet demand of planting material. How sustainable is this after the project ends?

Kirimi Sindi: Sometimes, the pressure to meet donor targets requires that you include some unsustainable strategies, but the DVM structure is also developed so that it can continue at the end of the project. At the beginning of the project, 0.15% of farmers said they were buying materials and now it is 22%. Between June and August, we have participated in three events talking about OFSP including a trade fair and radio. We ensure that we build capacity of partners to deliver on root and vine production and nutrition education.

Srini Rajendran: Do you have any protocol for impact assessment? Also, how do we connect products developed in different socio-economic contexts with good productivity?

Julius Okello: We have a sound theory of change. MSU developed a very good protocol that was reviewed internally and externally and it seemed to be sound.

3.3.3 Lessons emerging

Julius Okello: In Western Kenya, we did an operational study and came up with a strategy to reach more consumers with information about OFSP. Our findings showed that the most trusted sources of information were medical doctors, extension officers and local vernacular radio. People listened to radio every day, but interacted with doctors and extension officers occasionally.

Sind Kirimi: It is easy for us to state that we can work with private sector, but the reality is different. For sustainability, one has to change the mode of engagement often, and be more obliging instead of setting very strict parameters.

Robert Ackatia-Armah: In Malawi, Nankwhali farm have slowly started weaning themselves off the project, but they still need support especially for expensive technologies.

Penina Muoki: We have to draw a balance between commercialization and research. For example, commercialization of bread is of interest to CIP, but how about private sector, what is of interest to them?

Simon Heck: Thank you to the panelists for the very specific observations. My lesson is that scaling takes time, and talking about scaling takes more time than we have this afternoon. We need more opportunity to exchange information, and we should explore other opportunities that are available to us, including the CoP.

3.4 The Bill & Melinda Gates Foundation agricultural strategy

By Jim Lorenzen

The BMGF has undergone some reorganization within the agricultural development team that will influence implementation. In this presentation, Jim Lorenzen summarized the new structure.

Public goods: Crop research and development and discovery, livestock research and development, and innovation and systems services and partnerships, as well as policy and data, fall in this section.

Geographic group: The focus is on SSA and South Asia.

In terms of delivery, focusing on trying to go to scale, the priority geographies within SSA have been reduced from seven to three, i.e. Nigeria, Tanzania and Ethiopia. Within South Asia, Bangladesh fell off the priority list for delivery. That created some confusion with regard to going to scale, but not with regard to developing global public goods, where these restrictions do not apply.

In spite of this, one of the changes will be a reduced emphasis on going to scale, which after an internal assessment, it was determined that other institutions would have a comparative advantage. Therefore, BMGF will continue to support the development of innovative ways of going to scale, and pilots showing how it can be done effectively together with private sector and scaling agents but leave the actual scaling up efforts to large partners who have the mandate and resources, such as national governments, major donors, bilateral and multilateral donors.

With regard to the downstream efforts, BMGF has increased its structural capacity to ensure that country teams are in place to help drive the agenda for what happens in the priority geographies when going to scale. The country teams will work in collaboration with the technical teams to take advantage of important opportunities.

There is great emphasis on public policies because policy can be a major enabler for many of the components that partners are implementing. BMGF will take advantage of the existing goodwill from other interventions, to define and present options and opportunities to policymakers so they can help to improve the policy environment.

The impact goals are inclusive agricultural transformation, empowered women and well-nourished families that are transforming the economy. Gender goals have been made more explicit. For example, nutrition continues to be very important.

The strategic goals are increased agricultural productivity for smallholder farmers, increased incomes for smallholder households, increased consumption of a nutritious and diverse diet, and increased women empowerment in agriculture.

The results framework will define the indicators by which M&E and impact assessment can be done. Because seeds systems is important to this group, there will be more emphasis in seed systems on innovations and delivery models-how to have a market-led focus in accelerating farmer adoption of new varieties. This is really important since that is part of BMGF's genetic gains initiatives. There will be a focus on improving early generation seed production technologies and developing business cases of how to do early generation multiplication. Although the importance of informal community-based seed systems is recognized, BMGF does not have a comparative advantage and therefore this will be de-prioritized.

While local seed production for vegetatively propagated crops is vital, BMGF feels this should be connected to formal seed systems. Some of this work, and other downstream work that is consistent with AGRA's new strategy will be relinquished to them.

4 Session 4 (Friday afternoon, 7th October)

4.1 Postharvest challenges in sweetpotato: NRI partnership with CIP to support SASHA

By Andrew Westby

A new emphasis was introduced into SASHA: to improve the utilization pathways for sweetpotato consumption and production to boost the economic viability of sweetpotato value addition and business activities; and to alleviate vitamin A deficiency through intake of processed products containing OFSP.

CIP envisaged that storage and handling would be important issues and therefore NRI was brought in to join the team. NRI has worked with CIP on postharvest issues of sweetpotato for several decades, e.g. study of simple on-farm storage structures in Uganda, understanding varietal characteristics associated with storability, Triple S system for storing seed, and understanding retention of carotenoid during processing and storage.

NRI has also worked on consumer acceptance of OFSP which is central to SASHA. Consumer preference is important in the value chain, but often neglected regarding poor people. Information about preference and markets can increase the success of new more nutritious varieties or safer products. NRI has explored preferences and willingness to pay of biofortified sweetpotato and cassava. For example, new vitamin A OFSP was liked by 82% of consumers in Uganda but 18% did not like it. There are clear differences in preferences between urban and rural consumers. While there is increasing demand to understand preference, the challenge is that the varieties and products vary, and there is lack of knowledge about markets and demand.

4.1.1 NRI inputs to SASHA 2

Commercial scale storage - to develop cost-effective technologies that enable commercially oriented farmer organizations to supply quality sweetpotato roots year-round to specific agro-processors or urban markets (NRI lead).

Domestic scale storage - to assure year-round supply of OFSP in nutritionally at risk households, develop convenient and low-cost methods for fresh root storage (NRI support).

Analytical support - to develop the regional capacity and appropriate protocols for analysis of roots and derived products at reasonable cost to ensure that they have adequate nutritional quality and meet safety standards (NRI support).

4.1.2 Value chain analysis and fresh root storage feasibility study in Kenya

Sweetpotato harvesting methods in Kenya

In order to identify opportunities to expand marketing of fresh and processed OFSP, Tanya Stathers and Ilaria Tedesco carried out a value chain analysis and fresh root storage feasibility study in Kenya. The study focused on fresh sweetpotato root production, availability, trading and service provision in main production areas (Homa Bay, Migori, Siaya, Busia, and Kericho); and fresh sweetpotato root trading, retailing and consumption in major urban markets (Nairobi, Nakuru and Kisumu).

The study found that sweetpotato is important for urban populations as it is easy to prepare and nutritious, and that production of sweetpotato is increasing relative to other crops. The volumetrics of sweetpotato trading are complex. To exploit the existing opportunity to produce OFSP puree for bakery products in one of Kenya's supermarket chains, there is need to ensure organized scheduling and staggering of OFSP planting and use storage facilities at production sites to be able to store at least one month's supply of OFSP (capacity 20-30 tons).

4.1.3 Improved strategies for OFSP handling and short-term storage

In August 2015, a trial on strategies for sweetpotato handling for short-term storage (up to 14 days) was undertaken. The treatments included in the trial were harvesting method (ox plough, hand), methods of soil removal (wet brush, dry manual, wet manual, no removal), packaging (plastic crate, wooden crate, sack), and variety (Kabode, Vita).

The findings were that manual wash, air drying, and sack storage were better than all other treatments. This underlines the importance of curing (maintaining roots at high humidity after harvest to allow healing of wounds). Further handling trials will be conducted once storage conditions have been optimized.

4.1.4 Long-term OFSP storage

To ensure that puree production is not constrained by root supply, there is need for a cost-effective storage facility, capable of storing for at least one month. The costs of construction, power supply and consumption, and maintenance should be kept low, preferably by using off-grid solar power. The facility should be capable of maintaining temperatures for curing and storage

temperatures of 15-17°C. The trials should be written up as a case study to inform subsequent ventures, including a set of plans for store construction.

Two storage rooms have been constructed within an existing processing facility. An evaporative cooling system has been developed with low installation costs, and low power demand to allow the use of an alternative power supply such as solar power. An initial challenge was shortage of meteorological data, especially lack of information on solar radiation through the year. A light meter with a data logger has been installed, and the number of solar panels increased to provide sufficient power. The cooling system is currently working at 70% efficiency, but work to increase efficiency and improve temperature reduction is still ongoing.

Trial 1 indicated that heating was required to achieve the temperatures necessary for optimum curing (28-32°C). In trial 2 the two varieties, Kabode and Vita, were stored each washed and unwashed. Curing (with heating to achieve 28-32°C and high humidity achieved for reducing ventilation) was carried out for 4 days, followed by cooling with the evaporative system. Inefficiencies of the evaporative cooling system meant that the storage temperature was above 20°C (typically 20-25°C) while 15-17°C would be optimum. Despite higher than optimum temperatures, after 4 months, more than 80% original weight of good quality roots that provided good quality puree was retained. Washing may increase rots, but this needs to be rechecked.

Trial 3 identified some challenges. Mechanical breakdowns underlined the need for user-friendly controls and a problem solving checklist for facility users. These are in the process of being implemented. There was increased weevil infestation of the stores which could be reduced by lower temperature storage. It is recommended that stores are completely emptied at regular intervals and fumigated.

4.1.5 Other NRI inputs to SASHA

NRI also worked with SASHA to construct a store for puree in Kisumu, carry out a value chain analysis, advice on the potential for storage in Mozambique and consult on methods of vitamin A analysis. The Institute has also supported the development of protocols for food safety tests on OFSP products.

In year 3, NRI's inputs will be as follows:

- Final development and testing of two sweetpotato stores at the Organi site in Kisumu
- Complete construction of puree store in Kisumu
- Final root storage trial within completed/tested storage facilities
- Follow up postharvest handling trial in Kenya
- Optimize household/small-scale commercial storage facilities in Ghana
- Disseminate material for Triple S storage in Kenya
- Provide support for development of appropriate training in hygienic practices for processors and microbial challenge tests on OFSP puree

4.1.6 Discussion

Erna Abidin: We talk of static storage, is it possible to move OFSP using containers to a different location?

This is about optimizing the storage depending on the market you have. For example, you can cure and heal to prevent moisture loss and fungal deterioration. You can also dehaulm to thicken the skin. It comes down to utilizing key bits of knowledge and the cost of transport system to fit the market you are working in.

4.2 Discussion with two 2016 World Food Prize winners: How Mozambique led the way – a sisterhood story

Two of the 2016 World Food Prize laureates, Maria Andrade (left) and Jan Low (right)

"If you come from an island you are a very different person. When I was young I would stand there and wish to go somewhere, yet you know you will go but your soul will remain on the island. It is how the poets also feel." Maria Andrade explains her favorite song – Cesaria Evoria's *Soldade*, as the panel discussion begins. With her opening words, she transports the audience to the island of Cape Verde, where she was born and raised. It is also where she did her initial breeding work, before she relocated to Mozambique.

Maria and Jan Low, the two 2016 World Food Prize laureates present at the annual SPHI meeting, have just been ushered to the stage by the moderator, Margaret McEwan, accompanied by their favorite tracks.

Margaret starts the discussion by showing them a photograph of the first multi-sectoral meeting in Mozambique, when they had discussed the potential of OFSP. She makes an interesting observation – almost all the varieties released by Maria are named after women.

Maria explains, "In Portuguese, the verb '*batata doce'* is feminine." But it goes deeper than that. The names honor women who have dedicated themselves to agriculture, nutrition and biofortification, and who have actively contributed to the breeding efforts. Some were there from the very beginning, as the idea of using OFSP to combat high levels of malnutrition were discussed on relaxed Saturday afternoons. Others came later, helping to facilitate and manage the ongoing work, or even volunteering to cook OFSP recipes. But among all these female names is only one male name – Tio Joe. It means Uncle Joe. "This variety is in honor of Joe DeVries, because he was the first one who believed in us and put in some money to start a breeding program in Mozambique, for Mozambique with a spillover in southern Africa," Maria explains.

Jan's soundtrack is Helen Reddy's 1971 hit, I am woman. It is a song of strength and determination. "This is a song I chanted to myself as I made my way up Mt. Kenya and did not quit. It is one of those songs that just stays in your head," Jan explains.

Turning adversity to opportunity

Maria recalls the first time that she and Jan met. It was 1996, and when she heard someone call out the name of the person she had been waiting to meet. She got out of her office and into the corridor to say hallo. She quickly overcame her surprise at the fact that Jan Low was not a man, as the name had led her to believe, and from that day, they have stuck together, through good and bad times.

The devastating floods of 2000 are a memorable period, which was a disaster that the two turned into an opportunity. The money for their sweetpotato work was running out, and they submitted a proposal to Oxfam for emergency distribution of sweetpotato vines. "We convinced them that to make it work, we needed to do a nutrition campaign. At emergency time you cannot do community level nutrition education, but we developed a series of promotional materials like the *capulanas* and community level theater," Jan recalls.

The foundation for this intervention had been built long before this, when Jan did her post-doctoral work with CIP in 1995. The study showed that a nutrition education component is needed when introducing OFSP in the young child diet. Jan felt that one of the challenges to do a good controlled trial was to avoid contamination of your sample. “Central Mozambique is as isolated as you can get and at the time the prevalence rate for vitamin A deficiency for children under 5 was 65%. It was an environment which we could do a food-based study and be able to measure the impact of the work,” she recalls.

What Jan did not count on, was how difficult it would be to get donor support at a time when supplementation was all the rage. “The health donors would say it was an agricultural project, and the agricultural donors would say it was a health project. I spent my summer vacations during three years going around to 21 donors before we got lucky.”

After 3.5 years of trying, the breakthrough came, when the Micronutrient Initiative acknowledged that this food-based method was likely to work. With USAID and Rockefeller Foundation also coming on board, there was enough funding to do a two and a half year proof-of-concept study in Mozambique, with varieties supplied by Maria, with World Vision and HKI as the implementing partners. That culminated in a seminal paper that was awarded the best scientific article in the CGIAR in 2007.

The floods provided an opportunity to promote dissemination of vines and social market strategies. OFSP was first promoted in Mozambique in 2001, and since then, 40% of sweetpotato producers are growing orange-fleshed varieties. Vitamin A deficiency has reduced from 69% in 2002, to 55%, according to the 2013-14 Global Nutrition Report. Despite the progress made in using integrated production, marketing and nutrition strategies in Mozambique, Maria suggests that they can learn from countries such as Kenya and Uganda, where OFSP uptake has been faster. Jan adds that developing adaptive varieties in nine countries is a key investment to go to scale, and that the lessons learned breeding in Africa for Africa should be taken advantage of. According to her, radio is an effective tool for raising awareness at the community level in terms of creating markets.

A multi-sectoral approach has been central to the operations in Mozambique. “You cannot talk of only OFSP, agriculture or nutrition; policy, markets, education and other sectors are also necessary,” Maria says. The *Secretariado Técnico de Segurança Alimentar e Nutricional* (SETSAN) network, which brings together government programs and organizations working on policies related to food security and nutrition, have provided communication and coordination that has had a positive effect. Maria notes that due to the large country and dispersion, SETSAN has set up provincial level networks to convene people at decentralized locations.

The UN Decade for Action on Nutrition provides new opportunities

The UN Decade for Action on Nutrition 2016-2026 is focusing on the double burden of under and over nutrition. The award of the 2016 World Food Prize to four scientists working on OFSP and biofortification is an opportunity to create momentum to work with governments, the UN and other partners to speed up progress towards achieving the SPHI goal, which is to reach 10 million households through improved varieties of sweetpotato and their diversified use by 2020.

The laureates are full of ideas about how this goal can be achieved: improving sweetpotato seed systems, integrating nutrition education into school curricula, strengthening private sector involvement in the value chain, social marketing, influencing policies for increased government investment in sweetpotato, and strengthening the sweetpotato community of practice to share lessons and approaches.

As the last of their inspirational words fade away, Margaret McEwan queues in their upbeat soundtracks, and they go back to their seats amid resounding applause from the participants, who no doubt, are looking forward to a moment to continue the discussions.

5 Session 5 (Saturday morning, 8th October)

5.1 Lessons learned by HarvestPlus scaling up biofortified crops

By Anna-Marie Ball

In a food basket approach, a household gets more than one crop e.g. iron-rich beans and OFSP. Sweetpotato and beans is considered a complete meal in Uganda. HarvestPlus uses an integrated approach with seed systems, agronomy, nutrition and demand creation, marketing and product development. The goal is to reduce micronutrient malnutrition and improve dietary intakes of vitamin A and iron for 315,000 households in 25 districts in Uganda by 2016.

5.1.1 Progress

Clean seed system: 14 secondary vine multipliers were provided with mini screenhouses and over 30 tertiary vine multipliers were established. There is a network of vine multipliers who self-regulate, they meet once or twice per year and receive technical support to improve. They monitor each other because they understand that poor performance would hurt them all. Building on the work of CIP, inspectors have been trained, including development of protocols and training of district inspectors on their roles.

Mothers are counselled on improved feeding practices in Uganda

Improved feeding practices: Cadres of women are trained under the 'lead mother initiative' and they then provide support to mothers and caregivers.

Increased promotions and advocacy: Drama, exhibitions and field days are popular tools for promotion and advocacy. Demonstration gardens have been established at health centers and more schools are taking up OFSP and requesting for trainings in schools and vines for school gardens.

Training multipliers and inspectors on protocol use: Technical guidelines were developed by a consortium of partners and pretested. They are ready for rolling out.

ICT for agriculture: In Uganda the challenge has been to link farmers to their closest vine multiplier. Using pre-set phone numbers, advertised on the radio, farmers can call in to get information about vine multipliers based in their area. Mobile phones are also used for polling during radio dramas about OFSP. Answers to questions about consumer and farming preferences can be texted to the radio station at no cost to the respondent. The answers are given in real time and geo-located, which allows radio presenters to respond to listeners within the same program. The data also informs future radio programs

Commercial farmers and traders: People eat a lot of sweetpotato in Uganda, and small-scale farmers cannot support the demand. HarvestPlus is working with commercial farmers who are already linked into the market. There is need to get more farmers involved in off season production.

Marketing and product development: Increased processing is intended to deal with surplus and small roots. OFSP flour is being made by millers and used by bakeries. There is increased demand for flour but the production is still low. HarvestPlus is working with Makerere University to develop products using OFSP puree.

5.1.2 Accomplishments

Over 400,000 households have been reached by the project, and through these, 205,006 children. Two new OFSP varieties were released and Triple S technology has been rolled out to ensure access to planting material in areas with long dry periods. New technical guidelines were developed and are ready for roll-out.

Research results indicate that there has been a high diffusion of information and planting material. There was increased understanding about the importance of vitamin A and a higher adoption by farmer groups that were directly targeted.

5.1.3 Discussion

Julius Okello: Who mobilized the farmers to work as a group and who helps them to stay together?

We started with a small group who met each other and shared ideas and then kept in touch with each other and they have associations in the different regions. These associations are made up of individual groups. In preparation for inspection, they have been trained. Within the association, there are groups which are supposed to inspect the materials before the government inspectors come.

Julius Okello: What are the challenges with seed production and how are they addressed?

We are operating in areas with long dry seasons, the technologies used are Triple S and irrigation. To maintain the quality of planting material, especially in the central region with high SPVD virus, we have established links with pre-basic seed production lab and some DVMs have net tunnels. Partners have developed protocols to guide the different stages of seed production.

Kwame Ogero: How are farmers linked to seed using the mobile app, and what are the costs involved?

Farmers do not bear any cost for using the mobile app.

5.2 Panel: Technical innovations in pre-basic seed production – Burkina Faso, Ethiopia, Nigeria, Rwanda and Uganda

Moderator: Felistus Chipungu

Panelists: Benard Yada (Uganda); Some Koussao (Burkina Faso); Jude Njoku (Nigeria); Jean Ndirigwe (Rwanda); and Beyene Demtsu (Ethiopia)

5.2.1 Introduction by Jude Njoku

The production of pre-basic seed is expensive and efforts have been made to develop technical innovations to make seed more affordable for farmers. One of the challenges is to ensure sustainable production. This can be done by making it affordable so that it can be taken up by other stakeholders after the end of the SASHA project.

The objectives of the ongoing work are to:

- Strengthen technical, institutional and financial capacity for increased production of quality planting materials.
- Promote awareness on quality sweetpotato planting materials, and strengthen coordination among stakeholders in the seed system.
- Ensure quality assurance for the pre-basic seed production process.

The production cycle is as follows: First generation/breeder seed is produced in small amounts and taken into the tissue culture lab for virus indexing and production of plantlets. These are acclimatized and then multiplied in the screenhouse as second generation/foundation seed. After

this, basic seed is produced in the net tunnels which are conducive for the farmers' environments. Where the virus pressure is high, multiplication is done in isolated fields. The basic seed goes to DVMs who multiply QDS to distribute to commercial root growers. This clean seed is intended to ensure that farmers achieve high yields.

The technical innovations are (i) consistent supply of pathogen tested pre-basic cuttings; (ii) strengthened tissue culture lab and screenhouse procedures; and (iii) technologies to increase multiplication rate and reduce cost of seed production.

National Crops Resources Research Institute (NaCRRI) Uganda uses MS stock solutions in place of pre-mixed MS salts, and agar in place of phytagel to solidify the media. Sugar is used as a carbon source in place of research grade sucrose. Wooden boxes are used in place of buckets and organic poultry manure and foliar fertilizer is used to boost growth in the first three weeks of transplanting.

Tigray Agricultural Research Institute (TARI) Ethiopia recognized that using sweetpotato can successfully be propagated using cuttings as small as two nodes, meaning that several cuttings can be taken from each hardened tissue culture plantlet. Greenhouse multiplication of tissue culture plants is being used to significantly reduce cost. TARI is also using coco peat plugs and rooting hormones to enhance rooting. TARI has found that apex cuttings root faster and better followed by middle cuttings, and that cuttings obtained from the bottom perform poorly as compared to distal cuttings.

In Burkina Faso, multiple entries are the cause of white flies in the screenhouse. A sprinkler irrigation technique with control from outside the screenhouse has been devised, with relative humidity inside the screenhouse being monitored by season to better control irrigation interval. The installation is in progress. To manage heat in the screenhouse, a double shade net-roof reduces sunlight and temperature inside the screen house. The sprinkler irrigation system may also help to increase relative humidity and to reduce the temperature.

In Nigeria, work started in 2015. Apex vine is preferred compared to middle or basal as it has fast establishment and escapes diseases and pests. Sterilized sawdust mixed with sea sand is used for acclimatization to cut costs. To cope with the high temperatures, leaves are stripped before planting to conserve moisture and ensure good establishment. Planting materials are steeped into systemic insecticides for 15 minutes before planting to control whitefly infestation. It is recommended that vines be planted as soon as they are cut, but if this is not possible, they should be tied in bundles with their base covered with wet soil. However, they should not stay for more than two days. When the site in Kano was selected, an innovation was started, where PVC pipes are used as a frame for net tunnels. This is because the area has high levels of termite infestation and wooden frames get damaged quickly. With this innovation, the frames can be used for 4-5 years instead of one year. In the screen house, the pot mix of 3:2:1 (top soil: poultry manure: sand) is used, and urea (1.5kg/100m^2) applied after each cutting (ratoon). Fertilizer use has increased multiplication rates. When planting, either poultry manure is used at 4 tons per hectare, or a mix of 2 tons of poultry manure and 200kg of NPK per hectare are used.

In Rwanda, innovations relating to sustaining pre-basic seed production include the selection of preferred high yielding improved OFSP as well as white-fleshed and dual purpose sweetpotato varieties. Actions taken to increase multiplication rates include application of urea to stimulate the growth and vines cut when they are long enough (8 weeks at screenhouse). Some of the actions to reduce costs of production are reduction of the amount of plantlets at tissue culture, increased number of plants in the screenhouse, increased number of ratoons and generations at nursery.

5.2.2 Discussion by panellists

Members of the panel (l-r) Jude Njoku, Beyene Demstu, Benard Yada, Some Koussao and Jean Ndirigwe

Felistus Chipungu: Please introduce yourselves and tell us the quantities of pre-basic and basic seed in the last season, your production targets for the next season, and the challenges you face in estimating the demand.

Jude Njoku: Pre-basic seed production started in Nigeria in 2015. We sent released varieties for cleaning up to the CIP facility in Ghana. I work with the National Root Crops Research Institute (NRCRI) in Nigeria and I backstop three OFSP projects – Jumpstarting project, pre-basic seed production and the Better Nutrition through Food Baskets (BNFB). Our target was to produce 1,000 first generation seed, 150,000 pre-basic seed for three years and 750,000 basic planting material. We have produced 60% of our first generation target, as well as 5,000 pre-basic seed. We had some challenges when the new government changed policies and introduced the single treasury account, which mopped up all our funds. This adversely affected our operations. We also lacked infrastructure in our tissue culture lab and we had to send material either to Kenya or to Ghana for clean-up, which is a cumbersome and time-consuming exercise. We did not have a functional screenhouse when we started, so we had to expand the net tunnel as a mitigating measure. Electricity failures affect our tissue culture lab operations, and we have discussed with other crops to potentially share the cost of running a generator.

Beyene Demtsu: I work for TARI. Last year, the plan was to produce 600,000 pre-basic planting materials. With basic problems of irrigation water and power outage, we managed to produce about 557,000. For the coming season, we plan to produce 600,000. The number is fixed by the capacity of our net tunnels. With the help of the Better Potato for a Better Life (BPBL) and SASHA projects, and the government, we hope that we will solve our irrigation water problems. We plan to plant two varieties of basic seed on two hectares. We have institutional buyers, so we estimate demand by holding a stakeholder meeting with these institutions and multipliers. For example, last year, GIZ promised to buy approximately 4.5 million cuttings. The challenge is that this estimate does not reflect the actual demand of root producers, but reflects the availability of institutional buyers.

Benard Yada: I am from NaCRRI Uganda: We are working on pre-basic seed production of three released varieties – Naspot 12 and 13 and *Dimbuka Bukulula*. We set our limit to between 100 and 200 tissue culture plantlets, and to multiply 2,000 cuttings, each measuring 20 cm. This is because we have a fairly small screenhouse. Our slogan was to start at the lab and end at the screenhouse. We could not break even, so we established one acre of basic seed multiplication, from which we plan to get 80,000 cuttings for sale. We plan to increase the acreage of basic seed multiplication because this is where we feel we could generate money for our revolving fund. To

address the challenge of drought, we procured a mini-irrigation facility. All proceeds that come from sales of planting material goes to a common account and we all have ledgers. At the end of the year, the cash reverts to the central bank, and we have to find ways of dealing with this. Demand is not all-encompassing even when you hold a stakeholder meeting, because not everyone can be invited.

Some Koussao: I work for *L'Institut de l'Environnement et de Recherches Agricoles du Burkina Faso* (INERA). We started pre-basic seed production one year ago. We started multiplication in July 2015, but the first semester was slow. We planned to produce 100,000 cuttings from the pre-basic seed, but we managed to produce only 11,000. In the next semester, we reduced the target to 35,000, but we produced 28,000. We distribute through two main NGO partners, HKI and Catholic Relief Services (CRS), who multiply basic seed and sell to farmers. The seed company NAFASO produces commercial basic seed using the pre-basic seed we provide. NAFASO used the ratooning system to produce more than one million cuttings. HKI and CRS produced 750,000 cuttings. In the past year INERA did not produce basic seed. We have irrigation facilities around dams, so in the coming season we will produce one hectare of basic seed in the western region and one hectare in the northern region. Estimating demand is difficult because we have formal markets, which are NGOs and NAFASO. They take time to come back for more material. We trained some DVMs but they do not buy enough planting material, so it is difficult to determine the demand. We got material for pre-basic seed production from Ghana.

Jean Ndirigwe: We started pre-basic seed production last year. Together with partners, we distributed 2.2 million cuttings at household level. Our target was to reduce the amount of plantlets at tissue culture and increase the amount at screenhouse and nursery stages. With this, we produced 540,000 cuttings. The challenges were many; you need to manage the available space i.e. screen house and net tunnels. One must know the demand outside the project, and the market segmentation. We use assumption rates, but we find estimating seed requirements at different stages difficult.

5.2.3 Response to audience questions

Glato Kodjo: The biggest problem for the farmer is availability of cuttings during the planting season. How can the technologies you have developed address this?

Some Koussao: In West Africa we have a long dry season and access to planting material is a problem. There must be a place for seed business. The habit is farmer-to-farmer distribution, so we have pushed people to produce vines. Commercial multipliers target institutions and their prices are therefore too high for farmers.

Richard Gibson: All of you are growing the crop out in the field, and no one has mentioned resistance. Is it addressed by the technologies you mentioned?

Jude Njoku: We multiply in isolated fields to reduce the chances of virus infection.

Some Koussao: When producing basic seed, we find isolated fields where there is no sweetpotato because this prevents virus spread to the field.

Jean Ndirigwe: SPVD tolerance varies among varieties but we are trying to introduce varieties adapted to different zones.

Richard Gibson: Everything you talked about focuses on public sector. One of the innovations you can make is to link with the private sector. How are you doing this?

Jude Njoku: We are trying to link with private sector partners in Abuja, who can produce pre-basic seed.

Some Koussao: In Burkina Faso, NAFASO sells planting material to farmers as far away as in Mali. That means that we are making progress.

Jean Ndirigwe: We are trying to involve the private sector in Rwanda. One of the enterprises do their own multiplication and sell cuttings to root producers for the factory.

Francis Amagloh: In West Africa, how do we control the temperatures during the Harmattan season?

Jude Njoku: In Nigeria, especially up north, the temperatures fall within the ideal range for sweetpotato production, especially during the Harmattan.

Jean Claude Nshimiyimana: Some varieties have very short internodes, how have you managed to use two-node cuttings? Is there an effect on establishment?

Jude Njoku: We conducted an experiment and collected data on two-node cuttings at NRCRI. It increases multiplication rates.

Beyene Demtsu: We tested the idea of two-node cuttings. The short cuttings (4 cm maximum) are adapted to our environment. The purpose of this innovation is to reduce the number of tissue culture plantlets. Last year, due to high demand, about 96,000 plantlets were multiplied and sent directly to multipliers, they established, but it took time. The establishment was the same as with the cuttings.

5.3 Can RTB systems learn from each other?

By Graham Thiele

RTB crops have a challenge of accumulation of diseases leading to degeneration and relatively low multiplication rates. Because they are bulky and perishable, they have to be produced relatively close to the users. Farmer-based seed systems make up over 95% of planting materials. Therefore, there is need to improve quality, access and dissemination of new varieties in a commercially sustainable way. In addition, insufficient attention is usually given to gender issues.

There have been many interventions but little systematic learning, which now begs the question: Can RTB seed systems learn from each other? The RTB CRP works in partnership with many CGIAR members and other institutions. To generate knowledge and learning, there is need to come up with instruments that help to compare the dissimilar. The diverse set of seed systems were compared using three rulers: (i) stakeholder framework – seed security (ii) seed degeneration and (iii) Impact Network Analysis.

5.3.1 Stakeholder framework – seed security

This framework allows one to compare the social roles of various stakeholders within a seed system. The framework has been used to do 13 case studies, from which a book was published in 2013. These case studies were selected to try to provide as much variability as possible, in terms of scale and objective of the intervention (to respond to a crop disease emergency, to improve household nutrition, to meet the new opportunities of developing markets, and others).

The theory of change was that small holders specialize in producing clean planting material and commercialization. Few of the case studies even tried to estimate demand, so the basis for the business case was not very clear. Seed systems projects need action-research to formulate explicit assumptions and a plan for collecting information. Seed purchase should be linked to the market, especially if the industry demands a new variety.

5.3.2 Seed degeneration

The key problem in most of the case studies was degeneration. There was a bias in favor of managing degeneration by distributing clean planting material. However, several cases also emphasized host plant resistance or on-farm seed management. There is need for a more integrated approach for managing degeneration, where on-farm management and host resistance

are the starting points, especially with resource poor farmers. A risk assessment framework for seed degeneration has been developed for an integrated seed health strategy for vegetatively propagated crops. One paper has a profile of yield loss and different dimensions that interact with it. This was produced using a modeling approach. One can see how different management practices help in managing farmer level seed quality. Generally, positive selection was managing and controlling virus accumulation. A study from Tanzania has yet to go through full modeling, but it shows how yields vary over three generations in seed coming from net tunnels and open field. Generally, the net tunnel seed had higher yield. The detailed papers are available upon request.

5.3.3 Impact Network Analysis

Impact Network Analysis is a platform for evaluating system management strategies (seed systems or integrated pest and disease management). One can look at the impact of research products, impact on spatial ecological processes and impact through communication and decision making networks, and linked bio-physical networks. It can be used for biological and social processes. In the seed system, there is the bio-physical network and the socio-economic network, and the interaction between these two can be examined.

A community of users have to commit to using the rulers. The RTB community is one way to bring the different crops together. This cross-cutting cluster has tools that can be used. The rulers are being applied in ongoing projects to ensure that the knowledge generated is useful during the lifetime of the project. For example, it is being used in a cassava project in Nigeria. The expected outcome is that seed companies sell high quality early generation seed. The project has two seed loops: processor outgrowers and village seed entrepreneurs. The rulers will be used to compare the seed loops and see what the outcomes are. Seed network maps and a gender differentiated network map will be developed.

Another knowledge product is the Cassava Seed Tracker, which is an integrated seed resource management software for the seed sector.

5.3.4 Conclusion

In response to whether RTB seed systems can learn from each other, the answer is yes. There is strong progress in “rulers” for cross crop learning and modeling. In terms of knowledge management, the RTB cross crop dedicated seed cluster is connecting with the sweetpotato seed system CoP. However, limitations exist in that most of the ‘soft’ information is lost. Some rulers are missing e.g. profitability/willingness to pay and multi-crop seed tracker.

5.3.5 Discussion

Theodore Munyuli: We have experienced cases where farmers reject planting material because they are not adapted for the area.

Graham Thiele: We need to understand the local perspectives, and introduce material that will work for that environment. That is part of the learning, and it has to be documented while it is happening. It is also important to understand that to start off, there is need for material to come in from outside.

Godfrey Mulongo: How significant are the findings that planting material from the net tunnels has higher yield?

Kwame Ogero: This is raw data from three generations. There is higher production from material coming from net tunnels. We looked at root production and how net tunnels contribute to reducing virus infections over generations. You can see an increase in materials in open field, while those in net tunnels were clean for a very long time. This is a significant finding.

5.4 Progress in sweetpotato genomics and strengthening the SpeedBreeders community of practice

By Craig Yencho

This presentation drew the attention of participants to up-stream applications of genomics for breeding. The Genomic Tools for Sweetpotato (GT4SP) is a large project that is led by North Carolina State University (NCSU) and implemented along with several partners including CIP, Michigan State University (MSU), Cornell University, Biosciences eastern and central Africa (BecA) and the national programs at NaCRRI and CRI. There are also partners in Australia.

The GT4SP project started with a convening at the BMGF back in 2013, to figure out what is needed to facilitate breeding and next generation breeding tools for breeders in SSA. Craig Yencho was given the responsibility to lead the project, which started in 2014 and is fully focused on sweetpotato. There are 20 principal investigators, spread across seven institutions, six countries and 15 time zones; it is an unprecedented level of focus on sweetpotato genomics that has never been heard of before.

5.4.1 A "vision" for marker-assisted breeding in SSA

The GT4SP consists of several platforms. First, is the development of genomic resources. This requires a reference genome, good markers, advanced laboratory sequencing capabilities and good mapping populations. Second is high throughput phenotyping and a database to capture the tremendous amount of data that are being collected.

The challenge is to bring these tools, technologies and capabilities to sweetpotato. Phenotyping has been improved and is web based. The project has developed a database and electronic data capture tools to manage resources. It is all predicated on human resources and good capacities, so a major emphasis of the project is to develop those human resources and to develop the capacity to conduct genomics-assisted or marker-assisted breeding of sweetpotato. Lastly, there is need for a common vision and continuity of efforts by the project implementation team.

5.4.2 Progress update

The start-up meeting was held in January 2015 and the first annual meeting was held during the Plant Genome meetings in San Diego in 2016. The group has grown substantially during that time.

Breeders participate in a training on genomic tools during the annual meeting in June 2016

It is really important to translate the knowledge from the lab to the breeding community in SSA. In 2015 and 2016, the genomics team held a joint annual meeting with the SASHA project for breeders. The meeting consists of all the major breeding groups across the entire continent plus some major players around the globe. During the past year's joint meeting, a two-day workshop was held to begin to introduce applied breeders to the new genomic tools. The program consisted of an overall view of genomics-assisted breeding in sweetpotato, how to analyze diversity and basics of marker-assisted selection in sweetpotato, how to select phenotypes in the field, and practical exercises of extracting high quality DNA.

The capacity building leader has visited Ghana and Uganda to train staff and will soon visit Mozambique. Webinars are scheduled and all the information is posted on the Sweetpotato Knowledge Portal.

NARS programs are still not able to do marker-assisted breeding due to lack of genomic infrastructure, but many of them have the basic infrastructure required to interface with the advanced institutions to facilitate marker-assisted breeding in the future. Three people in GT4SP will spend 3-6 months at BecA, working on advanced marker-assisted breeding methodologies and techniques.

5.4.3 Major accomplishments to date

A reference genome for two wild relatives of sweetpotato is an outcome of the GT4SP efforts, achieved in less than two years. Eighty percent of the genome has been covered, which has paved way for the identification of genes. This will provide information about what these genes do, how they interact and what role they might have as candidate genes for specific breeding characteristics such as resistance to sweetpotato virus disease, dry matter content, beta-carotene production, yield etc.

RNAi sequencing has been done to look at gene expressions across the various sweetpotato wild relatives. All this is annotated on the genome and presented in a genome browser. This work is led by Robin Buell at Michigan State, published on the sweetpotato genomic resource online and presented on the genome browser. The information provided will be of use to the genomics team who can help to improve breeding. A genotyping procedure has been developed, which gives low density and high density markers using genotyping-by-sequencing.

Populations are being developed by national breeding programs. Currently populations in Peru, USA, Ghana and Uganda are being phenotyped. Major traits of interest include orange-flesh, high dry matter, tolerance to sweetpotato virus disease, weevil resistance, and high beta-carotene.

To deal with the large amount of data being generated, some of the partners, notably BTI and CIP have developed a database called SweetpotatoBase. Tools have been developed for breeders to design trials and introduce their data into a three-dimensional relational database. A new data analysis platform called HiDAP has also been developed. This is a highly interactive data analysis platform that can also be used offline. Both of these tools are continually changing and evolving.

5.4.4 Conclusion

During the last two years, the following lessons have been learned:

- A reference genome is valuable from a sweetpotato breeding perspective. There is need for a sequence-based platform.
- Bioinformatics are easy to talk about in the analytical environments, but utilizing them in real life requires a lot of technical support. This is why it is important to train breeders in this area.
- The breeding community is highly capable of developing populations and markers, but it may be difficult to do all the phenotyping work required in the field. There is need for more capabilities in terms of mechanising data collection.
- Sustainable funding and sustained capacity development, human resources, institutional program support as well as support from farmers and industry players is going to be important for this effort.

During the annual breeders' meeting held in June 2016 in Nairobi, participants were asked if genomics-assisted breeding in sweetpotato was hope or hype, and they agreed that it had potential.

Every major project starts with a vision. With the support of BMGF, the resources are now available to realize that vision. The ultimate goal for breeders is to use marker-assisted breeding tools to develop new varieties for farmers to use to improve their livelihoods.

5.4.5 Discussion

Julius Okello: Recently, I was in a meeting where a major donor said we cannot think of adoption without mapping cultivars. For sweetpotato, are we close to getting reference genomes for the varieties we have now?

Not yet, but we are at the point where we can fingerprint all our varieties using markers and distinguish whether they are very different or very similar.

Christiane Gebhardt: Are the two variety sequences diploid homozygous or are they hexaploid heterozygous?

They are diploid homozygous: the one for *I. triloba* is highly homozygous and the one for *I. trifida* is fairly homozygous – homozygous enough to do a good reference genome. We never expected to use those materials. It was by a stroke of luck and a conversation with Jim Lorenzen that I recognized that we actually had some populations we could use. The message therefore to the breeding community is that one should always be open to opportunity and luck.

Sam Namanda: We have a lot of difference in the expression of the orange-flesh color of sweetpotato in different agro-ecologies. I know there is the factor of environment, but what is your comment on this?

You have highlighted a great opportunity in the reference genome, and extending that reference genome which is at diploid level to the hexaploid level. We know a lot about beta-carotene production and the pathways for beta-carotene production, not only in sweetpotato but in many other crops that serve as models. We can now begin to ask the question you have posed: why do we see different levels of expressions of beta-carotene according to environment? We can understand those pathways much better now that we can go to the genes that we know and begin to understand how the environment and genetics interact to mediate beta-carotene expression. Another example is that we know as breeders that dry matter content and beta-carotene are negatively linked. Now we have a new set of tools that can help us probe this further and breed better in future.

5.5 Panel: Insitutionalizing business plans and revolving funds for pre-basic seed production

Moderator: Graham Thiele

Panelists: Stella Ennin (CRI, Ghana); George Momanyi (KEPHIS); and Srini Rajendran (CIP)

5.5.1 Introduction

National Agricultural Research Institutes (NARIs) in 11 SSA countries are expanding their pre-basic sweetpotato seed production. Ten institutions have started to implement their business plans; of which six institutions earned revenue from the sale of seed, to start their revolving funds. A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis was conducted to identify strategies for exploiting opportunities, and for mitigating weaknesses to reduce vulnerability to threats in the business environment. There has been good progress, such as buy-in from senior leadership and the use of functional business tools. Members of this panel explained their experiences developing and implementing the business plans and revolving funds in their institutions.

The introductory presentation by Srini Rajendran, CIP's agricultural economist who is working with NARIs to develop their business plans, gave introductory remarks. He explained what a business plan is, why it is needed in sweetpotato early generation seed production, why and how real time cost data collection was being collected, as well as the current status and the way forward.

The business model is an objective document that aims to present a thorough analysis of a company's concept, so as to evaluate the idea's viability. The business plan, on the other hand, is a more elaborate document that comprises all the information, calculations, and analyses that demonstrate the business' viability. It should include the steps and the investment required to set up the company – alongside expenses, revenue, and return on investment forecasts. The business plan is important because it is the document that can be given to potential investors. It is a guide when planning a new venture or even expanding an existing one.

A cross-country synthesis was prepared, including lessons and challenges in developing business plans. The cross-country synthesis generated the following key messages:

1. There is a market for early generation sweetpotato seed, which is currently not met.
2. A business orientation is both necessary and possible for NARIs.
3. The business is either one or a combination of two products: pre-basic and basic seed.
4. NARIs should estimate and coordinate seed supply requirements.
5. It is critical to understand actual and potential customers.
6. Pricing strategy required.
7. NARIs should optimize their business environment – they often have a monopoly and comparative advantage in expertise.
8. The future market for pre-basic seed might be competitive as seed laws will be liberalized.
9. To maximize profits, it is necessary to reduce costs and minimize inefficient production practices. Tissue culture production is expensive.
10. Public-Private Partnership (PPP) opportunities should be exploited.

5.5.2 Discussion by panellists

The panel discussion covered the following questions:

- What products are already generating revenue and what strategies have you already implemented?
- How is the revenue being managed?
- What is the progress in implementing the business plans?

Panel discussion participants (l-r) Graham Thiele, George Momanyi, Stella Ennin and Srini Rajendran

Ghana: Council for Scientific and Industrial Research (CSIR)

Until 1994, CSIR existed as a public good institution. In 1997 parliament passed a new law that made commercialization of research a mandate. Research funding from government was restricted to salaries. In response, CSIR developed a strategic plan. Staff are an opportunity that has been exploited to generate funds through proposal writing, short-term training targeted at extension NGOs and private sector, and farmers in the field. Other opportunities being explored are licensing of developed varieties and multiplication of planting materials. Flagship projects include mango, rubber, pepper and lye seedling production. Within the management board, there is a sub-committee for commercialization. The provision that staff bringing in business get a share of the revenue is now being implemented. This is regulated at 10% for the hunters, 30% for the

team of workers who do the business, shared according to percentage contribution, and 60% for the Institute.

While there is buy-in and support by the board chairperson, infrastructure is also critical, e.g. electricity for the pre-basic work and water sources.

The business plan is being implemented. Log sheets are being used to carefully capture the costs at every stage. Lessons from the implementation of their commercial strategy has led CSIR to the realization that some business generated more profit in the outsourcing, which means that certain stages have to be improved within the work flow to increase efficiency and profits.

The pre-basic seed production project being implemented with the support of the SASHA project has the establishment of a revolving fund as a requirement. This is possible. The Institute considers a benefit-cost ratio of about 1.5 before engaging in any activity, and getting project funds is an advantage.

Kenya: The Kenya Plant Health Inspectorate Service (KEPHIS)

KEPHIS receives government funding, with targets to raise additional revenue. This is done through functions such as inspections, sample analyses and tests at a fee. Training is held at a cost-recovery basis and the projects office has successfully fundraised from USAID and the EU. Through partnership with the SASHA project, KEPHIS has identified opportunities in other crops such as passion fruit and banana.

KEPHIS has not been approaching pre-basic seed production as a business. No cost-benefit analysis is done. Instead, revenue is raised as required. Because charges for the services are gazetted, some of them do not make business sense.

Through the current efforts to develop a business case, KEPHIS has come up with a plan which has been marketed to the management and is now being institutionalized. There is potential for success. Together with Srini Rajendran, KEPHIS is working to adjust the costing and demand estimates in order to produce for an existing market.

5.6 The way forward with the evil weevil

Moderator: Jan Low

Panelists: Jurgen Kroschel; Marc Ghislain; Benard Yada

5.6.1 Introduction

In most areas, especially dry ones, weevils are a major problem. In this panel, moderated by Jan Low, various approaches to address weevil control and resistance were discussed. Jurgen Kroschel, an entomologist, gave an introduction to weevil basics and spoke about pest management and attract-and-kill. Bernard Yada, talked about the conventional breeding approach to increase weevil resistance. Marc Ghislain, a biotechnologist, explained progress in the transgenic approaches; Chad Keyser, an insect pathologist at AgBiome could not make it, and his presentation on screening for microbes for biological control was delivered by Marc Ghislain. The goal of the panel discussion was to explore what makes the best sense for small holders in terms of weevil management.

5.6.2 The way forward on weevils

By Jurgen Kroschel

The presentation sought to respond to three questions:

- What can we learn from past successful (Integrated Pest Management (IPM) programs in Latin America to control weevils in SSA?

- Can we make better use of sexual pheromones?
- How will climate change affect weevils in Africa?

There are three weevil species. The *C. formicarius* is globally occurring and has been reported in Africa, although there is no clear evidence. *C. puncticollis* and *C. brunneus* occur in Africa, with *C. puncticollis* being more prevalent. In Cuba, CIP Peru helped to develop an IPM program in the 1990s that was taken up with support of the government. There was no use of pesticides and within seven years 37,000 hectares were under IPM. Weevil damage was reduced from 40% to 10% and yield was increased from 3-5 tons to 7 tons per hectare.

What can be learned for the management of the African *Cylas spp*.: The components developed for IPM management considered that the adults feed on the leaves but the larvae damages roots. Therefore, in Cuba, they looked for resistant varieties and provided clean planting material. For external inputs they looked at sex pheromones, and practices such as predatory ants, good hilling, avoidance of soil cracking, harvesting at the right time, and destroying crop residues and volunteer plants, as well as avoidance of planting on old neighboring fields.

- These cultural practices were not enough, and there was need for stronger inputs. Here, the learning is that the following points should be considered:
- Plant Breeding: Selection of varieties with precocity, deep rooting, high latex content
- Cultural practices: Is the infestation pattern of the different species similar?
- Biological control: Which entomopathogens of sweetpotato weevils occur in East Africa? Are facilities available for mass production? Can low-cost products be produced and made available for farmers?
- Use of sexual pheromones: Sexual pheromones have been identified for all the weevils, but the sex pheromones of African *Cylas spp.* are less effective. In Cuba they were very effective and have been brought to the farmers with the support of the government. Can we improve efficacy? Can other trapping systems be developed and used to achieve better results?

The synthetic pheromones were found to be sufficiently attractive for monitoring weevils but not appropriate for mass trapping or mating disruption. Results of work done on sexual pheromone composition in collaboration with the Institute of Chemistry, University of Hohenheim (UoH), Germany, showed that each species produces a distinct bouquet of volatile major sex pheromone components, which act as synergists to the major compound (palmitic acid, methyl linoleate, and cholesterol). The highest biological activity to attract males was by palmitic acid and the combination with the sexual pheromone increased attractiveness of males of *C. puncticollis*. *C. puncticollis* sex pheromone has a higher efficacy to attract males than the sex pheromone of *C. brunneus*. Therefore, lower amounts of pheromones are needed to achieve similar efficacy. There is need for more research for C. *brunneus*. For practical field applications it is important to know which of the two *Cylas spp*. is more damaging in the field. UoH developed a highly efficient synthesis of the sex pheromones which could be used for a cost-effective, large-scale production.

Attract-and-kill approach has been successfully used for other pests e.g. potato tuber moth control. This is a combination of sexual pheromones, contact insecticide and some other ingredients. It could be a practical approach for *Cylas spp*. control. It has a special applicator, and once applied, weevils are attracted and killed within 48 hours. The results show that the formulation of *Cylas* sex pheromones with low-toxic contact insecticides caused a mortality of 70% and 95% of *C. brunneus* and *C. puncticollis* males respectively within 48 hours. The next step is to develop and test practical field applications.

Through modeling, information about the effect that climate change may have on *C. puncticollis* has been generated. In 2050, many areas remain the same but the number of generations produced per year will increase in some areas, leading to much more weevil damage. New technologies will be required to combat them.

More information can be accessed in a new publication called '*Pest distribution and risk atlas for Africa'*. It deals with potato, sweetpotato and maize pests, how they will change their distribution in the next 20 years, and how to adapt for this.

5.6.3 Progress towards breeding for sweetpotato weevil resistance in Uganda

By Bernard Yada

A grant from McKnight foundation provided the first funds to undertake consistent research on weevil resistance. Through the collaborative work between NCSU, National Agricultural Research Organization (NARO) and NRI, efforts were made to identify the possible forms of resistance that could be exploited. New Kawogo, a land race that was tested by breeders and released as a variety, had shown high resistance. New Kawogo produced a lot of hydroxycinnamic acid (HCA) esters that are associated with high levels of weevil resistance.

The next step was to figure out how to enhance the esters and combine with other resistance factors. Further experiments showed that higher HCA esters led to higher mortality in weevil larvae. A population was developed to segregate for resistance. The trait was found to be heritable. Four SSRs associated with field-based weevil resistance and three SSRs associated with HCA were identified. This work is ongoing through the PEARL project funded by BMGF, and through the GT4SP project.

A survey was done in the hotspot districts of Uganda. A number of accessions were collected from farmers' fields in sweetpotato growing areas. The accessions were characterized and phenotyped on incidence and severity. Root samples were collected and a bio-assay was done in the lab. The root samples were infested with both C. *brunneus* and *C. puncticollis*, and the data was monitored for six months. The bioassays were done for two seasons, and combined with field data to find the accessions that performed best. This was New Kawogo.

Those that performed better than New Kawogo were put in a crossing block, and they will be used to conduct seedling nursery trials for routine population improvement. To succeed in weevil resistance, efforts are being made to integrate breeding, biotechnology, microbiology and crop management technologies.

5.6.4 Genetic engineering weevil resistance in sweetpotato

By Marc Ghislain

This strategy was started years ago, based on the major success in Bt maize and cotton. It was hoped that it would be a major success in Bt-sweetpotato. Four cry genes that had been selected and found to be most active against the two weevils were used. About 132 transgenic events were screened with a bio-assay, and the screening was completed around July 2016. The control has full weevil emergence. There are results so far in two sets of events. Around six of each set of transgenic events have shown apparent difference from the control. A repetition with a new fresh batch of storage roots is being done and by the end of the year, a confirmation of the events is expected. If confirmed, the bioassays will be done a third time, because bioassays have a lot of variability, and also because it would provide the statistical significance for publication.

RNAi has been found to be more effective with some pests. It is not a toxin, but it is an RNA that targets genes of weevils resulting in their death. A series of 24 candidate genes that are vital to the weevil were tested. A few of them were toxic and if they were inhibited artificially, the larvae died. Focus was placed on three essential genes that had repeatedly shown the best result. The work was done in University of Ghent in collaboration with CIP. It was done by ingestion and injection for the *C. brunneus* and *C. puncticollis*. These small RNAi are being expressed into the sweetpotato roots and the bio-assay will be done after the roots become available. An alternative is also to use small RNAi as a bio-pesticide in combination with attract-and-kill technology.

The aim is to have a product with 100% resistance to weevil to make it worth the investment. Moving forward, these are the plans:

- Bio-assay to be repeated (new weevils, new storage roots) by December 2016.
- At least one of the RNAi gene constructs tested by the end of the project i.e. July 2017.
- Best of Bt-sweetpotato and best RNAi-sweetpotato combined for higher level and insect resistance management (new gene construct, transformation of popular African varieties) tentatively by 2020.

5.6.5 AgBiome: Better microbes, better crops, better world

By Marc Ghislain for Chad Keyser

Drs. Chad Keyser and Brooke Bissinger are part of a team at AgBiome that is working to discover and develop a biological agent that can be used to control sweetpotato weevils in SSA. AgBiome is a biotech company in the United States that discovers microbes with activity against agricultural pests.

They use the following pipeline: First they collect environmental samples from agricultural sources such as soil, plant material and insects. The samples are then processed, bacterial strains are isolated that produce proteins or biochemical pathways known to be active against a particular pest. Hundreds of microbes are screened for activity on a weekly basis against a panel of crop pest insects. Once activity has been established, microbes are formulated and scaled up and field trials are conducted.

As part of a BMGF-funded project, AgBiome will use their technology to discover microbes that are active against sweetpotato weevils. This is a multi-phase project with the ultimate goal of developing a biological agent to control sweetpotato weevils in SSA.

The first phase of the project is aimed at discovering microbes that are active against the weevils. They predict that microbes with the greatest potential to be active towards the sweetpotato weevil will be those that are associated with sweetpotato crops. For this reason, most soil and plant material will be collected from sweetpotato fields.

This project began in July and plant and soil collections have already been made in the USA, and microbes' isolation has begun. For this phase, microbes are being screened against multiple surrogate beetle species to window down the number of actives that will be tested on sweetpotato weevils. Starting in January 2017, active isolates will be screened on *C. formicarius* at Louisiana State University, which maintains a colony of sweetpotato weevils and is experienced at running bioassays with the weevil.

This project is just now getting started; however, Chad and Brooke have already found several isolates with activity against both surrogate beetle species. Once activity has been confirmed on *C. formicarius*, they will partner with researchers in Africa to test them against *C. brunneus* and *C. puncticollis*.

Since *C. brunneus* and *C. puncticollis* are endemic to Africa, microbes from African soils may be more likely to have greater activity against the African sweetpotato weevil species. They hope to collect samples and isolate microbes from African soils and will work to implement the appropriate legal and regulatory permissions before doing so. AgBiome will focus their efforts on plant colonizers with the hopes of finding active microbes that can associate closely with sweetpotato plants to provide durable season-long control.

AgBiome realizes that this will be a technologically challenging project and hopes to partner with experts in the field. Successful control of any pest needs to be based on multiple strategies and microbial control of weevils will need to be part of an IPM program.

5.6.6 Discussion

Panellists (l-r) Marc Ghislain, Jurgen Kroschel and Benard Yada

Jan Low: You mentioned that HCA esters are a main component in the breeding work, and you said it is contained in the latex, yet processors do not like varieties with high latex content because they jam the machines. Does this mean we have different breeding goals?

Bernard Yada: Trade-offs will have to be made. Processors need clean roots with no defects, and this requires resistant varieties. The HCA esters concentration is one of many factors that we focus on. Because it is highly heritable, it can segregate in populations as we continue to do population improvement. We can examine what HCA ester levels are appropriate.

Jan Low: The Cuba case was interesting in the sense that it was imposed. If a smallholder wanted to use the attract-and-kill technology in the field when the neighbors are not using it, would it be effective?

Jurgen Kroschel: The product will last in the field for up to 40 days. Apart from killing, it destroys mating patterns because the females get confused and cannot find the males due to the many contact points in the field.

Jan Low: What are the bottlenecks in the process of getting new transgenic events so that they can be tested again?

Marc Ghislain: For sweetpotato, it takes between 8-12 months to obtain a transgenic event. Secondly, we started out with the idea that we should transform African varieties, but we did not find a suitable one. We are now using the Jonathan variety. The third bottleneck is the production of storage roots, which must be transported from Lima. Finally, the bio-assay requires many storage roots to have been reproduced.

Jan Low: Why are you using surrogates to develop biological agents?

Marc Ghislain for Chad Keyser: In our facility, we have a lot of experience with beetles, and a lot of the pathways are known. Secondly, *C. brunneus* and *C. puncticollis* are endemic to Africa. Where we work in North Carolina, there are no weevils and they cannot be imported. That is why we use surrogates. We plan to use *C. formicarius* which is closer to the other two weevils. Eventually, at some point, it will go to be tested with weevils in Africa.

Christiane Gebhardt: There is a general fear of the danger of transgenic crops in the field, but also with the specificity of microbes and attractants. Can they cause an environmental problem and is there research in this direction?

Jurgen Kroschel: Nothing new is introduced; you just look at what already exists in the environment that would work against the pest. They are not so specific that they would not kill other insects, but they are endemic and not introduced. In an IPM method you never affect the beneficial insect.

Mihiretu Cherinet: It seems that we will not have the Bt-sweetpotato varieties soon. How do you think cultural practices will help especially as weevil population will increase with climate change?

Jurgen Kroschel: We should complement cultural control with technologies as they advance. We also have some research gaps with regard to the behavior of the weevils e.g. migration and how they mate etc. All these things must be examined further.

Ibrahim Koara: When Bt cotton was introduced in Burkina Faso it was found that the fibers were short. Is there any risk with the Bt-sweetpotato?

Marc Ghislain: Bt is expressing a protein into the plant that specifically interacts with certain insects and kills these insects. Cry proteins are not known to have any other function or collateral effect. The issue with the short fiber is because the Bt is in a genotype that produces short fiber. It would be interesting to know why Bt has not been introduced in a variety that produces long fiber, but for sweetpotato, there is no unforeseen effect observed from the 132 transgenic events that were looked at.

Jan Low: If the Bt-sweetpotato was working in a variety that was not adapted to Burkina Faso, would it be possible to breed it to adapt to that or any other environment?

Marc Ghislain: It will take so long to introduce this gene into a suitable variety through breeding. Using biotechnology to transform one that works well in Burkina Faso would be faster.

Erna Abidin: A series of research shows that growing a number of plants/crops on the border e.g. maize and onion were effective. Maybe you can encourage such a practice.

Bernard Yada: We are looking at a number of resistance factors e.g. hairiness, latex and storage root cortex thickness.

Joseph Nchor: There are a lot of health concerns about Bt in Africa, and for local seed systems, about promoting the monopoly of multinationals. How are you addressing these concerns?

Marc Ghislain: It is important to diffuse information about the health implications to people, so that they know that sufficient testing has been done and there is proof that it is not harmful.

5.6.7 Conclusion

At the end of the session, SPHI meeting participants were asked to vote for the strategy that they felt would be effective. The results are presented in the chart below.

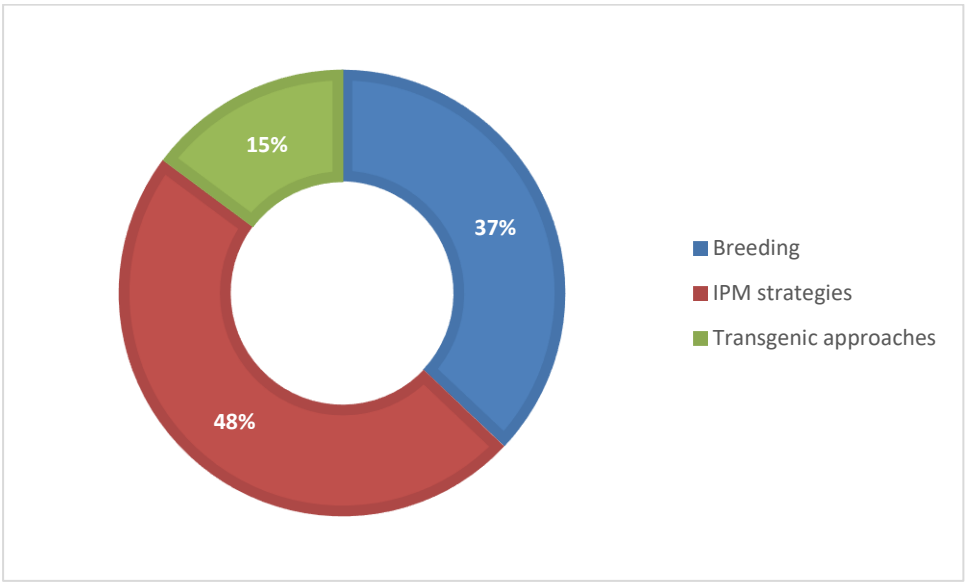


Figure 5: The way forward with the evil weevil - how participants voted

5.7 Panel: What was our progress in growing as a Community of Practice in Year 2?

Moderator: Tawanda Muzhingi

Panelists: Francis Amagloh; Jude Njoku; Richard Gibson; Julius Okello; Ibrahim Koara; Lukas Wanjohi and Antonio Magnaghi

5.7.1 Introduction

A community of practice is a group of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly. This definition reflects the fundamentally social nature of human learning. The purpose of the panel discussion was to expose all participants to the progress being made under the non-breeding CoP groups i.e. the Seed Systems and Crop Management; Marketing, Processing and Utilization (MPU); Monitoring, Learning and Evaluation (MLE).

Panellists (l-r) Antonio Magnaghi, Francis Amagloh, Jude Njoku, Julius Okello, Ibrahim Koara, Luka Wanjohi and Richard Gibson

5.7.2 Reporting progress

Francis Amagloh: The main purpose of MPU CoP is to come up with marketable products that meet end user preferences for consumers and processors. In the second meeting, the MPU CoP decided to champion bread business, and that is now catching on. The main drive for bread is the high level of wheat importation into Africa; which means that substitution will increase incomes for Africans.

Jude Njoku: Without quality planting material, sweetpotato production would be low. In the Seed Systems and Crop Management CoP, we try to solve the crucial problems in the sweetpotato seed system so that it translates into increased production of sweetpotato. We share information and members are committed to learn from each other. We have generated a large pool of information from our discussions, which we are using to carry out some concrete activities guided by specific research questions.

Julius Okello: The MLE CoP has 38 members that came together to harmonize approaches, learn from each other, and share tools. Majority of the members are from CIP, but other partners are starting to join the CoP. We quickly realized that people were using different yardsticks to measure the specific indicators that show progress towards the SPHI goal. We decided to try to standardize indicators and tools, and a manual consisting of ten modules is almost ready for publication. A lot of the content is from the proof-of-concept work done by Jan Low and Kirimi Sindi during the Mama SASHA project, and from the other projects. While in Rwanda, MLE CoP members tested some of the modules in the field to get feedback from the users.

Ibrahim Koara: I joined the MLE CoP in last year's SPHI and attended the first meeting in April 2016, it was very interesting. One member encouraged us to join an online course on impact evaluation where I learned a lot. Together with the CIP team in Burkina Faso, we have tried to

improve the way we gather, manage and analyze data. We train research extension staff on using Open Data Kit (ODK) to collect field data, track DVM activity etc. and that is going on well. There are two things I would like to note: it is important to design an M&E system that suits the cropping situation of each country; secondly, comparisons of country data, and how many people they reached should include cost-effectiveness.

Tawanda Muzhingi: What is ODK and how do you go about it?

Luka Wanjohi: It was developed by Washington State University. It runs on Android, which by 2015 was the most popular operating system. We have used ODK to register DVMs, carry out a consumer survey in five counties with 1,092 respondents, and it is now a regular part of the monitoring tools in SUSTAIN Kenya, Jumpstarting project, and in some monitoring activities in Mozambique. In the last two months, we did a monitoring survey in Rwanda in 1,691 households and a crop cut survey in 91 households. Within these two years, we have been able to invest in an online dashboard to do basic visualization and export data into SPSS among other things. You need server access and sometimes internet to work with the data.

Tawanda Muzhingi: Please share your experiences in the Seed Systems and Crop Management CoP?

Richard Gibson: Maize has the biggest seed system in Africa, but I think sweetpotato has the biggest potential. The main reason is that planting material is lost during the long dry season and farmers have to get replacement material. You do not see this because it is happening in the swamps. Recently, we had a discussion about whether to give out planting materials for free. It was a very lively and active discussion that gave an idea of what the general thought in the community was about specific things. I have seen a notable change of opinion over the last two years. We also had a discussion about preservation of planting material, which was very useful for a student of mine. I think it is excellent.

Tawanda Muzhingi: The idea of CoPs is to have membership from all kinds of institutions. Antonio will talk about the role of private sector. How has it benefited you?

Antonio Magnaghi: I got to notice that there was no information about the benefits of sweetpotato as a functional ingredient that can be used in the market. The CoP is a platform that helps to create awareness. We should work harder to increase awareness like the one organized in Ghana by CSIR with CIP. We should also have a cross-link between different communities.

5.7.3 Views from SPHI Steering Committee members

Adiel Mbabu: We are happy that the MLE CoP is agreeing on a minimum set of data and standardization of tools so that we can deal better with impact orientation and management for results. The question is how to link quantitative data with qualitative monitoring data.

Anna-Marie Ball: The Uganda team are part of the CoPs, and I am encouraged that they attend meetings. I have seen new ideas coming in because of that. CIP leads the way in many things but you have to take care to bring other partners along that are not as better resourced or do not have the capacity to participate. I am otherwise impressed with the changes.

Mette Kinoti: HKI are not active, not because of lack of interest, but because we are very strict about how much we can travel. This hinders participation in face-to-face meetings, but I think we need to find ways to participate virtually. We have done a lot of work on dietary diversity and we should discuss how we can contribute to developing the tools.

Andy Westby: Clearly, people are benefiting from the discussions. The deliberations about strategies for scaling up should be applied for this CoP.

5.7.4 Feedback from the audience

After the presentation, the audience gave feedback, which is summed up in the points below:

- We should cross-post summaries of the discussions.
- There has been no systematic way to work together as people who are interested in communication and to share discussions.
- Ideally, CoPs bring people together who want to engage and have the capacity to do that. I am interested in the MLE CoP because we have to count progress towards the SPHI goal, I wonder about ownership. It is also hard to fill forms on DVMs depending also on the complexity of the tools.
- I view the CoPs as a really great think tank to share ideas and knowledge and think freely. I get concerned when you try to quantify too much as it would hinder this free flow of thoughts.
- We are funded based on commercial orientation, so I am concerned about dependency syndrome especially in the case of vine distribution.
- I am particularly interested in the MPU CoP but would like to know more about moderation.

Participants can participate in a CoP by registering on the Sweetpotato Knowledge Portal, updating their profile and subscribing to the CoP group of interest. This will enable them to engage with the community. They can also support and/or attend annual meetings.

6 Closing remarks

The 7th annual SPHI meeting was officially closed by Dr. Barbara Wells, the Director General of CIP. She explained that biofortification has gained recognition and stated that it has taken a long time for OFSP to achieve the status it has today, where 2.2 million households or about 10 million people had been impacted. She urged participants to celebrate these accomplishments while strategizing to pick up momentum for the future.

7 Evaluation of meeting

The evaluation of the meeting was undertaken through a questionnaire survey. It was completed by 82 respondents. A summary of the evaluation report is presented in this section.

7.1 Participants by age, gender and origin

Over the years, the SPHI has continued to grow, and this is reflected in the composition of the 94 participants, who came from 17 SSA countries, the United Kingdom, USA and Germany (see Figure 1).

The minimum and maximum age of the participants was 28 and 69 years respectively. About 62% were within the range of 35-55 years. Only 4% of participants were below the age of 30 and 1% were above 65 years.

A quarter of the participants were female. This was the lowest compared to the previous two meetings, i.e. 36% in 2014 and 34% in 2015. This suggests the need for increased affirmative action to encourage female participation in sweetpotato activities in SSA.

Promoting public-private partinership is an essential step to further scale up the research findings and bring significant change in the research for development activities. In SPHI 2016, the private sector representation was very low. The chart below shows the type of organizations represented at the meeting.

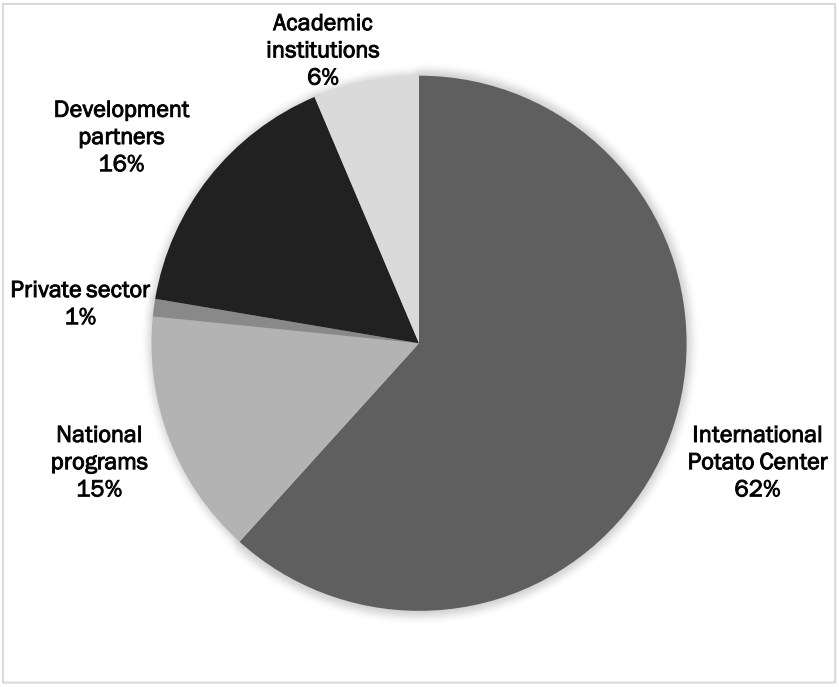


Figure 6: Types of organizations at the 2016 SPHI meeting

7.2 Content

Half of the participants felt that the meeting had completely met their expectations. Participants especially found the panel discussions useful. They also valued the networking opportunities provided by the meeting. When asked which part of the meeting was least useful, 86% did not respond, while 8% said there had been limited time for discussions.

Presentations: About 50% of this year's participants were of the opinion that the quality of the presentations was good, 30% replied that the content was very good, 16% indicated that it was alright while 5% indicated that presentation content was poor.

Panel discussions: The meeting had five panel discussions. Participants were asked to rate the quality and usefulness of each panel discussion either as poor, alright, good or very good. The chart below compares the panel discussions by the total number of participants that rated each one either as good or very good.

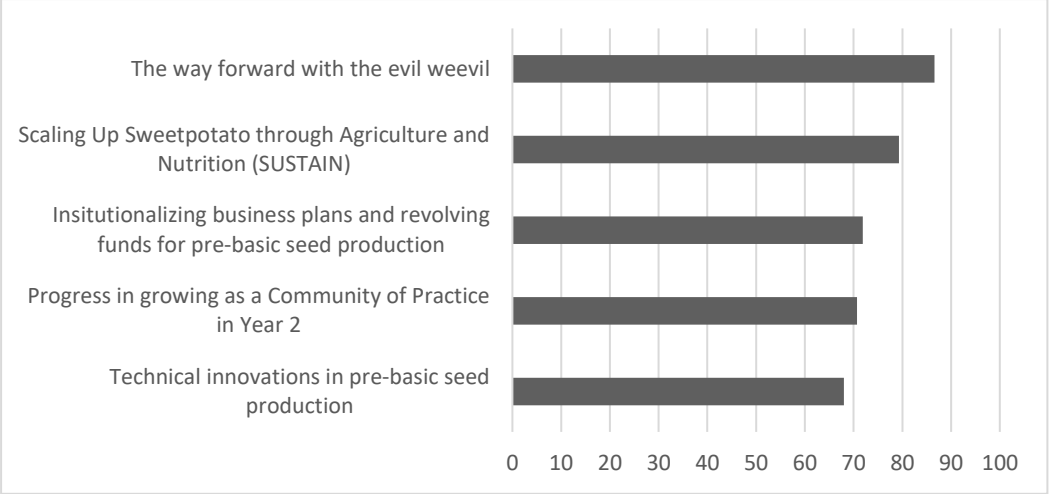


Figure 7: Percentage of participants who rated the quality and usefulness of the panel discussion as good and very good

7.3 Meeting organization and recommendations for improvement

In terms of the organization of the meeting, about 7% the participants rated the organization as poor, 17% alright, and 50% indicated that the organization was good while 26% rated it as very good. Visa problems were encountered by 39% of all participants, with 7% almost not making it to the meeting. The 7th SPHI meeting was planned to precede the 10th Triennial APA for effective resources utilization and management. About 87% of the participants indicated that it was a good idea to do this.

Forty-five percent of the participants did not suggest areas for improvement in the future. Those that did, made the following suggestions:

- Inclusion of more critical analysis of the contents of presentation.
- More private sector involvement.
- More critical analysis in presentations.
- Increased time for discussions.
- Improved transport arrangements.
- Better choice of meeting venue.

8 Annexes

8.1 SPHI Steering Committee: Terms of Reference and members

The new TOR for the SPHI Steering Committee is as follows:

- Strategic Guidance on progress toward target, based on the annual report on *Status of Sweetpotato in SSA.*
- High level advocacy and resource mobilization for SPHI agenda.
- Review of and guidance of functioning of CoPs.
- Review and guidance on impact of regional technical backstopping.
- Support the broadening of SPHI membership.
- As illustrated by the members' code outlined below, the SPHI Steering Committee is committed to partnership for collective impact. Each member:
- Is committed to the SPHI vision of reaching at least 10 million African households by 2020, with knowledge, improved varieties and diversified use of sweetpotato, for improved incomes and health.
- Will demonstrate commitment of human and financial resources to sweetpotato-related activities.
- Will regularly share knowledge gained through its activities and interactions on the Sweetpotato Knowledge Portal.
- Will share information about SPHI activities with its networks and so contribute to building the network of actors working on sweetpotato in Africa.
- Will share progress on the reach and impact of its sweetpotato-related activities on a regular basis.
- Will participate actively in annual meetings of the SPHI, covering its own attendance costs.
- Will participate in relevant CoPs and contribute to the growth and development of these communities.

Co-leadership: CIP (Jan Low) & FARA (Yemi Akinbamijo) Nelson Ojijo

Organizations:

- CIP: Adiel Mbabu, Regional Director – SSA
- HarvestPlus: Anna-Marie Ball, Strategic Alliances for Africa
- Farm Concern: Antony Masinde Kilwaki, Senior Programme Manager
- Helen Keller International: Mette Kjaer Kinote, Vice President for Africa
- PATH: Allison Bingham Program Advisor
- Natural Resources Institute: Andrew Westby, Director
- Roots, Tubers & Bananas: Graham Thiele, Director
- North Carolina State University: Craig Yencho, Leader of Sweetpotato & Potato Breeding
- Farm Africa: James Mwalolo

Donors:

- BMGF
- USAID
- DFID/UKAID
- Irish Aid
- Alliance for a Green Revolution in Africa

8.2 SASHA Project Advisory Committee: Terms of Reference and members

Based on the changes, the new Terms of Reference (TOR) for the SASHA PAC is as follows:

- Provide advice to the SASHA Phase 2 project management team
- Participate in SASHA PAC meetings
- Advocate for sweetpotato integration and alignment with other relevant agriculture and nutrition initiatives on the continent
- Comment on any project reports and external reviews of the SASHA project
- Comment on team function and suggest how to improve it
- Review and evaluate emerging risks, threats and opportunities and provide relevant recommendations

Members of the SASHA PAC:

Position on the PAC	Name (gender in parentheses)	Current Position
Breeding & Genomics	Christiane Gebhardt (F)	Senior scientist and research group leader at the Max-Planck Institute for Plant Breeding Research.
Seed Systems	George Bigirwa (M)	Senior Program Officer, Program for Africa's Seed System for the Alliance for a Green Revolution
Postharvest & Nutrition	Ibok Oduro (F)	Head of Department of Food Science & Technology, Kwame Nkrumah University of Science and Technology
Business Marketing	Stanley Karichu Mwangi (M)	Associate Director; Business Models, Farm Concern International
Support to SPHI	Anna-Marie Ball (F)	Manager of Partnerships & Strategic Alliances for Africa, HarvestPlus
CIP representative	Barbara Wells (F)	Director General, International Potato Center
BMGF representative	Jim Lorenzen (M)	Senior Program Officer, BMGF

8.3 2016 SPHI photo contest: through the lens of a camera

Entrants to the photo contest were associated with a project aligned to the SPHI. There were two categories:

OFSP History: The past two decades: This year, our efforts in promoting OFSP and biofortification were acknowledged when scientists from the International Potato Center and HarvestPlus were awarded the 2016 World Food Prize. It is a great achievement for all of us. This category gives you the opportunity to take a nostalgic walk back in time, to remember all those moments that your work with OFSP contributed to this big win. So dust off those old photo albums and retrieve the best from the past.

Men and sweetpotato: This year, we realized that we have lots of photos of women and children with sweetpotato, but not so many highlighted the involvement of men. So in this category, we want to get you all on board to spotlight the role that men are playing in the sweetpotato value chain.

There were two types of entrants: International Potato Center (CIP) staff members and partner organization members. A selection of the top photographs graced the cover of the 2016 SPHI annual meeting folders and will be featured on the Sweetpotato Knowledge Portal.

8.3.1 OFSP history

Category: Partner

1. Akinwande, Bolanle Aishat (Lautech) "Moving round the market to market OFSP as food"
2. Elizabeth Nduta (KEPHIS): "Screenhouse multiplication of virus-indexed SASHA II pre-basic seed materials"
3. Ibrahin Koara (iDE): "Training on processing of OFSP"

Category: CIP

1. Jean Claude Nshimiyimana: "Rwandan culture dancing during field visit by participants to 2nd global Bio fortification conference held in Kigali"
2. Srini Rajendran: "A Farmer feeding OFSP to her child"
3. Isaac Korku Dorgbetor: "Action: not words! : Women farmers in Naaga during the GAP training decided to be doers but not just hearers"

8.3.2 Theme: Men and sweetpotato

Category: Partner

1. Akinwande, Bolanle Aishat (Lautech) "Market children eating boiled OFSP"
2. Marian Quain (CSIR) "Ghanaian Fireman receiving OFSP vine at food fair"
3. Richard Atuna (UDS) "Men and children enjoying boiled orange-fleshed sweetpotato roots (Apomuden) during cutting of sweetpotato vines at a decentralized vine multiplication site"

Category: CIP

1. Kwame Ogero: "Planting virus-cleaned cuttings inside a screen house for pre-basic sweetpotato seed production"
2. Frezer Asfaw: "Husband and wife weeding their OFSP plot in Southern part of Ethiopia Boricha District"
3. Norman Kwikiriza "In his rosy OFSP vine garden, Isingoma ensures there are no weeds. The 26-year-old is one of the few youths in Africa that multiply OFSP vines"

8.3.3 People's choice

Benjamin Rakotoarisoa (CIP) "Evaluation of OFSP processing by visitors led my men"

Bruno Rasoloniaina (FIFAMANOR) "A young child brings a heavy sweetpotato"

8.4 Agenda

7th Annual SPHI
Technical and Steering Committee meeting
ILRI Campus
ADDIS ABABA, ETHIOPIA
Technical: 7-8TH October 2016
Steering Committee: 8 October 2016

Time	Subject	Responsible
6 October 2016, Thursday		
	Participants arrive in Addis Ababa	Tassy Kariuki
14-17:30	*Pre-meeting workshop:* How to use the renovated Sweetpotato Knowledge Portal	Luka Wanjohi & Christine Bukania
17-19:30	Registration Open	Tassy Kariuki
7 October 2016, Friday		
	Session 1: Moderator: Berga Lemaga	*Rapporteur: Penina Muoki*
8:30	Welcome remarks & Introductions	Nelson Ojijo, FARA
8:50	AGRA's new strategy & the potential roles for sweetpotato	George Bigirwa, AGRA (not present, but presentation on stick)
9:00	Jumpstarting Orange-fleshed Sweetpotato in three West African Countries: Lessons from Pilot Experiences & Thoughts on going to scale	Erna Abidin (CIP), Ted Carey (CIP), Koussao Some (INERA)
9:20	Integrating OFSP into the Enhanced Homestead Food Production Approach in West Africa	Mette Kjaer Kinoti (HKI)
9:40	Scaling up biofortified crops through a food basket approach in Nigeria and Tanzania	Hilda Munyua (CIP)
9:50	Discussion	Berga Lemaga
10:00	Opening Address by the Director General of Ethiopian Institute of Agricultural Research (EIAR)	Dr. Adugna Wakjira, Deputy Director, for the EIAR Director General: Dr. Fentahun Mengistu
10:30	*Group Photo & Health Break*	
	Session 2: Moderator Robert Ackatia-Armah Integrating Nutrition in Agricultural Projects: The Influence of Different Socio-Cultural & Agro-Ecological Conditions in delivery	Rapporteur: Christine Bukania
11:15	Integrating Nutrition in Agriculture Projects: SNNPR & Tigray Ethiopia	Wellington Jogo (CIP)
11:35	Integrating Nutrition in Agriculture Projects: Niassa, Mozambique & Nampula, Mozambique	Benjamin Rakotoarisoa (CIP)
11:55	Integrating Nutrition in Agriculture Projects: VISTA Tanzania	Fred Grant (CIP)
12:15	Integrating Nutrition in Agriculture Projects: SUSTAIN Kenya and ACVD	Penina Muoki (CIP)
12:35	Questions & Synthesis	*Robert Ackatia-Armah*
13:00	*Lunch*	
	Session 3: Moderator Oscar Ortiz	Rapporteur: Christine Bukania
14:00	Progress in Tanzania, Uganda, and Ethiopia under SeFaMaCo (Seed Farmer Markets Consumer)	Worku Tsega (Farm Concern)

Time	Subject	Responsible
14:20	Progress in developing shelf-storable puree and OFSP bread improvement	Tawanda Muzhingi (CIP) and Antonio Magnaghi (Euro Ingredients Ltd)
14:40	Panel on Going to Scale under *SUSTAIN* (Scaling up Sweetpotato through Agriculture and Nutrition)	Moderator: Simon Heck (CIP) Panel: Penina Muoki, Roland Brouwer, Kirimi Sindi, Julius Okello, Robert Ackatia-Armah
15:35	The Bill & Melinda Gates Agricultural Strategy	Jim Lorenzen (BMGF)
15:45	*Health Break & Voting on the People's Choice in the Photo Contest*	Christine Bukania
	Session 4: Moderator Roland Brouwer	Rapporteur: Srini Rajendran
16:30	Postharvest Challenges in Sweetpotato	Andrew Westby (NRI)
16:45	Discussion with two 2016 World Food Prize Winners: How Mozambique Led the Way: A sisterhood story…	Moderator: Margaret McEwan (CIP) Panelists: Jan Low & Maria Andrade
17:30	Close for day	
17:30	Cocktail & Announcement of Photo Prize Winners	
8 October 2016, Saturday		
	Session 5: Moderator: Adiel Mbabu	Rapporteur: Gerald Kyalo
08:00	Lessons learned by HarvestPlus Scaling in Uganda	Anna-Marie Ball (HarvestPlus)
08:20	Panel: Technical innovations in pre-basic seed production	Moderator: Felistus Chipungu (CIP) Beyene Demstu, Koussao Some, Bernard Yada, Fekadu Gurmu, Jude Njoku, Felistus Chipungu
09:20	Can RTB seed systems learn from each other?	Graham Thiele (RTB Director)
09:40	Progress in Sweetpotato Genomics and Strengthening the *SpeedBreeders* Community of Practice	Craig Yencho (NCSU) and Godwill Makunde (CIP)
10:00	*Health Break*	
	Session 6 : Moderator Anna-Marie Ball	Rapporteur: Christine Bukania
10:30	Panel: Institutionalizing business plans and revolving funds for pre-basic seed production	Moderator: Graham Thiele (RTB) Srini Rajendran (CIP), George Momanyi (KEPHIS), Stella Ennin (CRI, Ghana)
11:20	Panel: The Way Forward on Weevil	Moderator: Jan Low Marc Ghislain, CIP Bernard Yada, NaCCRI Chad Keyser, AgBiome Inc. Jurgen Kroschel, CIP
12:20	Panel: What was our progress in growing as a Community of Practice in Year 2: Seed Systems & Crop Management, Marketing, Processing and Utilization, Monitoring, Learning and Evaluation Feedback from SPHI Steering Committee members	Moderator: Tawanda Muzhingi (CIP) Participants: Francis Amagloh (MPU), Jude Njoku (Seed), Richard Gibson (Seed), Julius Okello (MLE), Ibrahim Koara (MLE), and Lukas Wanjohi (MLE)
13:15	Evaluation of Meeting	Jan Low
13:25	Closing Remarks	Dr. Barbara Wells, CIP Director General
13:30	Lunch	
14:30-17:30	SASHA Project Advisory Committee Meeting	Anna-Marie-Ball, Chairperson
9 October 2016, Sunday		
8:15	Transport to the Venue for the SC Meeting	
9:00-13:00	SPHI Steering Committee Meeting	Jan Low (CIP) & Nelson Ojijo (FARA)
14:00-16:00	Registration for the APA: Transport will be provided	
16:00-20:00	Celebration of CIP's 45th Anniversary: Elily Hotel, Green Room	Tassy Kariuki

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SASHA PAC and SPHI SSC

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8.6 Annex of abstracts of papers supported for the 10th Triennial APA

8.6.1 Participatory selection of orange-fleshed sweetpotato varieties in north and north-east Côte d'Ivoire

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Abstract

Sweetpotato is cultivated in all regions of Côte d'Ivoire for consumption and as a source of income. Only varieties with white and yellow flesh are grown. Production of nutritious orange-fleshed sweetpotato (OFSP) is hampered by the lack of genetic resources and planting material. To evaluate and release OFSP varieties, on-farm demonstration tests were conducted with women farmer groups in Bondoukou, Nassian, Korhogo, and Bondiali in north and north-east Côte d'Ivoire. Six varieties—'Kabode', 'Kakamega7' ('Irene'), 'Tacha2', 'Bela Bela', 'Vita', and TIB-440060—were evaluated in comparison with locally grown varieties. The on-farm demonstration was laid out in a randomised complete block design replicated three times per location. Assessments were made on yield; disease and pests; and consumer preference on attractiveness of skin colour and flesh of the root (fresh and boiled), taste, texture, and starchiness. Results showed that introduced varieties have generally recorded higher yields than the local varieties: Yields of about 25 t/ha have been recorded on the sites. The best average yield, about 15 t/ha, was recorded for TIB-440060 and 'Kakamega7' varieties. Farmers' acceptance of OFSP varieties based on the attractiveness of their colour and taste was more than 90%. At the end of the sensory tests, 'Kakamega7', which achieved the best compromise between all observed and measured parameters, was most appreciated and was the farmers' first choice, followed by varieties TIB-440060 and 'Bela Bela'.

Keywords: Orange-fleshed sweetpotato, on-farm demonstration, participatory varietal selection, sweetpotato

8.6.2 Screening cold-tolerant, dual-purpose sweetpotato in Kenya

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Abstract

In East Africa, sweetpotato storage roots serve as food and as a health remedy, whereas all parts of the crop are useful as livestock feed. Diminished pasture and grazing land among dairy farming highland cold areas calls for sweetpotato to be used as food and forage. On-farm trials were conducted to evaluate 14 elite sweetpotato clones, plus a control for cold tolerance and dual purpose use in four agro-ecological zones in Kenya: Runyenjes and Manyata (tea zones); Kangundo (coffee zone); and Kakamega (highland), which ranged 1,600–2,100 masl. The clones were evaluated in five rows of 3 m long at a spacing of 90 x 30 cm between rows. Plants were replicated three times in a randomised complete block design. Data on forage and root biomass, foliage/root ratio, organoleptic test, and farmer–scientists yield evaluation and selection were collected and analysed using R statistical software. Marketable root weight, vine weight, and vine root ratio differed significantly among the genotypes at $p<0.001$, an indication that there were significant genotype effects on root and foliage yields. Farmers selected genotypes 'Silklow 6' (deep orange-fleshed), 'Shock 5' (light yellow-fleshed), 'New Kawongo 7' (cream-fleshed), 'Naspot II 2' (cream-fleshed), 'Magabari 3' (light yellow-fleshed), 'Kigabali 6' (light yellow-fleshed) as potential clones for dual use. These clones differed significantly on root dry matter (DM) (15–17%) but not in vine DM (26–28%). In addition, they had DM of 26–28%, vine yield of 25–37 t/ha, root yield of 19–23 t/ha, and vine root ratio of ≥1.5. Moreover, 'Kigabali 6', 'New Kawogo 7', 'Shock 5', and 'Silklow 6' had positive selection effects on root, vine yields, and virus and *Alternaria* scores. These clones have been put in National Performance Trials with the aim of releasing the best varieties for dual purpose use in cold highland areas. The significant genotype variation on root and forage yield implied presence of genetic potential that could be exploited to select cold-tolerant, dual-purpose sweetpotato varieties.

Keywords: Forage, storage roots, vine root ratio, genotype, dual purpose

8.6.3 Performance of ARC informal market sweetpotato cultivars in on-farm trials

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Abstract

South Africa's Agricultural Research Council (ARC) promotes sweetpotato for addressing food security and contributing to both enterprise development and income generation. From 2004 to 2011 ARC released several new sweetpotato cultivars aimed at the informal market. The present study reports on the performance of these cultivars in on-farm trials conducted at nine sites in Kwa Zulu-Natal, four in Gauteng, and one each in the Eastern Cape and Limpopo Province during the 2011/12–2014/15 planting seasons. Cultivars 'Ndou', 'Monate', and 'Mvuvhelo' (cream-fleshed), and 'Bophelo', 'Impilo', and 199062.1 (orange-fleshed) were included. Data collection included marketable and unmarketable root yield classes, dry matter, and taste acceptability. The sites were divided into subtropical, cool subtropical, and temperate regions. A combined analysis of variance was performed using SAS. The additive main effects and multiplicative interaction (AMMI) model was used to analyse genotype by environment interaction using Genstat. Discriminant analysis (using XLSTAT) was done to determine the most prominent cultivar characteristics. Significant effects were detected for locality × cultivar and region × cultivars for total and marketable yield, and for cultivar only for marketable yield. The mean total yield ranged 24.8–28.5 t/ha, with the highest being for 199062.1. The most prevalent unmarketable class was insect damage (mean of 15.1%); the mean marketable percentage was 59.1%. A trend was seen that the orange-fleshed cultivar 'Impilo' produced lower root yield in a subtropical climate. The AMMI analysis indicated stable high marketable yield for 'Ndou', whereas 'Bophelo', 199062.1, 'Mvuvhelo', and 'Impilo' had unstable high total yields. Cultivars developed for the informal market produced significantly better yields than the commercial cream-fleshed variety 'Blesbok', generally due to their ability to adapt to low-input farming conditions. The discriminant analysis divided the cultivars into three groups, mostly based on percentage of vines, dry matter, and average roots mass. A ranking exercise was used to recommend cultivars in each site. The new cultivars produced sustainable yields and have been sold successfully on local informal markets. Vine dissemination during 2014/15 raised 3,363 bags (compared with 1,893 bags in 2013/14), which is enough to plant an area of 75 ha, of which 66% were orange-fleshed sweetpotatoes. 'Bophelo' was the dominant orange-fleshed cultivar, and 'Ndou' topped the cream-fleshed informal market cultivars.

Keywords: AMMI, discriminant analysis, sweetpotato, yield

8.6.4 Exploration for hyper-accumulators and partitioning of iron and zinc among sweetpotato genotypes in heavy metal-contaminated soils of Copperbelt in Zambia

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Abstract

An exploratory survey was undertaken in the Chingola District mining area to study the impact of mining on the surrounding environment. Of the crops grown in the area, sweetpotato is the second most common after maize. The soils are contaminated with heavy metals, including copper, nickel, iron, cobalt, lead, and zinc; and variations were observed in the growth performances of sweetpotato genotypes that are grown in the area. Over the years some genotypes have adapted to the contaminated environment. This adaptation gives them the potential to serve as hyper-accumulators which can be utilised in the phytoremediation of sites polluted with heavy metals and, hence, reclaiming them for use as agricultural land. A collection of sweetpotato germplasm was obtained from the national genebank and farms around the mining area. These were evaluated for heavy metal hyper-accumulation abilities. Twenty-five genotypes were planted in pots in a screenhouse at Copperbelt Research Station using a complete randomised design with three replications. The plants were hand irrigated with water obtained from the mine tailing dams and which contained zinc (0.289 ppm), manganese (3.29 ppm), lead (0.111 ppm), copper (0.064 ppm), cobalt (0.56 ppm), and iron (85.0 ppm). Heavy metals and their levels found in the soil comprised zinc (47.04 ppm), manganese (321.8 ppm), lead (26.15 ppm), copper (3,425.92 ppm), and cobalt (15.7 ppm); sulphur was found at 121.8 ppm. There were significant ($p<0.05$) variations among genotypes with regards to heavy metal and sulphur accumulation in plant tissue. Accumulation of heavy metals and sulphur in plants were zinc (22.1–83.5 ppm), copper (34.4–89.1 ppm), cobalt (0.01 ppm), lead (0.01 ppm), manganese (98.0–300.0 ppm), iron (86.0–349.0 ppm), and sulphur (910–4,204.4 ppm). The study helped to identify genotypes with hyper-accumulation traits which will be included in the crossing block for further hybridisation to pass on the gene to progeny.

8.6.5 Yield and nutrition quality stability of orange-fleshed sweetpotato cultivars across different harvesting periods, Mozambique

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Abstract

Storage of sweetpotato roots for a prolonged period is a great challenge at the smallholder farmer level in Mozambique. Piecemeal harvesting allows a continuous supply of roots for household consumption for several months if weevil infestation is avoided. No systematic study has been done to look at the dynamic changes in yield and nutritional content among orange-fleshed sweetpotato (OFSP) cultivars harvested at different times in Mozambique. The objectives of the studies were to determine yield and changes in key macro- and micronutrients associated with early or late harvesting of OFSP cultivars in Mozambique. Four trials were established at Gurué in December 2015. The trials were classified into harvesting period, 3, 4, 5, and 6 months. Each trial had 30 OFSP cultivars laid in a randomised complete block design with three replications. Twenty-two of the cultivars are already released in Mozambique, 2 are elite clones, and 3 are common checks in 2016. Yield measurements were done in the field and samples were selected and sent to the quality laboratory in Maputo for determination of dry matter (%), β-carotene (mg/100g dry weight basis [dwb]), iron (mg/100g dwb), zinc (mg/100g dwb), and carbohydrate content, including starch, using near-infrared spectrometry. Data of the collected traits were analysed using R. The cultivars had significant differences in the measured traits within each harvesting period and among the harvesting dates. Yield and dry matter sharply rose as the harvesting period increased from the date of planting. Sweetpotato is perennial, hence partitioning of photosynthates to the storage roots is a continuous process. Dry matter, starch, iron, and β-carotene increased linearly in some cultivars as harvesting was prolonged; zinc was not affected by harvesting period. Genotype x environment interaction was small for the quality traits. Stability of micronutrients is essential for piecemeal harvesting. The study allowed accurate grouping of the cultivars tested into maturity groups as this was never done before.

Keywords: sweetpotato , stability, cultivars, CloneSelector, photosynthates, maturity group

8.6.6 Wound healing and dry matter of orange-fleshed sweetpotato cultivars as influenced by curing methods

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Abstract

Curing (wound healing) in sweetpotato is a crucial postharvest practice that could guarantee improved shelf life, but it is rarely practised by sweetpotato farmers in sub-Saharan Africa, principally due to lack of knowledge. Wound healing ability of cultivars has been associated with good root storability. In this study, two orange-fleshed sweetpotato (OFSP) (cultivars 'Apomuden' and 'Nane') were either cured in-ground by dehaulming prior to harvest or field-piled for 7 days to study their responses to wound healing and changes in dry matter (DM). 'Apomuden' is a released, low DM (19%) variety in Ghana, whereas 'Nane' is a high DM (27%) farmer cultivar that is being tested for formal release. To create the wounds, 21 roots were deliberately damaged using a potato peeler; the curing treatment was applied; and the subsequent quality status of the roots monitored daily for 7 days post-treatment. The experiment used a 2 × 2 factorial design. For the in-ground treatment, the canopies of sweetpotato plants were removed 7 days prior to harvest. For the field-piled curing treatment, roots were harvested carefully (trying to avoid wounding), sorted and heaped on the field, and covered with fresh sweetpotato vines. The wound healing was scored based on a scale where 0 = no lignification, 0.5 = patchy lignification, and 1= complete lignification. Wound-healing ability score was not significantly different for 'Apomuden' and 'Nane' (0.83 vs. 0.78, respectively; $p = 0.120$). However, roots cured by field-piled curing method resulted in significantly ($p = 0.001$) better wound healing ability (0.86) than dehaulming (0.75). Over the 7-day curing period, 'Nane' had a significantly higher ($p = 0.008$) and stable DM compared with 'Apomuden' which was lower and fluctuating. The field-piled curing resulted in higher ($p = 0.020$) DM (24%), compared with in-ground curing (DM 22%). The field-piled curing method, which can easily be adopted by sweetpotato farmers, increased the DM content of the roots; indications are that it could potentially reduce sweetpotato postharvest losses. The high DM of Nane is a desirable root quality attribute for orange-fleshed cultivars. Therefore, efforts should be intensified for its release as a variety in Ghana.

Keywords: Curing, dry matter, field-piled, orange-fleshed sweetpotato, wound healing

8.6.7 Testing "Triple S" in a new context: sweetpotato planting material conservation over the long dry period of Ethiopia

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Abstract

Farmers who produce sweetpotato in Ethiopia save planting material on farm during the long dry months. Water stress and virus and weevil pressure during this period are the main causes of both the loss of farm-saved sweetpotato planting material and the country's shortage of planting material. In other African countries, "Triple S" is a newly emerging root-based sweetpotato planting material conservation technique that has enabled small-scale farmers to conserve planting material for up to 3 months in dry periods. The dry months in Ethiopia last 3–5 months in the Southern Nations, Nationalities, and Peoples' Region (SNNPR) and 7–9 months in Tigray region, where direct adoption of the original Triple S technique is not feasible. Therefore, the aim of this study is to modify and test root-based sweetpotato planting material conservation methods appropriate for Ethiopia. In SNNPR, 12 farmer research groups compared Triple S techniques with shade conservation and conventional methods. In Tigray, an on-station trial was conducted to test the sprouting potential of different sizes (small, medium, and large) of roots stored in sand-filled containers after different storage periods. Results show that roots stored in sand-filled containers start sprouting 4–6 weeks after first being stored. On average, 82% of roots stored could sprout after 3, 4, and 5 months and be transplanted for vine multiplication. Forty-five days after transplanting, each root gave above-ground fresh vine yields of 883 g, 656 g, 680 g, and 615 g in Dorebafana, Kedidagamela, Humbo, and Mirab-Abaya woredas, respectively. Storing only 40 roots using Triple S can produce enough planting material to plant 400 m^2 of land. In addition, the quality of vine produced through Triple S is better than that from farm-saved planting material in terms of being free of viruses and weevil. In our separate experiments to adapt Triple S for 8–9 months during the dry period in Tigray, 61%, 62%, and 52% of roots sprouted after 6 months of storage. The present study confirmed the potential of Triple S to increase the security of sweetpotato planting material in drought-prone areas in Ethiopia. Additional studies are being conducted to refine factors such as age and size of roots and storage and transplanting time.

Keywords: Sweetpotato, Triple S, planting material, dry season, Ethiopia

8.6.8 Specialised sweetpotato vine multiplication in Lake Zone, Tanzania: What "sticks" and what changes?

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Abstract

In Lake Zone, Tanzania, the Sweetpotato Action for Security and Health in Africa Marando Bora project trained farmers to become specialised multipliers to produce and distribute sweetpotato seed. The objectives of the case study were to analyse (1) how farmers and trained multipliers characterised and managed quality in sweetpotato planting material; (2) changes in skills and practices as multiplication became a specialised task; and (3) what other transactions were happening as planting material was exchanged. The study used mixed methods to investigate the sweetpotato seed system as a social and technical configuration and the processes and interactions within it. A formal survey of 88 trained decentralised vine multipliers (DVMs) was conducted in March 2013. Detailed observations and semi-structured interviews were also carried out with 21 farmers and a sub-group of the DVMs. The survey results showed that 70% of DVMs were multiplying vines 9 months after the project finished; 34% were using close spacing in beds; 61% were using conventional plant spacing on ridges for roots and vines; and 5% were using both multiplication beds and ridges. Further, 97% of DVMs irrigated from wells, springs, lake, river, or dam water; 34% used pumps. During the life of the project, 89% of DVMs used fertilizer, and 26% continued to use it after the project finished. The in-depth interviews showed that farmers selected planting material not only on the basis of plant health, but also used cues to plant vigour. The use of own-saved seed involved a complex performance of managing seed and root production across different agro-ecologies according to inter- and intra-season characteristics. As the vine multiplication cycle became a specialised activity, vines were treated differently, depending on whether they were to be used for high root production or high vine production. The resilience and viability of the existing seed systems depended not only on individual knowledge and skills, but also management practices across agro-ecologies and negotiating social settlements at community level. As specialisation of seed production developed, the multiplication and root production cycles were separated and tasks became segregated. New knowledge and skills were formed in different ways; the trained multipliers adapted the new techniques into the existing system of shifting vine conservation and root production between different ecologies. Interventions aimed at building the capacity of specialised vine multipliers and scaling-up seed interventions should consider the implications of skills-building and segregation of tasks in the broader context of society choice of technologies and agrarian change.

Keywords: Sweetpotato vine multiplication, specialisation, skills-building

8.6.9 Access to lowland areas for vine conservation: a key determinant of increased utilisation of orange-fleshed sweetpotato in Niassa Province, Mozambique

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Abstract

Malnutrition and vitamin A deficiency (VAD) affect 44% of children under 5 years in Mozambique's Niassa Province (2013). To combat VAD, the International Potato Center, in collaboration with diverse partners, promotes the use of orange-fleshed sweetpotato (OFSP) in agricultural and nutrition interventions. Sweetpotato is the third most important crop in Niassa Province after maize and beans (Baseline Survey 2013) and is consumed mainly as breakfast in rural areas. The availability of vines during the main planting season remains an important production constraint. The objective of this study is to evaluate the use of lowland areas for vine conservation to improve the availability and access of planting material during the main planting period and, subsequently, improve access to OFSP roots for consumption and income. The study was implemented among 271 households (HH) in 8 districts in Niassa in December 2015. About 77% of these HH had children under 5 years and 34% of the respondents were women. These HH were selected randomly among those that had received OFSP planting material in 2013–2015. Data about vine conservation, use of lowland areas, OFSP consumption, and income from OFSP were collected and analysed using SPSS statistical software. Results were compared with the baseline results from 2013. About 87% of HH have access to lowland areas; those using these areas for vine conservation increased from 41% in 2013 to 58% in 2015, and the use of small garden plots went from 14% to 26%. HH conserving vines in upland fields dropped from 56% in 2013 to 7% in 2015. About 53% of HH still planted in June (beyond the main planting season), whereas 24% continued to plant year-round. However, cultivation on small plots dominated from March to December, mainly for vine multiplication. 'Delvia', 'Irene', and 'Gloria' varieties were mentioned, respectively, by 43%, 21%, and 20% of HH as their preferred varieties. And although all HH consumed OFSP roots, more than 50% consumed OFSP from April to October. Some 56% of HH sold OFSP roots which generated an average income of US $48 /HH/year. The use of lowland areas for vine conservation has increased and vine management has improved. Consequently, production area has increased by 23%, root yield has increased by 100%, and the period of consumption from own production has increased to 7 months. Awareness campaigns will continue to promote year-round production of OFSP.

Keywords: Sweetpotato vine conservation, lowland, access to OFSP, income, malnutrition

8.6.10 Climatic gradient and its relation to sweetpotato diversity structure in West Africa

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Abstract

Sub-Saharan agriculture is considered vulnerable to ongoing climate change. Adaptation of agriculture has been suggested as a way to maintain productivity. Better knowledge of intra-specific diversity and adaptation of varieties are prerequisites for the successful management of such adaptation. Among crops, roots and tubers play important roles in food security and economic growth for the most vulnerable populations in Africa. Sweetpotato (*Ipomoea batatas*) was domesticated in Central and South America and was introduced later into Africa, where it is now cultivated throughout tropical agro-climates. We evaluated its diversity in West Africa by sampling a region extending from the coastal area of Togo to the northern Sahelian region of Senegal which represents a range of climatic conditions. Using 12 microsatellite markers, we evaluated 132 varieties along this gradient. We also obtained phenotypic data from field trials conducted in three seasons. Genetic diversity in West Africa was found to be 18% lower than in America. The Wilcoxon paired test revealed significant differences in diversity between America and West Africa (*p* value = 0.0083) but no difference between Oceania and West Africa (0.048). Genetic diversity in West Africa is structured in five groups according to Discriminant Analysis of Principal Components result. The BIOCLIM data, principal component analysis, and Kruskal-Wallis test showed that some groups were found in a very specific climatic area (e.g. under a tropical humid climate, or under a Sahelian climate). We also observed genetic groups with occurrence in a wider range of climates. The Kruskal-Wallis test revealed that the genetic groups observed were also associated with morphological differentiation, mainly the shape of the leaves and the colour of the stem or root. This particular structure of diversity along a climatic gradient can be used to propose conservation strategies as well as to recommend specific varieties to be grown in current and future climate conditions. This knowledge will help adapt agriculture to ongoing climate variation in West Africa.

Keywords: *Ipomoea batatas*, genetic diversity, agro-morphology, climate, West Africa

8.6.11 Adaptation to mid-season drought in a sweetpotato [*Ipomoea batatas* (L.) Lam.] germplasm collection grown in Mozambique

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Abstract

In Southern Africa, more pronounced drought episodes are a serious abiotic threat to agriculture, affecting storage root yield and quality of roots and leaves in sweetpotato. Two experiments were conducted at Estacao Agraria de Umbeluzi in February and August 2015. The three objectives were to (1) determine cultivar response to mid-season drought; (2) determine best traits for improvement of storage root yield in the mid-season, water-stressed period corresponding to initiation of storage roots compared with non-stressed environments; and (3) assess the selection criteria for identifying drought tolerance in sweetpotato cultivars that could be recommended for regular use in breeding programmes. The experiments involved two trials with two watering treatments, irrigated and water-stressed. The distance between the experiments was 10 m and furrow irrigation was applied. The irrigated and water-stressed trials received 640 and 400 mm of moisture, respectively, throughout the season. Water stress was imposed from 30 to 70 days after planting. Each trial consisted of 48 genotypes, composed of 24 released varieties, 16 landraces, and 8 introductions from different countries. All the genotypes were cleaned and indexed by the tissue culture laboratory in Mozambique before multiplication for trial establishment. Each treatment had two replications arranged in a randomised complete block design, with dimensions of each plot measuring 3 x 5 m. Data were collected on storage root and vine yield, total biomass, stem and internode length, leaf area index, and derived drought tolerance indices—geometric mean and drought sensitivity index, including harvest index (HI). The data were subjected to analysis of variance in SAS (1996). Cultivar performance varied significantly within and between treatments. MUSGP0646-126 had the highest storage root yield across treatments and over seasons with a high HI. The mid-season drought imposed reduced the magnitude of all traits measured. HI was significantly correlated with storage root yield. HI stability and the geometric mean may be key to identifying cultivars with storage root yield stability and high storage root yield under both treatments. Cultivars with high storage root yield under mid-season drought were associated with high HI, indicating that partitioning of assimilates, rather than whole-plant biomass, was the driving factor to high yield. The released varieties group had higher storage root yield under both treatments than landraces and introductions from other countries. The use of drought indices and HI is encouraged for selecting improved cultivars for varied production environments. Their regular use as part of accelerated breeding schemes is encouraged.

Keywords: Storage root initiation, geometric mean, harvest index, stress susceptibility index, yield stability, sweetpotato

8.6.12 Interaction of population density of sweetpotato pests with changes in farming practices and physical environments: a preliminary observation from the eastern Democratic Republic of the Congo

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Abstract

Sweetpotato is a major food security crop grown in eastern DR Congo; however, its production is limited due, among other factors, to high prevalence of pests and diseases. Field observations (population dynamic of different soil- and surface-dwelling arthropods visiting sweetpotato fields) were combined with a survey of farmers' knowledge of sweetpotato pests and their practices in the management of these pests in South-Kivu Province were conducted from 2010 to 2015. Farmer-based data were obtained using a semi-structured questionnaire administered to several farmers. Different varieties of sweetpotato (local and improved) are grown three times (three seasons) a year under different cropping systems (mono-cropping, mixed crops) in various agro-ecological zones at different altitudes. Various arthropod species visit the crop at its different stages of development and include classically known pests (*Acraea acerata*, *Cylas* spp.) or as vectors of diseases (*Bemisi tabaci*, *Aphis* spp.). There was a significant correlation (r=0.90, $p<0.001$) between population density of *B. tabaci* and mean monthly maximum temperature in sole crop fields at lowland altitudes than at highland altitudes. However, a significant relationship ($p<0.001$) was observed between adult aphid population density and average temperature. Whereas *Cylas* spp. correlated significantly with rainfall at high and mid-altitudes in both sole and mixed crops. The population density of *A. acerata* was not related to either variability in rainfall or variability in relative humidity and rainfall because the species seemed to occur in a number of crops (mono-cropping and mixed crops) in marshland areas in June–July and December–February. Virus pressure (measured as the number of leaves symptomatically showing virus attack) followed the population density of whiteflies. Population trends of other arthropods was not affected by crop variety, altitude, or climate variability; but more by the farmers' practice (mixed or monoculture). It is possible that the resistance or tolerance of some varieties (including biofortified ones) may be reduced in the future under changing climatic conditions to the region's crop-growing areas. The data indicate that building resilient sweetpotato crop will require various approaches. It is likely that climate change may affect both pests and diseases, and therefore crop yields in eastern DR Congo.

Keywords: Sweetpotato, pests and diseases, climate change, farming practices, crop resilience, yield reduction, altitude, agro-ecological zone

8.6.13 Genotype stability index for root yield and tolerance to sweetpotato weevil *Cylas puncticolis*: a tool for identifying climate smart varieties

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Abstract

Despite the ability of sweetpotato to grow in marginal areas, large differential genotypic responses have been reported under varying environmental conditions. Differences in pest and disease pressure contribute significantly to inconsistencies in performance of genotypes in various environments. Using a randomised complete block design, six sweetpotato genotypes were evaluated in one location for five (seasons) years (2010–2015). Additive main effects and multiplicative interaction stability value was used to identify best genotypes that combine stability with high resistance to sweetpotato weevil *Cylas puncticolis* across the five seasons (years). Stability of genotypes for weevil infestation and damage thereof, leaf retention, "stay green", storage root mass, and fresh storage root yield were determined for each season. The data on each of these parameters were correlated with rainfall and temperature data for each season and across all five seasons. Results show variability in the ranking of genotypes' stability for resistance to weevil infestation and associated damage. Significant positive correlations were recorded between ambient temperature and weevil sweetpotato infestation and associated damage. In contrast, annual amount of rainfall appeared to be negatively correlated to weevil infestation. Spearman's correlation calculated between pairs of traits indicated that leaf longevity traits stay green and leaf retention were highly correlated with weevil infestation. However, Spearman's correlation of rank order of genotype stability index indicate that two of the genotypes consistently ranked highest for increased mean root yields, with an average >20 t/ha and mean dry mass >35% each within and across five seasons. This held despite progressive increase and consistent reduction in ambient temperature and amount of annual rainfall, respectively, in 2010–2015.

Keywords: Genotype stability index, *Cylas puncticolis*, resistance, climate smart, leaf longevity

8.6.14 Gender-sensitive agricultural intervention improved profit efficiency among orange-fleshed sweetpotato producers in Rwanda

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Abstract

The economy of Rwanda, land-locked and land-constrained, is dominated by agriculture. With a population density of 460 persons/km^2, average farm size in 2014 was only 0.6 ha. Sweetpotato (*Ipomoea batatas L.*) is an important staple food crop here, with annual production of 940,000 tonnes on just 5.2% (69,269 ha) of cultivated area. Dominant local varieties are white-fleshed, lacking in pro-vitamin A and low yielding due to virus accumulation. During peak period of production, farmers complain of glut and low prices for their sweetpotato. The objective of the Rwanda Super Foods project was to demonstrate whether it would be possible to build an efficient, gender-sensitive sweetpotato processed product value chain. Processing of sweetpotatoes was unknown in Rwanda, and the project promoted the use of pro-vitamin A-rich orange-fleshed sweetpotatoes (OFSP) for processing. The intervention explicitly set a target that 75% of the participant households must be women. This study analysed the direct measure of profit efficiency by applying stochastic profit frontier and inefficiency effects model on 846 households in rural Rwanda, 39% directly involved in the intervention; 37% indirect beneficiaries of vines; and 24% control households not accessing any part of the intervention. The data were obtained from the project's endline survey conducted in five districts (Burera, Gakenke, Kamonyi, Muhanga, and Rulindo) in September 2014. The survey included households belonging to established marketing groups backstopped by Imbaragga, a non-governmental organisation (NGO), and those part of vulnerable groups (widows, orphans) backstopped by the NGO YWCA. The survey gathered information on input (seed, labour, land, and fertilizer) use, marketing, and other factors affecting the profit efficiency. Results showed that average level of profit efficiency in sweetpotato production system is 55%, suggesting that an estimated 45% of profit is lost due to the combined effect of technical, allocative, and scale inefficiency. Notably, the profit efficiency of female beneficiary and female spill-over was 3.5% and 5%, respectively, higher than that of male control households where no intervention occurred. The profit efficiency of participant households was 64% compared with 20% of the control households. Efficiency appeared to be negatively associated with area under sweetpotato (p-value<1%) and age of household head (p-value<1%), but positively to participation in intervention (p-value<1%). The implication is that profit efficiency in sweetpotato production can be increased by almost 40%. In conclusion, OFSP, if designed with special attention to women's needs, can enhance the profit efficiency of the poor and disadvantageous households.

Keywords: profit, efficiency, sweetpotato, gender, Rwanda, agriculture

8.6.15 Sweetpotato market structure in Nasarawa State and Federal Capital Territory of Nigeria

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Abstract

The study was conducted to assess the sweetpotato market structure in Nasarawa State and the Federal Capital Territory (FCT). Forty wholesalers and eighty retailers were randomly selected from the eight markets of Nasarawa State and FCT. Descriptive statistics and Gini Coefficient were used to analyse the data. The findings show the existence of product differentiation and little or no barriers to entry into the sweetpotato market. The Gini Coefficient values of 0.5457 (wholesalers) and 0.6001 (retailers) indicate the existence of some degree of the concentration of sellers. This implies that the sweetpotato market is an imperfect competitive one. Government policies should be directed at reducing transportation costs, rent charged by the Local Government Authority, and provision of micro-credit for the traders so that they can expand their purchases.

Keywords: Assessment, sweetpotato, market structure, Gini Coefficient

8.6.16 From lab to life: making storable orange-fleshed sweetpotato purée a commercial reality

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Abstract

Research conducted in Rwanda demonstrated that orange-fleshed sweetpotato (OFSP) purée (steamed, mashed roots) was an economically viable, vitamin A-enhancing ingredient in baked products when it was produced and used at the same bakery. Having a storable, packaged OFSP purée produced in quantity by a firm to supply bakers is an alternative model. Vacuum-packed OFSP purée with preservatives with a shelf life of 4 months at 20ºC was successfully developed by the International Potato Center (CIP) under laboratory conditions in 2015. Turning that product into a commercial reality requires developing a public-private partnership to establish an OFSP purée value chain. The company Organi Ltd was competitively selected from bids solicited by CIP in October 2014. EIL provided technical support on equipment and process flow at the factory and collaborated on purée storage studies. In April 2015, CIP facilitated an agreement between Organi Ltd and Tuskys, the second largest supermarket chain in Kenya, to provide OFSP purée to Tuskys' bakery department. This paper examines the technical, economic, and social aspects along the chain during the first 18 months, using sensitivity analysis to examine drivers of profit. The first OFSP bread began to be marketed in six Tuskys' stores in June 2015, at a premium price (5 Ksh above its regular bread), reaching 18 stores by August 2016. The OFSP bread was well-received by consumers, and the limited stocks sold out by noon. During the first 8 months the factory struggled with supply due to (1) reluctance of farmers to switch from their traditional white-fleshed varieties, for which strong market demand exists, to OFSP varieties until they were certain that the OFSP roots would be purchased; (2) management problems at the factory due to inexperienced staff; and (3) cash flow problems. Daily purée supply rose from 200 kg to 500 kg by January 2016, but then issues of root oversupply and low absorption by Tusky's arose. The transition from the use of OFSP purée requiring freezing to a vacuumed-packed, preserved product was slower than envisaged due to needing excellent food-handling standards, the cost of packaging and preservatives, and the effect of the preservative sorbate on dough development. Switching to machinery that could puree unpeeled, cooked OFSP in lieu of peeled roots led to a profit margin increase of 20%. Consolidated transport of sufficient quantities of purée, fresh root storage capacity at the factory, and a price premium for the bread are requisite for successful commercialisation.

Keywords: Orange-fleshed sweetpotato, purée, value chain, storage, viability

8.6.17 The market potential for sweetpotato pre-basic and basic seed in Eastern and Southern Africa

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Abstract

Sweetpotato is a major food crop in Eastern and Southern Africa (ESA). Smallholders have not been able to achieve its potential yield, however, due to lack of access to and use of quality certified seed. Majority of farmers rely on farmer-to-farmer exchange of vines, which without a linkage to a system able to produce and deliver starter seed, regularly and sustainably, often results in seed of unknown quality. This means that national agricultural research institutes (NARIs) must improve their capacity to supply the starter seed into these systems in a sustainable manner. Therefore, since 2014, the International Potato Center (CIP) has been working to strengthen technical and financial capacities for sustainable production of pre-basic sweetpotato seed. In collaboration with the national sweetpotato programmes, CIP has also prepared business plans that reflect the institutional and market context. This study conducted a cross-country synthesis of the business plans to (1) examine the overall business opportunities for public institutions that are involved in pre-basic seed production; (2) identify options for financially sustainable enterprise models by identifying direct and indirect potential benefits from the early generation seed business as well as the potential growth of the business using financial analysis; and (3) draw out potential strategies for implementing sustainable, pre-basic seed production business. The study used primary data collected from various NARIs located in ESA countries. The preliminary results indicate that the cost of tissue culture (TC) is high and that, on the whole, the total cost per unit of output declines along the value chain. The South Agricultural Research Institute in the Southern region of Ethiopia reports that production of the TC plantlets average 5.4 times higher than that of pathogen-tested screenhouse cuttings. (This is if the cost of hardening and cutting of pre-basic seed is included, which in turn is more than 195 times higher than basic seed in net tunnels.) Thus, pre-basic seed programmes need to rationalise how many TC plantlets they truly need to maintain in order to reduce the cost of TC plantlets production. However, overall results conclude that production of pre-basic and basic seed by public institutions is profitable due to relatively high gross margins and viable business in the long-run, given the positive net present values. The paper provides key messages to help public institutions to identify potential partners, including private sector, and can serve as a tool for raising funds for investment in this business.

Keywords: Financial analysis, business plans, NPV, IRR, gross margin, SWOT, TOWS

8.6.18 Consumer participation in Ghana sweetpotato breeding programme: a 2-year case study

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Abstract

Breeders in Ghana are now interested in knowing whether or not consumers will adopt their varieties and, in particular, the orange-fleshed sweetpotato (OFSP), which is viewed as generally too sweet. Factors such as gender, age (6–17 years for children, 18–60 years for adults), and local taste preferences can influence the acceptance of a particular variety, and hence are very important to consider during sweetpotato breeding. A consumer sensory analysis was conducted on sweetpotato advance trials at four different ecological locations (Komenda, Ohawu, Pokuase, and Tono) at the time of harvest for the 2014 season and five locations in 2013. The analysis used a pictorial rating ("smiley" face scale) scheme to aid young children and illiterate farmers, and included men, women, and children. Nine elite genotypes were used in the 2013 trial as compared with 16 elite genotypes (NK03/A Jitihada, CIP 442162, CIP 44039, Bun 5, Nanungungungu, PG12086-18, PG1111-11, PG12040-6, PG112136-2, PG12151-73, PG12164-21, PG12166-30, Orange, Purple, and AP3A). Selected genotypes from the 2013 advance stage (advance yield trial) were added to some introduced varieties and tested against five released varieties ('Ligri', 'Ogyefo', 'Sauti', 'Apomuden', and 'BlueBlue') serving as checks. Attributes evaluated were colour, taste, flavour, texture, and overall acceptability. In 2013, TIS9265/10 (overall likeness = 3.2) performed more poorly than the checks and other genotypes, and so was not selected. Although men rated texture (average likeness = 3.9513) above all attributes and women preferred appearance (average colour likeness = 4.0374) in 2013, women consistently ranked all attributes higher than men in 2014. Children consistently ranked sweetpotato higher in all attributes than did adults in both 2013 and 2014, indicating that they are less selective than adults. All the elite genotypes recorded higher consumer acceptability (≥3) in all the attributes across all locations in both years. Significant differences were observed between adults' and children's preference, whereas differences observed between women and men were not significant in all the attributes ($p<0.05$). Colour was ranked highest among all the attributes by gender and age groups for both years, indicating that appearance matters a lot in consumer choices. One can conclude that consumers generally accepted the breeders' varieties regardless of whether they were OFSP or how sweet they were. However, the changes in attribute preference between men and women in the 2-year study show that consumer preferences are not static and can change from one season to the next.

Keywords: Consumer, genotype, breeders, sweetpotato, 'Apomuden'

8.6.19 Evaluation of the evaporative cooling system for sweetpotato roots storage: preliminary results

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Abstract

The majority of sweetpotato farmers practice piecemeal harvesting and store harvested roots for many days. Studies show that significant postharvest losses occur because of improper handling and other factors, often because farmers lack appropriate storage technologies. We set up a zero-energy sweetpotato storage unit and compared the results with farmers' traditional house storage practice. Five sweetpotato varieties—'Gihingumukungu', 'Terimbere', 'Vita', 'Cacearpedo', and 'Magande'—were stored under cool and farmers' storage conditions for 70 days to evaluate the effect of both storage conditions on the shelf life of sweetpotato roots. The cool storage structure has double walls with charcoal in between. When water is added it evaporates, drawing heat out of the room and keeping the room cool. Four plastic basins were placed in the cool storage structure to increase the relative humidity. The percent weight loss for 'Gihingumukungu' stored in the cool storage structure was significantly low (6.1%, $p<0.05$) compared with when it was stored under the farmers' conditions (12.5%). The appearance was significantly high (better) (4.2, $p<0.05$; on a scale of 5 = excellent, 1 = worst) for 'Vita' stored in the cool storage structure than when it was stored under the farmers' conditions (3.3). Appearance of the roots for other varieties was also high when stored in the cool storage structure, but the differences were not significant ($p<0.05$). Both storage methods had nonsignificant impact on the concentration of the soluble substances, primarily the sugars present in the sweetpotato roots. Internal damage for 'Gihingumukungu' and 'Magande' varieties stored in the cool storage structure was significantly low (0.0 and 0.5, $p<0.05$, respectively; on a scale of 0 = 0% damage, 5 = 76–100% damage) when compared with the same varieties stored under farmers' conditions (0.7 and 2.7, respectively). Internal damage of the roots was characterised by darkening or softening of the root tissues. The temperature in the cool storage structure was significantly lower (20.9 °C and 19.2 °C, $p<0.05$) during the day and night compared with the temperature in the farmer's house (21.7 °C and 20.7 °C, $p<0.05$) during the day and night, indicating that the former method was cooler. However, the temperature recorded outside was also significantly lower (20.1 °C and 18.3 °C, $p<0.05$) during the day and night for both storage conditions. The relative humidity in the cool storage structure was significantly high (81.8% and 84.6%, $p<0.05$) during the day and night compared with it under farmers' storage conditions (72.3% and 71.8%) during the day and night. These preliminary results show that the technology can be effective when well-calibrated. More calibration is necessary to lower the internal temperature further.

Keywords: Evaporative cooling, sweetpotato, shelf life, zero-energy storage, sweetpotato storage

8.6.20 Factors affecting adoption of insect-proof net tunnels for production of quality sweetpotato vines among farmer multipliers in Tanzania

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Abstract

Insect-proof net tunnels have been shown to limit virus attack on sweetpotato planting material, hence reducing potential root yield losses. But net tunnels are a new technology among farmers who produce planting material (farmer-multipliers), and it is not well known what will influence the long-term sustainability of their use. This research sought to determine parameters that affect the technical feasibility of the technology under farmer-multiplier management. The following aspects were investigated: (1) the effect of different closing methods on durability of the nets; (2) plant spacing in the net tunnels; and (3) the skills and capacities required to manage the net tunnels. Experiments comparing different closing methods and plant spacing were conducted in the Lake Zone, Tanzania, and consisted of two net tunnels—one closed with a zipper and the other by tying the two ends using manila strings. One sweetpotato variety ('Kabode') was planted in both net tunnels but with different spacing (15 x 10 cm, and 20 x 10 cm). The experiments were replicated four times. The two different spacing regimes did not show any significant influence on both vine yields and the ability of the leaves to stay green. This might be due to the fact that the difference in plant population was only 60 plants, and that the plants quickly spread to take advantage of additional space. The use of the two alternative closing methods reduced damage caused when binding wires are used to close the net tunnels. Damage was even further reduced when knots were used. To investigate farmer-multipliers' experiences with the technology—in particular, the profile, skills, and capacities needed to manage the net tunnels—a mini-survey was conducted with a sub-sample of farmer-multipliers. From the mini-survey interviews, it was noted that one factor affecting successful multiplication of planting material in net tunnels is water availability. The current techniques for irrigation (use of buckets and watering cans), however, are very cumbersome and time consuming. Other management challenges mentioned by the multipliers included weed and caterpillar infestation after harvesting. This research indicates that the net tunnel technology can be cascaded down to farmer-multipliers successfully if there is proper management. There is a need to test weed and caterpillar management strategies and to continuously train multipliers on the importance of good agricultural practices. This will contribute to more effective management of the net tunnel technology for quality seed production.

Keywords: Net tunnels, sweetpotato, technical feasibility, farmer-multiplier, management

SPHI

Sweetpotato for Profit and Health Initiative

The Sweetpotato for Profit and Health Initiative (SPHI) is a 10 year multi-partner, multi-donor initiative that seeks to reduce child malnutrition and improve smallholder incomes through the effective production and diversified use of sweetpotato. The first five-year phase (2010-2014) concentrated on Proving the Potential, building up the supply of adapted varieties and testing models of delivery of improved varieties to producers and consumers. The second five-year phase (2015-2019) focuses on Achieving the Potential, ensuring that effective "seed" systems are delivering improved planting material to 10 million sub-Saharan African households.