Report of the Thirteenth Sweetpotato Breeders' Meeting held at Malawi Sun Hotel, Blantyre-Malawi, June 17-20, 2014

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2014

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List of acronyms

ABS	accelerated breeding scheme
AGRA	Alliance for a Green Revolution in Africa
ARC	Agricultural Research Center
AT	Advanced Trials
ATAAS	Agricultural Technology and Agribusiness Advisory Services
BMGF	Bill and Melinda Gates Foundation
CGIAR	Consultative Group on International Agricultural Research
CIP	International Potato Center
CRS	Catholic Relief Services
COVOID	Community Volunteer Initiative for Development
DARS	Department of Agricultural Research Service
EBV	Experimentally estimated breeding value
ECA	East and Central Africa
GEBV	Genomic Estimated Breeding Values
GMO	Genetically Modified Organism
GS	Genomic Selection
IFAD	International Fund for Agricultural Development
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
KOPIA	Korean Project on International Agriculture
LD	Linkage disequilibrium
MAB	Marker Assisted Breeding
MAS	marker assisted selection
NACRRI	National Crops Resources Research Institute
NARI	National Agricultural Research Institutes
NARS	National Agricultural Research Systems
NCRI	National Root Crops Research Institute
NCSU	North Carolina State University
NGO	Non-governmental organization
NIRS	Near infra-red spectroscopy
OFSP	Orange-fleshed sweetpotato
OFT	On-farm trials
OP	Open Pollination
PCR	Polymerase Chain Reaction
QDPM	Quality declared planting material
QTL	Quantitative Trait Loci
RAB	Rwanda Agriculture Board
RAC	Reaching Agents for Change
ROI	Return on Investment
SASHA	Sweetpotato Action Profit and Health in Africa
SOSPA	Soroti Orange Sweetpotato Processors Association
SPHI	Sweetpotato Action for Security and Health in Africa
SPVD	sweetpotato virus disease

SPW	sweetpotato weevil
SSA	Sub Saharan Africa
SUSTAIN	Scaling Up Sweetpotato through Agriculture and Nutrition
USAID	United States Agency for International Development
VEDCO	Volunteer Effort for Development Concerns
WAAPP	West Africa Agricultural Productivity Program
WACCI	West African Center for Crop Improvement

A INTRODUCTION AND OBJECTIVES

The 2014 annual sweetpotato breeders' meeting was held at Malawi Sun Hotel, Blantyre, Malawi, June 17-20, 2014. This was the 13th meeting since 2003 and sixth since the start of the Sweetpotato Action for Security and Health in Africa (SPHI) project in 2009. Participants arrived on the 16th.

At the opening Dr. Felistus Chipungu, the National Research Coordinator for Horticulture and Sweetpotato Breeder for Malawi, welcomed the participants, Mr. Felix Chipojola of Bvumbwe Research Station offered a prayer, followed by self-introductions. Dr. Jan Low commended the progress Malawi had made in sweetpotato research and development.

Dr. Mackson H. Banda who represented the Director of Agricultural Research Services introduced Dr. Wilfred G. Lipita, the Controller of Agriculture Extension and Technical Services (CAS) in the Ministry of Agriculture and Food Security, who represented the Minister in the same ministry. Dr Lipita therafter addressed the participants - It gives me great pleasure to welcome you to this 13th Annual Sweetpotato Breeders' Meeting, here in Blantyre, Malawi, to be held for the next four days, June 17th to 20th, 2014. Most of you are probably aware that the Sweetpotato for Security and Health in Africa (SASHA) five-year project is part of the ten-year Sweetpotato for Profit and Health Initiative (SPHI). SASHA is run by the International Potato Center (CIP) and partners such as Agricultural Research Services of Malawi, with activities in 17 countries. I am aware that SASHA has five main components: 1) Population development and varietal selection, 2) Developing weevil resistant sweetpotato using transgenics, 3) Seed Systems, 4) Delivery systems (proof-of-concept sub-projects), and 5) Management and Sweetpotato Support Platforms.

The reason you are here for this meeting is to focus on the overall objective of the first component dealing with establishment of efficient population improvement programs at a sub-regional level in sub-Saharan Africa (SSA) linked with participatory varietal selection at the national level.

This objective enables rapid ongoing development of new varieties to contribute to improved farmer incomes and to deliver nutritional benefits to consumers, especially women and children. I am glad that CIP breeders work in collaboration with our national partners in the region at the Sweetpotato Support Platform (SSP) in Maputo, Mozambique, supported by efforts at CIP headquarters. Malawi has benefited as one of the national program partners among the 17 target countries that are assisted with their own breeding programs through CIP backstopping visits, provision and exchange of germplasm, standardized methodologies and analytical tools, and participation in an annual sweetpotato breeders meeting.

I am glad to mention that Malawi has been an active member of the community of practice of sweetpotato breeders in SSA, and as you know our sweetpotato breeder, Dr. Felistus Chipungu has attended all the Sweetpotato breeders meetings since SASHA started. Holding this 13th Annual Sweetpotato Breeders' Meeting in Malawi is our gesture of support and commitment to moving together to contribute to accomplishing the objectives of SASHA and SPHI.

In the prestigious British Journal, The Lancet, published in August 2013, it is stated that: Evidence of the effect on nutrition outcomes of targeted agricultural programs is inconclusive, with the exception of effects on vitamin A intake and status from homestead food production programs and distribution of biofortified vitamin A-rich orange-fleshed sweetpotato (OFSP). It is also stated that: The feasibility and effectiveness of biofortified vitamin A-rich OFSP for increasing maternal and child vitamin A intake and status has been shown; evidence of the effectiveness of biofortification continues to grow for other micronutrient and crop combinations. You also might have heard Britain's Prime Minister David Cameron, in his speech of June 8, 2013, informing his audience that "one scoop of OFSP meets a child's daily Vitamin A needs". He also mentioned specific names of African sweetpotato breeders at this meeting, where for him, science is about harnessing the power of innovation to develop better seeds and more nutritious and productive crops, and that is what you sweetpotato breeders have done by breeding improved OFSP. The Department of Agricultural Research Services (DARS) of Malawi is proud to associate with your success. This week you will be able to visit some of our sweetpotato work on the field day.

Malawi is a friendly country, you are invited to find some time off your busy schedule while you are here to meet the people. I wish you fruitful deliberations. I declare the meeting officially open.

Malawi's Minister of Agriculture and Food Security opened the meeting. In the opening address the minister highlighted the role of agriculture and the increasing importance of sweetpotato in the region, particularly when the potential of the crop is exploited by value addition. The opening event was covered by the national television channel.

The objectives of the meeting in Blantyre were:

a) To update participants on the Sweetpotato Potato for Profit and Health Initiative (SPHI)
b) To provide country reports to inform participants on:
    1) National sweetpotato breeding objectives
    2) Important sweetpotato landraces
    3) Types of trials conducted during 2012/2013 (crossing blocks, seedling nursery, observation, preliminary, advanced, and on-farm)
    4) Number of varieties released since 2009 to 2014
    5) Number of candidate sweetpotato clones in pipeline for variety release
    6) Publications
    7) Supported sweetpotato breeding projects, funding source, amount, duration
    8) Number of scientists and technicians
    9) Research facilities
    10) Constraints
    11) Proposed future activities
c) To update participants on progress on the Sweetpotato Support Platform activities
d) To provide input to graduate students' theses
e) CloneSelector training and introduction to selection indices
f) Discuss Variety release/ clean-up of recent releases and promising clones, use of weather data, and breeding community of practice.

This report, presentations and pictures from the 2014 breeders' meeting can be accessed at the Sweetpotato Knowledge Portal : http://sweetpotatoknowledge.org/germplasm/breeding/2014-breeders-meeting-blantrye

B PRESENTATIONS

1. Looking forward to Phase 2 of Sweetpotato Action Security and Health in Africa (SASHA) and the Sweetpotato for Profit and Health Initiative (SPHI)

Jan Low

The presenter who also leads both SASHA project and SPHI started by giving a background on the linkage between the two by stating that 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 on the other hand is a 5 year project led by the International Potato Center that will develop the essential capacities, products and methods to reposition sweetpotato in the food economies of Sub-Saharan Africa.

The SASHA project was designed to run in two five year phases during which the project was envisaged to lay a foundation for the broader initiative under SPHI. During the first phase the focus was on proving the potential. The specific areas of work during this phase included: breeding by the national programs in 14 countries; pre-breeding work focused on three sub regions; strategic transgenic research in one sub-region; seed systems and integrated crop management; and proof of concept action research in selected countries. As result of the work carried out during this phase, more than 44 sweetpotato varieties (35 of which are orange fleshed) were released.

During the second phase of the project the core focus will be on achieving the potential in which 10 million households are targeted for reach. A key area of work will be on market and nutritional delivery at scale in the 14 target countries. This will be supported by work on seed systems and integrated crop management at scale and breeding systems in the targeted countries. Achievement of the household targets will involve engagement with multiple donors to pool resources to tackle chronic malnutrition that is especially rampant among children. At present, of the 10 million households targeted in the target priority countries, 890,000 have been reached in the three sub-regions with 9 million households still remaining. The sweetpotato varieties that will be used to take the agenda forward will need to be able to meet the expectations of growers and consumers. The varieties will especially need to have virus resistance, drought tolerance, and resistance to sweetpotato weevil.

The new phase of the project (SASHA II) at the time of reporting had been approved by the Bill and Melinda Gates Foundation (BMGF) and had been forwarded to CIP for signing. This approval meant good continuity for the breeding work that had been initiated. The BMGF has proposed a change that SASHA II remains focused on research to solve the remaining bottlenecks. Of the resources allocated to the project, 55% will go into population development, 3% weevil resistance, 13% seed systems research, 7% post harvest management and nutritional quality, and 22% will go towards supporting the community of practice and governance. There will be no delivery system projects during this phase.

Under the objective on breeding the vision is to have sweetpotato breeding programs in SSA working efficiently through conventional breeding to attain genetic gains of 2% annually in selected traits, such as virus resistance and also make use of new heterosis exploiting breeding schemes to attain yield jumps of 10-20% in the next five years and in the process contribute towards developing at least 30 new superior varieties. These varieties will serve producer and consumer needs for food and nutrition security, fresh markets, diversified nutrition value chains, processed products for the expanding urban populations, and animal feed.

It was expected that the targets under the objective of breeding will be met since Alliance for Green Revolution in Africa (AGRA) will continue grant support to sweetpotato breeding through engagement with the national research programs. While it is notable that one of the challenges faced in the target countries has been difficulties in aligning with the priories of the different donors, during the new phase of the project, BMGF has agreed to provide limited support ($20,000 per year) to non-AGRA supported countries, Burundi and Madagascar, to intensify sweetpotato breeding efforts with backstopping from support platforms. Annual *Speedbreeders* meetings will continue but in collaboration with "Genomic tools for genetic improvement in sweetpotato", a project led by NCSU, to ensure that genetic gains or breeding progress become available for sweetpotato across different regions of the world and marker assisted selection (MAS) for sweetpotato virus disease (SPVD) resistance is used in applied breeding programs.

The second objective will focus on achieving weevil resistance. During phase I the target was to come up with a proof of concept that *cry* gene expression in sweetpotato could control the weevil but this has not been achieved so the team tackling the work under this objective have now been allowed one more year to prove this. The team working on weevil resistance has additionally engaged with the University of Ghent to explore the possibility of RNAi silencing technique as an approach to controlling the weevil but additional work still needs to be done on this to demonstrate efficacy of the approach.

The third objective will focus on sweetpotato seed systems to ensure a sustained availability of quality, disease-free planting material, at required quantities and in a timely fashion. The focus here will also be on demonstrating how quality can be cost-effectively managed through appropriate assurance mechanisms and new diagnostic tools. The vision under this objective will be to achieve cost-effective technologies and strategies for both male and female farmers to have improved access to quality planting materials and that there will be at least ten SSA countries with effective pre-basic seed programs at NARIs, supported financially by sales of quality planting material, well-linked to multipliers of basic seed. With this it is envisaged that sweetpotato yields will be enhanced by at least 30% and that factors enabling their integration into a seed system being managed using Quality Declared Planting Material (QDPM) protocols will be understood. To move forward with the work under this objective there will be limited support for 3 years to improve foundation seed systems in Mozambique, Rwanda, Kenya, Tanzania, Ethiopia, Zambia, Nigeria, Malawi, and Burkina Faso, but this work will await the results of Phase 1 hydroponics research. There are indications that AGRA may increase support towards this objective.

The fourth objective will focus on post-harvest management and nutritional quality. The vision of success under this objective is a situation where rural households can cost-effectively store fresh roots for two to six months with key nutritional quality traits sustained; commercially oriented farm organizations can supply fresh roots year round and sweetpotato agro-processors can store sweetpotato puree or concentrate for four to six months without refrigeration and without quality loss, and that regional capacity would exist to support scientists and processors to determine the nutritional content and safety of new varieties and products, and the bioaccessibility of the beta-carotene in the latter. To achieve the vision on this objective research will also focus on larger scale fresh root storage technologies with low energy requirements or those able to utilize energy from renewable sources such as solar. Work will also focus on processing to yield products such sweetpotato puree that can be stored for 4-6 months without refrigeration. The strategy will also aim at making use of facilities such as BecA's (Biosciences in east and central Africa) recently installed modern nutrition laboratory. Through the current phase of the project a technician will be recruited to work in this nutrition laboratory and thus provide support with nutritional quality analyses.

Objective five will focus on sweetpotato support platforms (SSP), knowledge management and governance. The vision of success under this objective is a vibrant and growing sweetpotato community of practice, in which knowledge advances are shared through virtual media and meetings, field visits, trainings and services for key functions of germplasm exchange, virus diagnostics, comprehensive training on sweetpotato. Further, nutritional quality data are available and utilized, and dissemination data are gathered consistently across countries, with policy makers clearly realizing that sweetpotato is a healthy food for all, not just a food for the poor. The new phase will continue building a gender-sensitive, sustainable community of practice, with a focus on engaging younger scientists and practitioners through information exchange at regional technical community of practice meetings and virtual platforms. There will be regional technical support platforms with strong support and backstopping on breeding, germplasm management and nutritional quality assessments. Sub regional meetings will focus on communities of practice on seed systems, markets, processing, monitoring, evaluation, learning or information exchange, and advocacy from the research program experiences and thus jointly contribute to resolving the remaining bottlenecks. To keep track of the progress during the new phase of the project there will be a communications specialist who will additionally be involved in making policy makers aware of the gains made in sweetpotato improvement.

Implemented alongside SASHA II will be projects on delivery systems and dissemination. It is through these projects that resources will be mobilized towards reaching out to the target farming communities. A few of such projects have been funded or are about to be funded. One such project is Scaling Up Sweetpotato through Agriculture and Nutrition (SUSTAIN). The SUSTAIN project targets to reach by 2018 some 1.2 million new households in Kenya, Malawi, Mozambique and Rwanda. Overall the dissemination focused work is expected to reach some 1.8 million households by end of 2016 through the activities of different partners working in Malawi, Mozambique, Zambia, Nigeria, Ethiopia, Uganda, and Tanzania indicating that the SPHI through the multi-partner approach has potential to reach the desired targets.

During a discussion that followed the presentation, Malawi's Director for Agricultural Research Services expressed the country's willingness to be part of the initiatives. One of the questions that arose was how to standardize protocols and bring the national program up to speed so that they effectively contribute to the envisaged synergies. To address this question it was proposed that the sweetpotato support platforms would help with this, but it would be important to factor in transfer costs in budget to cater for this. Additionally it was proposed that alternative protocols be assembled and availed for those lacking equipment such as that needed for freeze drying but a caution was that freeze drying was mandatory for better nutritional quality (beta-carotene) retention in sweetpotato samples. A clarification was also sought on whether through the project the partners could directly have their nutrition specialists work directly with BecA to carry out analyses on the parameters of interest. In response to this it was suggested that this would only work better once the bench fees were negotiated with BecA the relatively high bench fees currently charged.

2. COUNTRY, REGIONAL SUPPORT PLATFORM REPORTS AND PANEL DISCUSSION

2.1 Breeding and Seed Systems in Southern Africa

Maria Andrade

The major objective of the breeding work in the region is to generate drought tolerance, orange-fleshed sweetpotatoes that combine different quality characteristics with significant improvements in yielding ability. The main objective of the seed system work on the other hand is to establish community based seed systems for good quality seed dissemination and to develop and test strategies for the multiplication and dissemination of sweetpotato varieties.

Several projects, including SASHA, USAID Bilateral, RAC, Beira Corridor, SUSTAIN, Irish Aid, VISTA have been implemented or are undergoing implementation in the region to address components of the target objectives.

On the breeding work undertaken the major achievements up to date include:

1. Two genetically separate populations developed with new drought screening techniques;
2. First recurrent selection cycle for drought stress adaptation in two independent controlled cross populations in Mozambique by an accelerated breeding scheme (ABS) achieved in 2011;
3. Drought adapted population disseminated as true seed (half-sib) to NARS breeding programs to 12 SSA countries in June 2011;
4. 15 drought tolerant varieties released in 2011;
5. More seed distributed in 2013 (total of over 45,000) to 11 countries;

The crossing blocks remain active and generate seed for distribution. Between 2009 and 2013, 349 field trials were established especially towards release of new varieties and a further 457 on-farm trials were also carried out. For the same reporting period 528,910 seeds were collected and 84,529 clones evaluated resulting in the release of 18 varieties.

During the reporting period, (July 2013 to June 2014) 60 breeding trials were planted and a total of 139 on-Farm trials planted and 48 breeding trials harvested. About 134 advanced clones were multiplied to establish four multi-location trials and many on-farm trials for more varietal release in 2014 and 2015. In 2013 a total of 2,781 sweetpotato seeds received from Uganda for heterosis study were successfully germinated and rapidly multiplied in the field in readiness for the establishment of the planned heterosis trial in July 2014. A total of 51,135 polycross and 11,373 controlled cross seed were harvested from two sites and some of this was shared with the research partners. For 2014, 13,000 crosses were made in Gurue and 3, 400 crosses at Umbeluzi and seed harvesting from these crosses had commenced at the time of reporting. At the time of reporting there were about 200,000 seeds from controlled crosses and polycrosses ready for distribution. During the same period over 14000 freeze-dried samples were scanned using NIRS and 434 clones selected using results from the NIRS analysis.

For the period 2010-2013 sweetpotato vines were multiplied on-station on 62.7 hectares and 278 decentralized vine multipliers each in contact with 169 farmers were engaged. Through this arrangement 2,357,730 kilograms of vines were produced benefiting 341,269 households. For tissue culture during the same period 22896 plantlets were produced from 94 clones.

Presently plans are under way to upgrade tissue culture facilities to attain ISO-Standard 17025 compliance for germplasm indexing and distribution. This task will entail an audit of the diagnostics, reformulation of all the procedures and drafting recommendations for future work related to quality management; rearranging and reworking tissue culture protocols and virus detection, thermotherapy, virus indexing. Protocols for internationally exchanged germplasm will also be reworked. The focus will also be on upgrading of in vitro facilities and skills of tissue culture staff at SSP level to ensure safe reception and sending of in vitro and true seed material. Screenhouse technicians will be trained and a manual for training on quality produced.

Additional work at the sweetpotato support platform during 2009-2014 focused on information exchange, training or capacity building and knowledge management. With respect to capacity building 3857 farmers (2414 female) were trained on production, processing, vine multiplication and data management while a further 159 farmers (74 female) were trained on agro-processing. A total of 757 technicians (302 female) were given short term training during the same period.

During a discussion on the presentation a question arose on how information is managed for each trial undertaken to which a response was made that the information on the trials conducted and selections made are kept and tracked using clone selector and excel. Additional questions were on whether there was passport information on the released varieties and how the 15 released varieties were integrated into the farming systems given considerations such as seed systems. In response to these questions the presenter clarified that the released varieties were selected from over 200,000 clones and that through a participatory process farmers were involved in the selection of the varieties. In response to another question on how the pipeline clones were trialed, the presenter clarified that the trials were undertaken in the important agroecological zones.

2.2 Summary of sweetpotato breeding progress for the East and Central Africa Support Platform 2009-2014

Robert Mwanga

The main objective of the sweetpotato breeding work at the East and Central Africa Support Platform is to breed new populations with new methods and varietal development. The target is to generate radically expanded range of sweetpotato varieties that combine different quality traits with significant improvements in yielding ability. An additional target is to generate by population improvement new populations for users' major needs including sweetpotato virus disease (SPVD) resistance (for East Africa) and also important traits such as high beta-carotene content, and dual purpose types for animal feed. Among the new breeding methods used include heterosis and molecular markers in the breeding for virus resistance. Another objective has been to redesign the sweetpotato breeding systems in the region to produce varieties in 3-4 years instead of the current 7-8 years through an accelerated breeding scheme.

As part of the effort to develop populations for SPVD resistance and quality traits, two distinct gene pools (Population Uganda A and Population Uganda B) were developed using 18 SSR molecular markers.

Polycross crossing and controlled inter- and intra-gene-pool crosses for population improvement and between susceptible by less susceptible/resistant crosses and resistant by resistant by resistant are in progress. A total of 64 crosses were made for the inter-gene pool crosses and 56 intra gene pool crosses were made for the two gene pools.

At present preliminary trials involving 41 clones are on-going at three sites in Uganda (Namulonge, Serere, and Kachwekano). A trial on new sources of SPVD resistance with 81 clones obtained from a population developed in Lima is also on-going at the three sites. A total of 2686 clones targeted for dual purpose and high altitude areas are also being evaluated the three sites. A preliminary study to compare the selection efficiency associated with polycrosses (209 clones) and controlled crosses (277 clones) is also on-going at the three sites.

The focus on SPVD resistance is considered crucial for sweetpotato productivity improvement because the disease which is vectored by white flies and aphids causes yield losses of between 50 and 90% especially in the East Africa region. In the evaluation of clones for resistance to the disease methods ranging from visual symptom scores to real time quantitative PCR are used.

The East and Central Africa support platform is also tasked with maintaining collaboration with partners such as the AGRA. In the partnership the platform works with AGRA and national research program partners to develop and secure financing for projects on sweetpotato improvement in the AGRA target countries. At the time of reporting the status of national program AGRA funded projects under the collaboration were as follows: a) Proposals from Malawi, Rwanda, Tanzania, Kenya, Nigeria, Zambia and Mozambique had so far been supported with the projects from Malawi, Tanzania and Rwanda having expired and were due for renewal while Mozambique's had been renewed; b) The proposal from Uganda had recently been approved while that from Ghana was in the process of being submitted; c) The proposal from Burkina Faso was under review and one PhD from Burkina Faso had also been supported by AGRA at the West African Center for Crop Improvement (WACCI), Ghana; d) Two separate projects from Kenya had also targeted funding from AGRA with the first of the two projects having received funding before the start of SASHA and at the time of reporting was in the second phase while the second project had been rejected.

Focus of the East and Central Africa (ECA) support platform has also been on improving the capability of the CloneSelector statistical analysis software. Work during the reporting period had seen inclusion of: augmented and alpha designs, b) the genotype-by-environment biplot (GGE biplot), and c) two multi-trait selection procedures (Elston index and Pesek & Baker index) had been included. At the time of reporting sweetpotato breeders (21) and technicians had been trained from 14 countries: Malawi, Rwanda, Tanzania, Kenya, Ghana, Uganda, Ethiopia, Mozambique, Burkina Faso, S. Africa, Nigeria, Liberia, Zambia, and Madagascar.

Through work at the ECA support platform, a catalogue of released OFSP varieties had also been updated. The catalogue has pictures and the data collected for all OFSP varieties released since 2009. Some of the countries and their contributions to the catalogue are as follows: Mozambique (15), Rwanda (2), Malawi (4), Tanzania (2); Uganda (2), Ghana (2), Nigeria (1) and Zambia (3).

The sweetpotato varieties released in the different countries with the support of the platform are summarized in Table 1. Two of the OFSP varieties released in Kenya and one in Mozambique were first released in Uganda. An application had been filed for release of three varieties in Uganda. So far 84 varieties (36 of which are orange-fleshed) had been released in the SASHA focus countries since 2009.

Table 1. Summary of sweetpotato variety releases in SASHA focus countries in the decade preceding the SASHA project (1999 -2008) and 2009-2013 when the project was implemented.

Country	**Number of varieties released**		
	1999 to 2008	**2009 to 2013 (Orange flesh)**	**Total**
Ethiopia	10	0(0)	**10**
Ghana	0	4(2)	**4**
Kenya	5	7(5)	**10**
Malawi	6	7(5)	**13**
Mozambique	12	20(15)	**31**
Nigeria	3	5(2)	**8**
Rwanda	8	11(2)	**19**
S. Africa	11	18(5)	**29**
Tanzania	6	7(2)	**13**
Uganda	19	3(2)	**22**
Zambia	7	5(3)	**12**
Total	**87**	**84**(36)	**171**

Additional work at the support platform had also focused on identifying suitable approaches for rapid and clean multiplication of foundation material especially released varieties targeted for dissemination. One of the approaches tested was the sand hydroponic system. In this system sweetpotato plants were grown in a screenhouse on a sand medium to which nutrient solution containing macro and micronutrients were supplied by way of drip irrigation system. This system was compared with sweetpotato plants grown in soil-filled plastic pots (with no nutrient amendments) in the same environment and also compared with field grown plants. Results showed that while vine multiplication was faster in the hydroponics system compared to the pot grown plants the multiplication rate in the field was fastest. Based on the results that had had been obtained it was noted that the hydroponic system had the potential to produce clean stocks at low costs (compared to tissue culture). However the multiplication rates in the sand hydroponics was still low and therefore an optimization of the growth conditions was needed. Additional work was also need to establish the economics of the system under local conditions.

The major lessons learned during implementation of work at the support platform were:

a) Changing venue for annual breeders' meeting and training exposed breeders to different methods, conditions, and challenges, thereby enhancing the community of practice.
b) The CloneSelector program requires follow-up training in-country to get consistent use.

2.3 Report of the Sweetpotato Support Platform for West Africa

Ted Carey

The objective of the platform in West Africa is to be involved in sweetpotato population improvement at the sub-regional level and also to link with participatory varietal selection at the national level. The focus is SPHI target countries, Ghana, Nigeria, Burkina Faso, and Benin. The SASHA project had supported breeding, germplasm distribution, and platform partnerships for research for development and impact.

Sweetpotato selection is done at several sites in Ghana. The sites are Ashanti region within Forest agroecological zone; Central and Volta regions within the Coastal Savanna agroecology; and the Upper East region within the Guinea/Sudan Savanna agroecology. The production constraints experienced within these regions include: drought (which is worse in Savanna agroecological zone; SPVD which is more serious within the forest zone; low soil fertility in most places; and sweetpotato weevil.

In the breeding program in West Africa the target is less sweet quality but the other challenges such as SPVD, drought, low soil fertility are also important. the program has adopted an accelerated breeding scheme where from the time crosses are made to the time a variety is released is four years. In 2014 there were 14 breeding trials in Ghana. Ten of the 14 trials were implemented as part of activities under the SASHA project.

The program is currently moving toward:

- Having more than one selection cycle per year (dry season seedling nursery; possibly trials)
- Having two populations, A and B, in order to exploit heterosis in coming years
- A separation of early and later-maturing material at PT in order to ensure advance of OFSP
- A strengthened breeding capacity in northern Ghana through expansion of ATs and OFTs linked to seed program
- Carrying out a recurrent selection of breeding populations while also identifying good parents

Among the activities undertaken at the West Africa sweetpotato support platform include rapid proximate analysis for minerals, sugars and β-carotene done using NIRS. Barcode Labels and PDAs are also used in the research activities undertaken. The program has also focused on capacity building through which nine students have so far been trained in various fields of relevance to sweetpotato including breeding, agronomy and food science.

The West African program is also focused on seed systems research since clean foundation seed is integral to success of the breeding efforts. The objective of the work in this area is to establish a regional platform for safe and efficient exchange and maintenance of germplasm. To achieve this objective the focus is on: improved indexing, virus cleaning, in vitro maintenance and genetic fingerprinting in each sub-region; attainment of ISO 17025-compliant germplasm indexing and distribution capacity; and upgrading in vitro facilities and tissue culture staff to ensure safe receipt and shipment of germplasm.

An additional work for the West African program is on a project that seeks to jumpstart OFSP in West Africa through diversified markets. The three year project which is being implemented in selected areas in Ghana, Burkina Faso and Nigeria seeks to test the hypothesis that it is possible to simultaneously develop value chains for OFSP and maximize nutritional benefits to vulnerable populations. The outcomes that are sought in this project are:

1. Institutional and other diversified market opportunities for OFSP developed in project pilot areas in Ghana, Nigeria, and Burkina Faso.
2. Commercial seed system functioning in target areas and capable of expanding in response to increased demand.
3. Most at-risk households and individuals in target areas have increased vitamin A intakes.
4. Commercial sweetpotato seed and root farmers benefit from participation in OFSP value chains.

As a reaction to the presentation a concern was raised that early maturing sweetpotato varieties are challenging with regard to maintaining the seed system or vines once mature. Several comments were in response to the concern on earliness. These were:

- Much more of current advanced breeding materials are early maturing (about 30%). Earliness is a priority where it is useful otherwise it may be more important to focus on the priorities
- Selection for early maturing varieties calls for earlier evaluation. This would also help to avoid double trials.
- Storage roots are set 15-30 days after planting based on the ontogeny of SP and this affects the final outcome
- Early maturity is very important but there is need to look for the indicators for yield and not wait for 90 days or the target period. Alternatively one could consider having larger plots that would allow for sampling for yield trends

2.4 Discussion on sweetpotato storage and processing

Panelists: Kwadwo Adofo, Abidin Ernawati, Sunette Laurie, Jean Ndirigue

This discussion was held in view of the fact that low storability remains a challenge to sweetpotato farmers. The discussion was preceded by two presentations. The first presentation was by Ted Carey and it entailed a sharing of thoughts on breeding for storage and processing. In the presentation previous work on shelf life was reviewed and some areas that could be further pursued from the perspective of plant physiology and breeding pointed out. The second presentation was made by Abidin Ernawati and it focused on a project ''Breaking postharvest bottlenecks: Long-term sweetpotato storage in adverse climates''. The project is on-going in Malawi is looking at different storage methods such as Afghanistan ventilated pit storage, ladder pit storage and storage under a grass thatched granary. To monitor quality of the stored produce and the study has incorporated periodic consumer testing of the stored roots.

There were many reactions and comments on the topic of discussion. Some of the comments and reactions are summarized as follows:

1) Breeding programs need to be guided by user or industry requirements and in this case there is need to focus on improving sweetpotato for storability
2) Storability is a heritable trait but it is very complex. It is related with dry matter content, cleanliness from pathogens, and disease resistance. Current breeding programs that have focused on the problem do not use complex ways of evaluating for the trait in the clones of interest. The approach often adopted is simple and involves storing roots of the clones of interest and then evaluating them after a period of time. However, there is need to develop other simple assays that could be used during evaluation for this trait.

3) The challenge to breeders is how to link storability to root characteristics including quality analysis attributes such as those currently analyzed using the NIRS technology. The focus should be on building tools that would help in selecting for better storability. However, if use of the NIRS technology would be explored for this purpose then there would be need for investment to hire a biochemist who would look at the key biochemicals of importance for the trait. Knowledge about these biochemicals would help with calibration of NIRS as a tool for evaluation of the trait.
4) That while storability is a heritable trait and that clonal differences with regard to the trait have been noted to exist, there is need for a standardized approach that could be used in evaluation of the trait.
5) There is need for investment on infrastructure for sweetpotato storage and processing that growers could make use of. This could be large projects undertaken by governments for use by the farming communities as had been seen in South Africa
6) There is a need to look into low input technologies that would be easily adopted by the target groups.
7) The focus on improving fresh root storage should not stand alone but should be linked to tmarkets and processing. Processing sweetpotato into other forms could also help in addressing the challenge of storability. However, the processed products should have a long shelf life.

2.5 Sweetpotato breeding progress in Burkina Faso

Some Kousao

The objective of the breeding program in Burkina Faso (BF) is to develop high yielding, early maturing and drought tolerant sweetpotato with potential to address malnutrition. The most important landraces in the country are Saafare, Patate, Nakalbo, Tiebele-2, and Woswoule. These landraces mature in about four months and yield between 10-25 tons per hectare and have dry matter ranging from 25-32%. Only Tibele-2 is orange-fleshed. The most important bred orange-fleshed varieties are BF92*CIP-6, BF59*CIP-4, BF59*CIP-1 and BF59*TIB-6. The bred varieties have root yield ranges of 13-18 tons per hectare with dry matter content ranging from 22 to 27%.

During the current reporting period (2013-2014) the program has planted 25 clones in a preliminary yield trial at five locations in the country. Currently, the national breeding program has eight promising orange-fleshed lines which are early maturing (110 days to reach physiological maturity) which are targeted for release in 2015. In addition, seven non-orange fleshed lines have also been identified for possible release. These varieties are also resistant to SPVD. Introgression of SPVD resistance into local popular varieties was were started in 2009/10 season with the establishment of a crossing block.

All data is analyzed in SAS, GenStat and CloneSelector depending on objective.

Currently the sweetpotato seed system is not organized and informal in Burkina Faso. Present vine multiplication work is done in collaboration with NGOs such as CRS and NAFASO. Farmer groups are also involved in vine multiplication and the Ministry of Agriculture is responsible for vine distribution among sweetpotato farmers in Burkina Faso.

The breeding team has three papers published during the reporting period. One of the publications is the breeders PhD thesis.

Sources of funding for activities undertaken by the country's program during the reporting period included: AGRA (USD$25 000 per annum), CRS/BF (USD$11 000 per annum) and PIGEPE-IFAD (USD$43 000 for six months). The national program is currently seeking for funding of USD 177,500 from AGRA to support the work, but the application remains pending with AGRA since March 2014.

Major constraints faced by the Burkina Faso national breeding program include:

1. Current level of funding is inadequate to do wide scale vine multiplication and research
2. Problems of maintenance of planting material during the dry season
3. Availability of vines during planting season does not meet the demand of planting material.

A question was raised to understand whether there is variety release procedures followed in Burkina Faso. There is a committee which is responsible for assessing the proposed varieties under field conditions for two seasons. Normally the breeder has to plant the varieties and invite the committee members for assessment.

The program plans to secure funding from AGRA and work on market diversification to encourage use of a wide set of sweetpotato varieties which are to be released. The variety release process in Burkina Faso takes two years once all data is available.

2.6 Discussion on SSA regional sweetpotato germplasm characterization using DNA fingerprinting

Ted Carey (Lead discussant)

The participants were informed that the global genebank at CIP was in the process of establishing a core collection of sweetpotato. By definition a core collection (usually 300 – 400 germplasm) is a representative sample of all the germplasm in the genebank and is usually determined by diversity analysis using molecular markers but phenotypic characterizations from curators also help in developing core collections. Usually, 10% of the total collection makes the core collection. At the time of the meeting, the list of germplasm to be included in the core collection had not been assembled and the criteria to be followed in selecting the germplasm to include had not been shared. With a focus on sweetpotato being central to participants at the meeting, the planned work on assembling the core collection was shared so the participants could raise issues that they considered critical to this activity.

A major concern in the discussion that followed was a feeling that sweetpotato germplasm from Africa was not adequately represented in the global collection held by CIP in Lima. This situation had been partly attributed to phytosanitary requirements (quarantine requirements) for seed or planting material movement from Africa to Peru.

It was noted that it is important that CIP genebank continues to maintain the diversity of SP and also to disseminate the most important material for breeding and production. With regard to the assembly of the proposed core collection it was suggested that breeders in Africa (majority of whom were participants at the meeting that is the subject of this report) make a list of maybe 200 clones of importance in breeding and also to make a list of the important traits. The group would then play an active role in the planned exercise by proactively making submissions on what they considered priorities in Africa and then sharing (through various means including email) this with the leadership of the genebank at CIP. It was further suggested that the gathered group of swetpotato breeders form small committees that would look at the priority issues and communicate the same with the CIP genebank. The small committees were proposed to be built around the sub-regions.

There were many reactions and comments on the topic of discussion. Some of the comments and reactions are summarized as follows:

1) It would be necessary to do an assessment of diversity which can then guide the prioritization of genotypes to include in the collection. An alternative suggestion was that previous molecular data be used for this purpose.
2) Considering challenges related to quarantine issues, sampling of DNA was proposed as an alternative to facilitate analysis of the target clones.
3) The thinking process was noted to have the potential to also contribute to germplasm flow in the region and could build to support the current plan to have KEPHIS in Kenya to keep the 100 best bets of sweetpotato. This would contribute to the idea of a genebank platform in Africa for Africa. The clones maintained at KEPHIS should also be kept at CIP at the global genebank for more security and also facilitate movement of materials in and out of the continent.
4) That the limitation has been lack of funds but the materials currently in Africa are different from what is in other places. But this needs urgent attention since some landraces are getting lost fast through field maintenance. Perhaps to get the materials cleaned up there would be need for some fundraising to support the effort towards the conservation. This effort was deemed as very important for the national programs.
5) That there should be African material in the core but in the core there is not much space and there could be space for just over 50 collections from the continent. So the next question would be what would be the top priorities? As this is considered it would be important that breeding materials are also included among the submissions. That alleles are represented is important consideration.

2.7 Progress of sweetpotato breeding in Malawi

Felistas Chipungu

With respect to objectives the national sweetpotato breeding program in Malawi is mandated to develop varieties that:

1. Give high and stable yields (≥20 t/ha) per unit area and time
2. Are resistant/tolerant to major and prevalent diseases (SPVD and Alternaria) and sweetpotato weevil (SPW) in Malawi
3. Give desired root quality colour (white, cream, yellow, orange) to meet local cooking and consumption requirements (high dry matter content, sweetness)
4. Wide and specific adaptability to environmental conditions and cropping systems
5. Contribute to vitamin A source

The most important landraces in the country and their productivity per hectare are: Zondeni (8-16 t/ha), Yoyera (3-7 t/ha), Kamchiputu (3-7 t/ha), Babache (5-7 t/ha) and Mfumu. The dry matter ranges from

32-36% while flesh color ranges from light orange to white with the exception of Zondeni which is orange-fleshed. The most important bred varieties in the country, include Sakananthaka, Lunyawanga, Nyamoyo, Sungani, Anaakwanire, Mathuthu, Kaphulira, Chipika and Kadyaubwerere. Anaakwanire, Mathuthu and Kadyaubwerere are orange-fleshed and yield 25-30 t/ha.

During the 2012-2014 period the program established a crossing block that at present has 39 parents from which 16000 open pollinated seed (from 20 families) was collected in 2012/2013. During the period 2013/14,369 clones (235 orange) were planted as part of observation trials planted at two sites. During the same period 43 clones (17 orange) were planted in a preliminary yield trial at two locations while another 30 clones (17 orange) were planted as part of advanced yield trials at four locations. The program makes use of CloneSelector and Genstat for data analysis. There are three clones that are in the pipeline for release in 2014.

During 2009-2014 the program filed for release of some of the bred sweetpotato varieties. An available variety release document is detailed as follows

> *F Chipungu, T Mkandawire, I Benesi, P Pamkomera, O Mwenye, E Abidin, M Andrade, M Chiipanthenga, Paul Demo, A Mtonga, M Mantchombe and S Chilungo. 2011. Proposal to release LU06/0146, LU06/0252, LU06/0527, LU06/0428, BVU07/028, BV07/008 and BV07/016 sweetpotato varieties in Malawi. A paper presented to Agricultural Technology Clearing Committee. Ministry of Agriculture and Food Security*

During the reporting period the program also produced several publications including:

a) *Chipungu F, F Chipojola, M Maliro, AO Maluwa, J Njoloma, R Chimsale, I Benesi and M Chiipanthenga Innovative and biotechnology approaches for increased sweetpotato productivity along the value chains in Malawi. 2013. A poster presented at the Regional Agricultural and Environmental Innovations Network-Africa (RAEIN-Africa) International Conference entitled "Innovation Systems for Resilient Livelihoods: Connecting Theory to Practice." Johannesburg, South Africa, 26-28 August 2013*
b) *Chipungu FP, T Mkandawire, M Chitete1 IR Benesi, P Pamkomera, O Mwenye, EP Abidin, M Andrade, W Gruneberg and M Chiipanthenga. 2013. Speed breeding and variety release for orange fleshed sweetpotato cultivar diversity in Malawi. Proceedings of the 12th Triennial Symposium for International Society for Tropical Root Crops-Africa Branch, Accra, Ghana, 30th Sep to 5th Oct 2013. In press*
c) *Chipungu FP, T Mkandawire, MJ Chitete, IR Benesi, P Pamkomera, OJ Mwenye, EP Abidin, M Andrade, W Gruneberg and M Chiipanthenga. 2013. An analysis of genetic gain for sweetpotato root yield, varieties released and adoption in Malawi. A poster presented at the 9th Triennial African Potato Association (APA), Naivasha, Kenya, 30th June to 4th July 2013*
d) *Chipungu F., G Wolfgang et al. Breeding of efficient varieties for the changing environments in Malawi- an analysis of variance to predict selection of stable genotypes for root yield. Plant genetic resources. 2014*

The activities of the program which has seven scientists and 16 technicians have been funded by the Malawian government and AGRA. At the time of reporting the program was looking forward to renewal of funding by AGRA to support dissemination of the newly released varieties.

2.8 Rwanda Sweetpotato Breeding progress

Jean Ndirigwe

The objective of the sweetpotato breeding program is to develop sweetpotato varieties with:

a) High yield for dual purpose use (roots and animal feed)
b) Quality traits (mainly high drymatter, rich in beta-carotene**,** skin and flesh color). The preferred skin color is red which apparently farmers associate with some other good traits they had experienced with other varieties.
c) Resistant to pests and diseases (SPVD and *Alternaria)*
d) Suitable for specific or wide adaptation, and with farmer preferences)

There are three selection sites in the country. The selection sites are located within three agroecological zones high, mid and low which respectively are 1850-2450, 1650-1850 and 1350-1650 meters above sea level.

The strategy adopted by the program involves:

a) Collecting, evaluating and selecting from local germplasm.
b) Introducing promising genotypes from other countries/ NACRRI and evaluating them
c) Development of new sweetpotato varieties using an accelerated breeding scheme that involves more parents, more controlled crosses and a rapid selection scheme with the participation of farmers in the country.

Sweetpotato landraces include: Karibunduki, Mubiriwigisabo, Kigande, Mpakanjye, Mamesa II, Ndamirabana, Rukoma, Imbyo and Rukubikondo. The flesh color in these landraces range from yellow to white and yield 14 to 22 t/ha. The dry matter content ranges between 34-37%. At least ten varieties (three of which have dark orange flesh) have been released in the country. The orange fleshed varieties are: Cacearpedo, Gihingamukungu and Terimber/RW11-2560.

During the 2014 period, the program had a crossing block with 60 parents. A total of 2400 seeds from open pollinated crosses representing 60 families were collected. An additional 13500 seeds from controlled crosses representing 81 families were also collected. During the period observational trials with 452 clones were established at three locations. Preliminary trials with 125 clones were similarly been established at three locations. Advanced screening trials with 32 clones were also established at three sites. A total of 32 on-farm trials were also conducted across the country. The program makes use of Clone Selector, R and Genstat in data analysis. During the period 2009-2014 eight varieties, including three OFSP were released. Currently three varieties (two orange) are in the pipeline for release.

For sweetpotato foundation seed system, the program in Rwanda has four laminar flow benches and 12 cultivars are maintained in tissue culture. There are two screenhouses but one needs repair. About 1150000 vine cuttings are distributed every year. The program is linked to vine multipliers for further vine multiplication. The multipliers include: Rwanda Agriculture Board – RAB (50%), NGOs (15%), farmers with net tunnels (10%), pilot farmers (5%) and seed multipliers (10%).

The program which has a total of 10 full time staff (three with MSc degree) and has been supported by the Rwanda government and AGRA. The AGRA grant expired in 2013 and effort to get the project renewed is underway.

2.9 Breeding and promotion of sweetpotato genotypes for consumer preferred traits in time and space in Zambia

Martin Chiona

The objectives of the program in Zambia is to develop and select high yielding sweetpotato varieties with consumer preferences focusing on high dry matter and beta-carotene content. The focus is also on developing and selecting high yielding vegetable clones for consumers and on building the capacity of stakeholders in the production, seed multiplication and plant protection of sweetpotato.

The important landraces in the country include: Matembele. L2-20/5, Carrot, L4-138/3, and Unknown 2/1. The most important bred varieties in the country are Muluhgusi, Chingowa, Lukulu, Lunga and Zambezi. Only Zambezi is orange-fleshed but is comparatively low yielding (15 tons per hectare) and is low in dry matter.

The program has established a crossing block with 30 parents. A total of 7303 seeds previously harvested from the crossing block were planted in a seedling nursery with 2500 seedlings representing 89 families successfully establishing. Twenty two clones were planted at two locations as part of preliminary yield trials. Thirty five on-farm trials were also conducted across the country. The program makes use of CloneSelector and Genstat in data analysis. Five clones (four orange) are lined up for release in 2014.

The program is currently supported by AGRA to the tune of USD 185,000 for three years but this is now due for renewal. The program has five scientists (2 PhD) and four technicians.

The program faces challenges including lack of laboratory facilities for quantifying quality traits and virus indexing and cleaning. There is also a challenge with collaboration.

As a reaction to the presentation, a clarification was sought on why there was low seedling establishment in comparison to numbers planted. It was pointed out the number was very low and could lead to loss of important clones. It was recommended that the team consults with other breeders to get higher seedling germination and establishment and a suggestion was made that instead of 10 minutes for scarification the period be increased to 30 minutes and increase the time for soaking in the acid if the germination remains low.

2.10 Progress on sweetpotato breeding in Mozambique

Jose Ricardo

The objectives of the sweetpotato breeding program in Mozambique are

a) Develop, select and release sweetpotato varieties of white and yellow fleshed color with high yield, high dry matter and resistant to pests (weevils) and diseases (SPVD) and also drought tolerant for farmers in drought-prone areas in southern Mozambique

b) Increase availability of OFSP vines for farmers to mitigate the effects of droughts, floods and minimize the effects of vitamin A deficiency with the introduction of new OFSP varieties that are drought tolerant

Some of the important sweetpotato landraces in the country are: Xipone, Xitsekele, Mwamazambane, Nhacutse4, Canassumana, Cincominutos, Ligodo, Manhissane, Xiadlaxakau and Chulamete. The most important bred varieties in the country are Irene, Ininda, Sumala, Bela, Lourdes, Delvia, Esther and Namanga. The program established a crossing block with 68 parents from which 143,046 open pollinated seed were collected during the 2013/14 period. During the same period 8281 seeds were planted and 7204 were established and represent 125 families. a total of 2725 clones were planted in 2013/14 at two locations as part of observation trials. For preliminary yield trials, 324 clones were planted at two locations while for advanced yield trials 44 clones were planted at three locations. The program makes use of Genstat, CloneSelector, SAS and Plabstat for data analysis. Sixteen clones are in the pipeline for release by October 2015. None of the pipeline clones are orange.

The program also focuses on seed systems for disseminating sweetpotato newly released sweetpotato varieties. Currently the program has linkage to various vine multipliers, including government institutions (40%), NGOs (20%), farmer multipliers (35%) and others such as schools (5%).

At the time of reporting, financial support for this program came from AGRA which has since 2012 supported the program with USD 219,400 up to 2015. The major constraint the program faces is understaffing (only one MSc and a BSc). There is also the challenge of drought, floods and supplies.

2.11 Kenya Country Report: Progress in Sweetpotato Breeding 2009-2014

Laura Karanja

The overall objective of the sweetpotato breeding program in Kenya is to improve the livelihoods of the rural population by enhancing the sweetpotato value chain. The specific objectives are:

1. To increase capacity to develop and release improved orange fleshed sweetpotato varieties in Kenya with desired attributes through farmer participatory selection
2. To develop high yielding drought tolerant varieties
3. To develop dual purpose cold tolerant varieties
4. To increase farmer knowledge to adopt new improved sweetpotato varieties
5. To develop linkages with seed multiplication groups

Important landraces in the country are Bungoma, Sinia, Nyathi-Odiewo, Cunny and Namunyekera. All these landraces are either white or yellow. The most important bred varieties that have been released in the country are: Kenspot 1, Kenspot 2, Kenspot 3, Kenspot 4, Kenspot 5, Cunny and Namunyekera. Kenspot 4 and Kenspot 5 are orange-fleshed.

The program has established a crossing block that at the time of reporting had 34 parents from which 6940 open pollinated seed had been collected. In 2013/2014 7907 seedlings representing some 99 families had been established following the planting of 12342 seed. About 8050 clones had also been planted as part of an observation trial at two sites while another 260 clones were planted in a preliminary trial at five sites. Twenty six clones planted in an advance screening trial at three sites. There were 33 on-farm trials across the country. Since 2009 14 varieties (nine orange) had been released. Five clones (two orange) were in the pipeline for release by 2014. It takes about one year to release variety in the country once data is available.

The program also has an established sweetpotato foundation seed system in place and distributes 600,000 cuttings every year. The program has linkage to various vine multipliers including government institutions such as other KARI centers, Ministry of Agriculture and Universities. These act as primary nurseries and account for 30% of the linkages. There is also linkage with the NGOs (60%) and farmers (10%).

The program has been funded by AGRA since 2007 with a renewal for a second phase from 2011 with an additional USD 150,000. At the time of reporting AGRA had additionally funded the team for seed multiplication of the five newly released varieties under the project.

Several papers have been published through the program. Some of the publications are:

1. Agili S, Nyende B, Ngamau K, Masinde P (2012). Selection, Yield Evaluation, Drought Tolerance Indices of Orange-Flesh Sweet potato (*Ipomoea batatas* Lam) Hybrid Clone. J Nutr Food Sci 2:138. doi:10.4172/2155-9600.1000138
2. A.W.Gichangi**,** S. Y. C. Essah, R. N. Mbogo, J. G. Wamuyu and C. N. Macharia (2012). Sweet potato marketing and estimation of postharvest losses in Kenya. CROP RESEARCH, 43(3)
3. E. W Macharia, J.N. Malinga, L. Karanja, J.N. Ndungu, D.K Lelgut and A.W.Gichangi (2009) Occurrence of Sweetpotato cultivars in the High Potential Highlands of the Rift valley. African Crop Science Society Conference Cape Town 28th September to 1st October 2009.
4. Gichangi A.**,** Ngigi M., Njehia B.K., Karanja L., Macharia N. (2010). Analysis of structure – Conduct - Performance of Sweetpotato Marketing: The Case of Nairobi and Kisumu, Kenya. 8th Triennial Conference of the African Potato Association, Cape Town, South Africa. 5th to 9th December 2010.
5. Gichangi A, Ngigi M., Njehia B.K., Karanja L., Lelgut D.K, Malinga J and Macharia C.N.(2009). Sweetpotato markets in Kenya: assessment of structure conduct and Performance. 1st All Africa Horticulture Congress Association of Agricultural, Safari Park Hotel, Nairobi, Kenya, August 31st – September 3rd, 2009.
6. Gichangi A, Ngigi M., Njehia B.K., Karanja L., Lelgut D.K, Malinga J and Macharia C.N.(2009). Sweetpotato markets in Kenya: assessment of structure conduct and Performance. 1st All Africa Horticulture Congress Association of Agricultural, Safari Park Hotel, Nairobi, Kenya, August 31st – September 3rd, 2009.
7. Karanja L., Malinga J., Nyaboga E., Ndung'u J(2008). Virus screening in sweetpotato germplasm for Central Rift Kenya. Proceedings of 11th KARI Biennial Conference and the 3rd Agricultural Forum. 10-14th November, 2008. KARI HQ, Nairobi, Kenya.
8. Kivuva, B.M., S.M. Githiri, G. C. Yencho, J. Sibiya, (2013). Mitigating negative drought effects on sweetpotato productivity through tolerant cultivars in Kenya, APA 2013 abstract.
9. Kivuva, B.M., S.M. Githiri, G. C. Yencho, J. Sibiya, (2014). Genotype x Environment Interaction for Storage Root Yield in Sweetpotato under Managed Drought Stress Conditions; Journal of Agricultural Science, Accepted – awaiting payment of publication fees
10. Kivuva, B.M., S.M. Githiri, G. C. Yencho, J. Sibiya, (2014). Combining ability and heterosis for yield and drought tolerance traits under managed drought stress in sweetpotato, Euphytica Accepted for publication with minor corrections

11. Kivuva, B.M., S.M. Githiri, G. C. Yencho, J. Sibiya, (2014). Screening sweetpotato genotypes for tolerance to drought stress- Targeting field crops journal (finalizing manuscript to send to the journal)
12. Kivuva, B.M., S.M. Githiri, G. C. Yencho, J. Sibiya, (2014). Screening for drought stress tolerance mechanisms in sweetpotato- Targeting Plant breeding journal- manuscript undergoing internal review in order to send to the journal
13. Laura Karanja, Joyce Malinga, John Ndung'u, Anne Gichangi, David Lelgut and John Kamundia (2013). Development and Evaluation of New Sweetpotato Varieties through Farmer Participatory Breeding for High Altitudes in Kenya (under review by CABI)
14. L. Karanja, J. Malinga, J. Ndungu, D. Lelgut and A. Gichangi. (2009) Sweetpotato Variety Development in Central Rift Kenya through farmer Participatory approach. PASS Grantees' Meeting, Bamako, Mali , 2009.
15. Malinga J.N., Karanja L., Ndung'u J.N., Gichuki S., Ndolo P., Alomba E., Luvoga J., Meso M and Kamundia J. (2008). Participatory Phenotyping of Sweetpotato to meet demands in the highlands of Central Rift, Kenya. Proceedings of 11th KARI Biennial Conference and the 3rd Agricultural Forum. 10-14th November, 2008. KARI HQ, Nairobi, Kenya.
16. Remy Titien, Cyprian Ebong, Ben Lukuyu, Sammy Agili, Jan Low, Charles Gachuiri (2013). Effect of Location, Genotype and Ratooning on chemical composition of sweetpotato (*Ipomea Batatas* (L) (Lam) vines and quality attributes of the roots. Agricultural Journal 8 (6) 315-321, 2013

The program has 18 staff 12 scientists four of whom are PhD level breeders. Funding for the program comes from AGRA USD 335,665 (6 years), KAPAP USD24,000, KOPIA sweetpotato project: 30,000USD per year for 3 years (2012-2014).

The constraints for the program are:
1. Delays in the flow of funds
2. Inadequate Funds to carry out trials on breeding and dissemination activities

Proposed future activities:
1. Proposal writing to seek funding of the trials
2. Continue with breeding for drought tolerance
3. Up-scaling seed for the five new varieties
4. Proceed with advanced trials for cold tolerant and drought tolerant varieties

2.12 Screening techniques for sweetpotato drought tolerance

Robert Laurie

Collaboration between CIP and ARC goes back to 2009-2012. The reported collaborative work between the two institutions is aimed at addressing the challenge that drought stress poses to sweetpotato production. The goal is to improve sweetpotato by breeding and selection of genotypes that are able to tolerate drought. To be able to do this it is important to have fast and reliable methods for screening for responses to drought and for identify genotypes with the trait for drought tolerance. The reported study adopted a whole plant physiology approach to evaluating the response of sweetpotato to drought. The treatments involved exposure of four, eight and thirty five sweetpotato genotypes to three water regimes: 100%, 60% and 30%. The experiment was laid out in a split plot design. Data was collected at 60 and 120 days.

The parameters measured included: free proline which stabilizes the membrane structure; chlorophyll content (which is expected to reduce under water stress); leaf area; stem length; relative water content; stomatal conductance; carbon 13 discrimination analysis (based on the knowledge that during drought stress the ratio between C13 and C12 is high); yield; and carotenoids. For measurements that involved sampling of leaves for analysis, leaves were harvested before sunrise and kept at minus 80 degrees until analyzed to minimize enzymatic activity.

Pearson correlation analysis was conducted between various pairs of the measured parameters. Fourteen (14) repeatable correlations were found. Some of the established correlations were:

a) Glutathione reductase and proline were positively correlated
b) Glutathione reductase and 13C discrimination were negatively correlated
c) Glutathione reductase and nitrate reductase were negatively correlated
d) Stomatal conductance and glutathione reductase negatively correlated
e) Proline and nitrate reductase were negatively correlated
f) Stomatal conductance and nitrate reductase were positively correlated
g) Water use efficiency and yield were positively correlated
h) Nitrate reductase and 13C discrimination were positively correlated
i) 13C discrimination negatively correlated with yield
j) Proline and stomatal conductance negatively correlated
k) Stamatal conductance and yield negatively correlated
l) 13C discrimination positively correlated with nitrate reductase

However, the correlation between 13C discrimination and yield was not very strong calling for more effort to better this with more genotypes and repeats. There was also large variation in measurements such as stomatal conductance, chlorophyll content and this could be reduced by having more repeats.

The team from ARC was also exploring the possibility of using NIRS technology in the measurement of response to drought. This would for example involve measurement of proteins synthesized in response to drought. However, for this approach to be applied in screening for drought tolerance calibration of a NIRS machine would first need to be done.

Several questions and comments were raised in response to the presentation. These are summarized as follows:

1. That there was need to clarify on how NIRS would be applied
2. That the 12C and 13C measurements could be simplified by looking at other mechanisms such as proline which is important for osmotic adjustment
3. How to handle the many measurements on stomatal conductance within the recommended narrow window of time (within 2-3 hours). The presenter clarified that the work was done between 10 am and 2 pm.
4. Whether NIRS was used for leaf samples or root samples. It was clarified that it was used for both.

5. There was a comment that if NIRS was used to measure storage root parameters associated with drought then this would be useful for applied breeding. However these could be established using more genotypes rather than replications
6. That since many genes are involved in response to drought there is need to look at more genotypes so as to be able to bring out the different drought tolerance mechanisms
7. There is need to summarize the techniques for measuring drought tolerance especially those cost effective ones.
8. There was also a suggestion that all mechanisms should be elucidated on a single genotype before going into may genotypes
9. That drought tolerance is a clear strength of sweetpotato. It is interesting to note that there are genotypes that continue producing under true drought. The interest is on finding these genotypes and how to screen for these. At the moment 12 of such genotypes can be found. The methods would be important for applied breeding.

2.13 Systematic evaluation of elite clones, seed populations and check clones

Wolfgang Gruneberg, J. Ndirgwe, L. Karanja and S. Lurie

The focus on systematic evaluation of elite clones, seed populations and check clones was led by four panelists. A panelist submitted to the participants a concern that while already there was a manual on evaluation of clones and that in addition there was CloneSelector that could be used there was still no satisfactory standardization in application to field trials. There was therefore the need for more focus into statistics with a view to making improvements among the CoP members. The point of emphasis was that it is important to have a uniform way of analyzing of data as this would help individuals in resolving the challenges encountered in this area. Additionally more information could be obtained if data was recorded in a standardized form

With regard to check clones the participants were informed that agreement had been reached on check clones for different countries and those across different regions. The agreement on check clones was arrived at on the basis of performance of the checks at different platforms and their availability across all countries. However, the challenge that remained was that these checks were still not the best clones locally calling also for the inclusion of local checks. Working with different checks say, in the range of 4-6 would enable breeders to see how new materials perform relative to the checks.

There were many reactions and comments on the topic of discussion. Some of the comments and reactions are summarized as follows:

1. There is need to update checks to use in mega environments for easy comparison
2. There is need to have checks selected on the basis of attributes (traits) of interestand how the check reacts. If it is on-farm trial then getting a local check that cuts across the testing environments would be advisable but global checks would also need to be targeted.
3. That there was need to consider standardizing the system for naming. However, there was a dissenting view on this with an observation that standardization of naming may not work across countries because of different naming systems in countries.
4. There was a concern with regard to the standards on scoring for viruses and alternaria blight in which there were very few plants per plot and yet the scores were recorded as percentages. In response to this concern it was pointed out that Alternaria is an important disease of

sweetpotato in some regions. On scoring for viruses, a suggestion was made that check clones be used to make relative comparisons.

5. That there was no problem with using the available protocols because there was annual training on emerging issues. It was also pointed out that there was need for better communication to better understand situations.
6. That there was need to clarify on who benefits from global and local checks and if there would be a possibility of doing a mega study involving these global checks during the second phase of SASHA. In response to this it was submitted to the participants that if clones which appear to be better than global checks could be found then they would be super varieties. However, such varieties were rare. There was a clear advantage in using the global checks among checks in observation trials which have no replications. A future idea would be to work with check clones to eliminate the challenge that soil differences bring.
7. There was need for more clarification on potential of checks since the health status of check clones would also significantly affect their response. There was need to establish virus status of checks and also need to establish check clone degeneration over time as this has implication on interpreting the response of target clones relative to them.
8. Information could be lost if only local checks are used and global checks are left out
9. An additional challenge that needed to be resolved was the complication with the checks used in different countries as some have specifications on which ones to use as checks.

2.14 Ethiopia Country Report: Progress in Sweetpotato Breeding

Elias Urage

The objective of the breeding program in Ethiopia is to develop high and stable yielding sweetpotato varieties with resistance or tolerance to diseases and insect pests(SPVD, weevils, butter flies) and drought and with acceptable consumer preferred qualities such as high dry matter, high beta-carotene.

While in the past there were several landraces in the country, many of these have been lost largely due to many incidences of drought that affected traditionally sweetpotato growing areas. At the time of reporting some 24 varieties (six orange) had been released in the country.

The breeding program in the country had established a crossing block with 26 parents. However, majority of these parents have failed to flower with only seven flowering. The program is therefore looking for ways by flowering among the parents in the crossing block could be promoted to enable crossing to be made. In 2013, 3300 polycross seed from 33 families were planted and from these 2400 seedlings were established. One observation trial with 1700 clones and six checks was established at one location. A preliminary trial with 64 clones was also established at two sites. Adaptation trials with three introduced OFSP clones were also undertaken at eight sites.

The program is also involved in a foundation seed system which at the time of reporting had four hectares under foundation seed multiplication that is targeting commercial seed producers and is also for direct dissemination through the extension system. Additionally the program with support from CIP has tissue culture laboratories which are used to produce clean sweetpotato plants.

The program has one scientist and two technicians with eight other researchers at different centers who devote about 25% of time towards sweetpotato improvement. At the time of reporting one student was also undertaking PhD level training with support from AGRA. The program is mainly supported by the Ethiopian government, but also receives assistance from CIP through projects such as DONATA, BPBL and Irish aid nutrition project.

In response to the presentation, the presenter was advised to by Dr. Craig Yencho to try grafting on *Ipomoea setosa* to induce flowering. Craig also offered to assist by availing true seed of *I. setosa* acclimated to cooler environments.

2.15 Analysis of quality trait data in CloneSelector, Index selection, Accudatalogger

Luka Wanjohi, Ebenezer Obeng-Bio and Raul Eyzaguirre

CloneSelector
Luka Wanjohi

The participants were taken through a training on CloneSelector. The session focused on assisting the participants to install the latest version of the program into their computers.

CloneSelector is a tool developed to help plant breeders carry out field trials, analyze the results and make selection decisions. It is open source and based on MS excel and R statistical package. The new Version 3-1 was released in 2013 and has additional features including RCBD, Alpha (0,1) and ABD, G x E which would also be useful for analyzing plant breeding data. Among the features of the new version are:

a) Elaborate a list of germplasm to test
b) Design field trials with one or more experiments
c) Generate a field book for each experiment
d) Register metadata for each experiment
e) Data collection in field and post-harvest for each entry
f) Enter collected data into electronic field book
g) Calculate derived variables (yield/ha etc)

Introducing AccuDataLog: The Mobile Fieldbook for CloneSelector
Obeng-Bio Ebenezer and Luka Wanjohi

The participants were also introduced to AccuDataLogger which is iconsidered as a mobile fieldbook for CloneSelector. It is a mobile application that enables field data entry for trial data into the CloneSelector Fieldbook and offers capability for printing labels on demand for harvest samples. It is available on Windows and Android platforms.

The device has capability to automatically import CloneSelector Fieldbooks into mobile devices so that a field based data entry can take place and also has capacity for data import into CloneSelector. It has an integrated barcode technology and can print data labels. The device which currently is being used by the program in Ghana has worked very well. It can withstand harsh weather conditions. To reduce errors when recording different traits it is advisable to use different devices which at the time of reporting cost USD 15,000.

Commenting on the presentation it was suggested that data labels need to be linked to germplasm identification and that the approach would be a good way to link with current efforts on knowledge management and open access to information among the CGIAR centers.

Index Selection
Raul Eyzaguirre

In breeding, usually several traits have to be improved simultaneously. Very often intuitive procedures are used when it comes to selection. However, intuition usually fails when several correlated traits are involved, for example positive, correlations in which improving one trait improves the other or in the case of negative correlations where improving one trait can diminish the other.

An index helps to bring the traits together in a better way. The information entered is for early stages of the breeding process. It helps to learn about how populations are going to respond. Everything is linked together due to correlations. With this tool the breeder has the opportunity to see what the gain could be. However, the desired gains need to be realistically set. If the desired gain is one standard deviation then it is possible, but if it is more than two then it becomes almost impossible.

The presentation focused on two selection indices

- Elston, R. C. (1963). A weight-free index for the purpose of ranking or selection with respect to several traits at a time. Biometrics. 19(1): 85-97.
- Pesek, J. and R.J. Baker (1969). Desired improvement in relation to selection indices. Can. J. Plant. Sci. 9:803-804.

The participants were guided on how to work with the two indices. Examples on how to work with the two indices were done in R.

In the several learning points highlighted, it is important to:

1) Keep an eye in the correlations.
2) Keep both eyes in the standard deviations.
3) Specify your desired genetic gains in relative terms, and even better, specify your desired genetic gains in relative terms and in standard deviation units.
4) If a trait is important, give it a weight a little bit higher than one standard deviation (somewhere between 1 and 2). If a trait is not so important give it a weight lower than 1 standard deviation (between 0 and 1).
5) Do not ever try to improve a trait in more than 2 standard deviations (or maybe 1.5 could be a better and more conservative upper bound).
6) Play with different values for the desired genetic gains and compare the response to selection that you get with each group of values.

2.16 Feedback on APA/CABI manuscript

Ted Carey, Wolfgang Gruneberg and Robert Mwanga

The session was meant to get feedback on a manuscript titled *Advances in sweetpotato breeding from 1993 to 2012* that had earlier been circulated for review by the members. Among the comments made on the manuscript were:

- To address the concern that the manuscript was over the number of pages, it was suggested that some tables be moved to an appendix section. This was argued would also help to reduce the cost of publication. However, the lead author was of the opinion that reducing the length of the paper would be difficult and suggested that more than one project could contribute to meeting the cost of its publication. It was also thought that the length was justified given that it was a global focus on a commodity crop
- It was suggested that the title changes to 1993-2013
- The paper was hailed as a tremendous achievement having pulled together information from all the different countries together and that it was this kind of work that make a a community of practice to grow
- Commenting on the long list of authors, it was observed that it was advantageous to have the many authors as it gives the views put together in the paper to have more weight.

2.17 Progress of sweetpotato breeding in Madagascar (2009-2014)

Bruno Rosoloniaina

The objectives of the program in Madagascar are:

1) To identify high yielding sweetpotato varieties that can contribute to food and nutritional security
2) Produce planting materials of the identified varieties

The most important sweepotato landraces in Madagascar are: Rakotozafy mijoro, Galona, Vony and Votavo. Bred sweetpotato varieties that have been released in the country are: Naveto (440131), Riba (420027), Mendrika (199004.2) and Bora (199062.1)

In 2014, 2500 seeds from 12 families were planted. Also 12 clones were planted at four locations as part of advanced yield trials. Twelve on-farm trials were also conducted across the country. The data obtained is analyzed using Genstat. So far three OFSPs have been released by the country while another four is in the pipeline for release.

For foundation seed system program currently has three laminar flow benches and five screenhouses (one of which at the time of reporting needed repair). Using the tissue culture facility the program weans about 6000 plantlets a year. The foundation seed system is linked to various vine multipliers for further multiplication. The multipliers and extent of linkage to the programs are as follows: government (40%); NGOs (15%); farmers (40) and others (5%). The program has four staff with one having MSc level training.

The program faces challenges including:

1) variety release process taking a long time (> 5years)
2) the storage of vines (planting material) during the dry and cold season being difficult
3) lack of techniques for the storage of roots
4) absence of a sweetpotato processing factory
5) weevils
6) lack of training

2.18 Progress report on sweetpotato breeding in Ghana

Kwadwo Adofo

The breeding program in Ghana under the West Africa Agricultural Productivity Programme (WAAPP) and collaboration with SASHA (Ghana) is focused on:

1) Development of high and stable yielding consumer accepted sweetpotato varieties
2) Production and distribution of healthy primary (breeder) planting materials
3) Promotion of sweetpotato utilization (product development)
4) Carriying out studies on the availability, marketing and consumption of sweetpotato in Ghana.

The specific objectives under the breeding program is to develop varieties that are high and stable in yield, disease and pest resistant (SPVD and weevils), high in nutritional and processing qualities (high dry matter, high β-carotene, high starch, high flour yield with adequate mineral content) and are consumer acceptable and preferred

The important landraces in the country are: Blueblue, Akaten Red, Jukwa orange, Shashango, Koffour, Asamare, Sankase Nabogro, Obare and Nangunbungu. The most important bred varieties in the country include CRI-Okumkom, CRI-Faara, CRI-Sauti, CRI-Santom pona, CRI-Apomuden, CRI-Otoo, CRI-Ogyefo, CRI-Hi starch, CRI-Patron, CRI-Bohye, CRI-Ligri and CRI-Dadanyuie. None of these bred varieties are orange.

During the 2013/14 period the program had a crossing block with 18 parents from which 10482 open pollinated seed representing 17 families were collected. Additional 3767 seeds from 34 controlled crosses were also collected. As part of the seedling nursery some 2500 seeds were planted leading to the establishment of some 2125 seedlings representing 51 families. A total of 300, 170 and 5 clones were respectively planted as part of observation trials, preliminary yield trials and advanced yield trials. Up to 2012 120 trials had been conducted across the country and 12 varieties released. At the time of reporting two varieties (orange) were in pipeline for release by 2016. It takes one year to release a variety once data is available

As part of a foundation seed system the program has a tissue culture laboratory and distributes 90,000 vine cuttings every year. The program also has linkage to vine multipliers including government agencies (90%) and farmers (10%).

Some of the program's publications and variety release documents are:

1) *J.N.Asafu-Agyei, K. Adofo, E. Baafi, P. Appiah Danquah, J.N.L. Lamptey, E. Adu-Kwarteng, Patricia Acheampong, Victor Amankwaa, Adelaide Agyeman, Harrison K. Dapaah, Edward Carey, N*

Asamoah Obeng and J.K Awoodzie. Sweetpotato genotypes proposed for release. 2012. CSIR-CRI, Kumasi, Ghana pp 44.

2) *J.N. Asafu-Agyei, K. Adofo, E. Baafi, E. Carey, E. Adu-Kwarteng , E. Bio, J. N. Lamptey, N. Asamoah-Obeng, and J. Awoodzie. 2012. Testing the adaptability and acceptability of elite sweetpotato genotypes in Ghana, 16th Proceedings of ISTRC, Abeokuta-Nigeria*
3) *K. Adofo, J.N. Asafu-Agyei., J.N.L Lamptey, E. Carey, E. Baafi, E. Obeng-Bio, E. Adu-Kwarteng, E. Owusu-Mensah, P. Acheampong, J. Haleegoah, Victor Amankwaah, N. Asamoah-Obeng and J. K Awoodzie.2013. Farmer Participatory Development of Four Sweetpotato Varieties in Ghana, 12th Proceedings of ISTRC-AB, Accra-Ghana.*

At the time of reporting the program was funded by the World Bank and Government of Ghana to the tune of USD 350,000 period 2013 – 2017. There was also on-going effort to submit a proposal to AGRA for funding.

Some of the constraints that the program faces include

- Inadequate irrigable land
- Changing climatic and edaphic conditions
- Poor attitudes of some farmers

The proposed future activities included a resubmission of a proposal to AGRA,, germplasm collection (local and foreign), and development of fact sheets on new varieties.

As reaction to the presentation there were several comments including the fact that at the time of reporting no OFSP varieties were already released into the country and therefore effort needed to be intensified to get this done. There was a suggestion that to facilitate variety release breeders should aim at sharing data on their evaluation early in the process - maybe as early as the second year of trials. Quality traits such as beta-carotene in varieties could be quickly gauged using color charts.

2.19 Sweetpotato Breeding Activities for 2013 at the NRCRI Umudike, Nigeria

Solomon Afuape

The main objectives of the breeding program in Nigeria are

1) Development of new sweetpotato varieties that satisfy the agronomic, processing and nutritional requirements of various end users.
2) Population improvement for high carotenoid, high dry matter and virus resistance.

The specific objectives are:

1) Development of OFSP population with high dry matter through open pollinated (OP) and controlled crosses;
2) Evaluation of promising progenies at various yield trial stages for yield, SPVD resistance, dry matter and carotenoid content;
3) Conduction of varietal release-targeted multi-locational trials;

The most important landraces in the country are: Ex-Igbariam, Atsak pupu, Buttermilk and Danzaria. The bred varieties are: King J, UMUSP/2, Mother's Delight, TIS 87/0087, TIS 8164, TIS2532.OP.1.13. However, only Mother's Delight is orange-fleshed

During the 2013/14 period the program had a crossing block with 20 parents from which 4281 open pollinated seed representing 11 families were collected. As part of the seedling nursery a total of 2325 seeds were planted leading to the establishment of 2009 seedlings representing 19 families. Some 844, 33 and 12 clones were respectively planted as part of observation trials, preliminary yield trials and advanced yield trials. One variety was released during the reporting period. For the period 2009-2014 two OFSP varieties were released. At the time of reporting no variety was in the pipeline for release. It takes one year to release a variety once data is available.

As part of a foundation seed system the program has a tissue culture laboratory. The program also has some linkage to vine multipliers including government agencies (10%) and farmers (1%).

Some of the program's publications and variety release documents during 2009-2014 are:

- Afuape, S.O., Nwankwo, I.I.M., Echendu, T.N.C., Njoku, J.C., Low, J. And Egesi, C.N. (2012). Nomination of new sweetpotato varieties with nutritional qualities for naming, registration and release. Submitted to National Variety Release Committee in Nov. 2012
- Afuape, S.O., Nwankwo, I.I.M., Echendu. T.N.C., Njoku, J.C. and Egesi C.N. (2013). Nomination of Pro-vitamin A rich Sweetpotato Variety for Registration and Release. Submitted to National Variety Release Committee in June 2013.
- Afuape, S.O., Nwankwo, I.I.M., Omodamiro, R.M., Echendu, T.N.C. and Toure, A. (2014). Studies on some important consumer and processing traits for breeding sweetpotato for varied end-uses. Amer. J. Experim. Agric. 4(1): 114-124.
- Nwankwo, I.I.M. and Afuape, S.O. (2013). Evaluation of high altitude orange-fleshed sweetpotato (*Ipomoea batatas*) genotypes for adaptability and yield in lowland rainforest ecology of Umudike, Southeastern Nigeria. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 5(6): 77-81.*
- Omodamiro, R. M., Afuape, S. O., Njoku, J.C., Nwankwo, I.I.M., Echendu, T. N.C. and Carey. E. (2013). Acceptability and proximate composition of some sweetpotato genotypes: Implication of breeding for food security and industrial quality. International Journal of Biotechnology and Food Science, Vol. 1(5): 97-101.
- Nwankwo, I.I.M., Bassey, E.E. and Afuape, S.O. (2014). Yield evaluation of open pollinated sweetpotato (*Ipomoea batatas (L.) Lam)* genotypes in humid environment of Umudike, Nigeria. *Global J. Biol. Agric. Health Sci.,3(1):199-204*
- Atayese, M.O., Lawal, I.O., Afuape, S.O., Olowookere, F., Sakariyawo, O.S., Olaiya, A.O., Fetuga, O.G. and Idowu, H.T. (2013). Evaluation of growth and yield response of sweetpotato *(Ipomoea batatas L.*), to different rates of poultry manure in Abeokuta south-western Nigeria.
- Egbe, M.O., Afuape, S. O. and Idoko, J. A. (2012). Performance of improved sweetpotato (*Ipomea batatas* Lam.) varieties in Makurdi, southern guinea savanna of Nigeria. Amer. J. Experim Agric., 2 (4): 573-586.
- Ehisianya, C. N., Afuape, S.O. and Echendu, T. N. C. (2012). Varietal response of selected orange-fleshed sweetpotato cultivars to yield and the sweetpotato weevil, *Cylas puncticollis* (Boheman) (Coleoptera: Brentidae) at Umudike, Abia State, Nigeria. Intern. J. Agric. Sci. Vol. 2 (9): 251-255.

- Etudaiye H. Adinoyi, H.E., Oti E., Sanchez, T., Omodamiro R. M., Afuape S.O. and Ikpeama A. (2012). Effect of variety and influence of starch-hydrolyzing enzyme and yeast on the yield of ethanol generated from sweetpotato flours and starches. Advances in Applied Science Research, 3 (5):2774-2778.
- Afuape, S. O., Okocha P. I. and Egesi, C.N. (2011). Genetic variability, correlation and path coefficient analysis in quantitative characters of sweetpotato (*Ipomoea batatas* (L.) Lam). Nigerian Agricultural Journal, 42: 84-93.
- Ibitela, I., Afuape, S.O., Paliwal, J. and Nwauzor, E.C. (2009). Screening sweetpotato germplasm for starch, flour and fed quality characteristics. *Fruit, Vegetable and Cereal Science and Biotechnology* Vol. 3 (1): 62-67.
- Afuape, S.O., Nwankwo, I.I.M. , Njoku, J.C. , Echendu, T.N.C. and Egesi, C.N. (2013). On-farm assessment of yield and culinary attributes of selected sweetpotato genotypes by farmers for varietal release. 12TH ISTRC-AB Triennial Symposium in Accra from Sept. 30-Oct.5, 2013.
- Afuape, S.O., Njoku, C.J., Njoku, D. N. and Nwankwo, I.I.M. (2013). Development of new sweetpotato varieties: evaluation of advanced sweetpotato breeding lines at the uniform yield trial stage in contrasting agroecologies in Nigeria. 37th Annual Conference of Genetics Society of Nigeria (GSN), Lafia, Nasarawa state, Nigeria (21st- 24th October, 2013).
- Omodamiro, R.M., Afuape, S., Nwankwo, I.I.M. and Ofoeze, M.A. (2012). Quality evaluation of selected preliminary yield trial sweetpotato genotypes: Implication in sweetpotato breeding. Proc. 36th Annual Conf. of Nigerian Institute of Food Science and Technology, held at Auditorium of University of Lagos, Akoka, Lagos, 15th-19th October, 2012, pp 531-532.
- Omodamiro, R.M., Afuape, S.O., Oti, E. and Echendu, T.N.C. (2012). Effect of method of processing on the sensory attributes of sweetpotato chips. Proc. 36th Annual Conf. of Nigerian Institute of Food Science and Technology, held at Auditorium of University of Lagos, Akoka, Lagos, 15th-19th October, 2012, pp 529-531
- Omodamiro, R.M., Ukpabi, U.J. and Afuape, S.O. (2010). Assessment of quality characteristics of exotic sweet potato genotypes for suitable food traits and processing attributes in Nigeria. Proceedings of the 11th Triennial Symposium of the ISTRC-AB held at Memling Hotel, Kinshasa, Democratic Republic of Congo, 4-8 Oct., 2010, pp 423-427.
- Omodamiro, R.M., Oti, E., Afuape, S.O., and Etudaiye, H.A. (2010). Sensory evaluation of orange-fleshed sweetpotato extract drinks. Proc. 34th Annual Conf. of Nigerian Institute of Food Science and Technology, held at the Banquet Hall, government House, Yola, 12th-16th October, 2009, pp 171-172.

The program received AGRA funding of USD 158,700 for three years that ended in 2013, but effort is underway to get this renewed. There are nine scientists and four technicians in the program.

Some of the constraints faced by the program include:
1) Low ability to properly phenotype SPVD.
2) Difficulty in maintenance of germplasm over the dry season.
3) Inadequate laboratory for quality trait analyses
4) Lack of good screen house

2.20 Pre-breeding and seed discussion

Panelists: Wolfgang Gruneberg, Sunette Laurie, Maria Andrade, Matrtin Chiona, Laura Karanja

A key question that was posed to the participants was how sweetpotato seed systems should evolve as new varieties are released in the different countries. This was a concern because the reality is that farmers often do not have the money to pay for clean vines and clonally propagated crops in general.

As part of a reaction to the question, one submission was that it is possible to build a seed system but that it should be noted that it takes about 5 years to release a variety. During this time the material is already accumulating virus which leads to a yield decline of up to 20%. There is need to convince farmers on the benefits of clean seed and farmers would be willing to buy as has been noted in some places. There is a bottleneck in drought prone areas.

The experience from Ethiopia was that varieties developed and released had not benefited of farmers despite a formal seed system being in place in the country. This has been attributed to farmers being less sensitized on the importance of clean seed. For example, farmers currently using Awasa 83 are now complaining of its low yield. This is actually due to seed quality loss attributed to viruses. Working on seed system is therefore even more important than variety development.

The research in Malawi is mandated to maintain foundation seed which is bought by multipliers. There are regulations for multipliers on how to ensure clean seed is produced. In Malawi there is a huge market which is also fueled by NGOs intervening in the areas of crop diversification.

It was suggested that as part of the process of establishing a good and sustainable seed system, cleaning of mother plants can be done at the level of the support platforms. It was observed that what the participants had seen during the visit to Malawi was good as long as the primary planting material came from the platform. So it was important that the basic facilities at the platforms are well maintained.

It was also noted that a major challenge to seed system development is that it is at present focused on mostly through donor project based activities. Strong demand on deliverables associated with these projects often leads to short cuts that are not sustainable and wrong targeting of groups.

An additional contribution was that the driving force for a sustainable seed system is a strong market for sweetpotato. Farmers would be willing to pay if they had a definite market for the produce and seed companies would be willing to produce sweetpotato seed. However, because of the issue of degeneration, breeders should maintain breeder's seed and also ensure there is a linkage to the seed system. Moving forward there is also need for seed certification laws to enable the development of formal seed systems in many of the countries

2.21 Conventional breeding strategies: ABS - Polycross versus Controlled cross - Heterosis

Wolfgang Grüneberg

A key fact to remember about sweetpotato is that it is a polyploid (hexaploid). Heterozgous genotypes occur at much higher frequencies in hexaploids than in diploids and hence heterosis is much more important in the hexaploids than the diploids – for quantitative traits such as yield, yield stability, earliness and vigor, and drought tolerance. Recessive inherited traits are much more difficult to fix (in the hexaploids since inbreeding is much more difficult to achieve in these than in diploids, yet for some traits such as SPVD (and quality traits) strong inbreeding is needed.

The accelerated breeding scheme (ABS) whose aim is to accelerate the rate at which varieties are developed and released was first developed in 2005 when progenies from population Jewel were planted at three locations in Peru (San Ramon, Lamolina and Canete). The approach entails planting of many progenies in one-metre row plots without replication during the early stages of breeding and requires large fields to accommodate the many progenies. The variance results obtained showed that the ABS works. The ABS strategy has been adopted by many sweetpotato breeding programs since the potential approach was proven in speeding up sweetpotato breeding. Further experimentation with ABS has been planned. In one of the planned experiments heritability will be estimated using ABS applied in early breeding stages with a check clone and the followed by planting of the selected fraction again with the check for one further breeding stage to estimate the observed response to selection. This study will be conducted in SSA in Uganda, Ghana and Mozambique.

Current work is also focused on polycross versus controlled crosses. We must generate very large populations to get recessive genotypes with traits for resistance to diseases such as SPVD which is assumed to be recessively inherited but with some modifications. In the current study 22 mega clones are involved as parents. Each of the 22 clones was involved in four crosses with a focus on one trait – root yield. Preliminary results showed that a partial diallel resulted in a higher population mean compared to the other crosses.

An additional focus is on heterosis. The basis of work done in this area is the fact that offspring performance is superior to the mid-parent performance. In clonally propagated crops such as sweetpotato, the offspring is the family derived from a cross. From the heterotic cross combinations or families it is still possible to select the 'best' clone. Heterosis in sweetpotato is based on heterozygous parents (as opposed to homozygous parents in maize) and is much higher but this cannot be fully determined as the maximum heterosis will only be achieved under homozygosity, a state that is difficult to arrive at given the hexaploid nature of the crop. Crosses between good parents result in much higher levels of heterosis. To achieve higher levels of heterosis crosses need to be made between distinct populations. There is exploitable heterosis in sweetpotato and 30-40% yield jump can be achieved by recombining the best family makers. For example, heterosis increments of up to 58.7% have been observed in Wagabolige × SR02.174. The heterosis experiment offers an opportunity to raise sweetpotato population means.

2.22 Genetic dissection of complex traits, crop improvement through marker-assisted selection, and genomic selection

Awais Khan

In plant breeding, selection is a systematic procedure for genetic improvement through crossing plants with desired traits and selecting progeny with improved performance and or improved combinations of traits. Selection methods include:

1. Phenotypic selection which is selection based on appearance and performance. However this has disadvantages including: difficulty in separating environmental and genetic contribution;

difficulty in distinguishing homozygous and heterozygous effects; need for large space and labor input; being slow and time consuming.

2. DNA based selection methods which include: marker-assisted selection which involves selection for one or more (up to 8-10) alleles; marker-assisted backcrossing through which one or more (up to 6-8) donor alleles can be transferred to an elite line; and genome-wide selection which involves selection of several loci using genomic estimated breeding values (GEBVs) based on genome-wide marker profiling.

The concept of marker assisted selection is based on association between molecular marker and causative gene and it can be either direct or indirect association. To establish a suitable marker we need to know which part of the genome controls the trait. This can be established using quantitative trait loci (QTL) mapping. In the QTL mapping segregating populations are phenotyped through generation of quantitative data sets for the trait. At the same time the segregating populations are genotyped through scoring a large number of polymorphic markers in the populations leading to the generation of Linkage maps from marker data. The QTL are then located with the integration of genotype and phenotype data by determining whether there is a significant link between the genetic makeup (genotype) and trait phenotype.

The second method is association mapping analysis. This approach also involves genotyping and phenotyping of germplasm. Identification of marker-trait association via association mapping is also known as linkage disequilibrium (LD) mapping and involves the identification of marker alleles involved in the inheritance of traits by utilizing ancestral recombination for identification of marker and trait association. The basis of using ancestral recombination is that the traits we observe in a population are linked to the surrounding genetic sequence of the original evolutionary ancestor. Association mapping can be achieved through candidate gene approach or genome wide approach. The candidate gene approach involves a lower number of markers and is based on prior knowledge obtained through expert opinion and linkage mapping results. The genome wide approach on the other hand involves a high density of molecular markers throughout the genome. The choice of method to use in this case depends mostly on how fast linkage disequilibrium decays in the crop.

It is important to remember that quantitative traits are complex since they often involve: multiple loci; pleiotropy (one gene has many effects); epistasis; and interactions with the environment (that results in production of a range of phenotypes). Since QTL and association mapping will only allow identification of linked markers that explain a small fraction of total genetic variance, these approaches are inadequate for most quantitative traits that are controlled by several genes some of which contribute small effects. To accurately estimate small effects, a large data set is needed (a large population to be genotyped and phenotyped) since individual genes will have small effects.

Another approach to predicting phenotype is genomic selection which involves selection of several loci genome-wide linked to traits of interest using GEBVs based on genome-wide markers. This is different from the traditional marker assisted selection in which DNA markers that are tightly-linked to target loci are used to select genotypes with the desirable combination of alleles (identified through prior QTL mapping). Thus the genomic selection approach is suitable for complex quantitative traits that are controlled by many genes each with a small effect while marker assisted selection on the other hand is suitable for simple quantitative traits controlled by a few genes each with a large effect.

Compared to a traditional breeding approach, the time needed to identify superior individuals (breeding value) is shorter since breeding value can be estimated earlier and individuals do not have to mature before breeding value is estimated. Also with the continuing decline in the cost of marker technologies for “Genotyping’’, the genomic selection approach is more cost effective compared to the traditional breeding approach which is more costly with respect to space requirements of trials, and phenotype measurements are costly.

The accuracy of genomic section can be predicted by way of correlations between GEBV and experimentally estimated breeding value (EBV). The prediction accuracy of the genomic selction is affected by

1. Linkage disequilibrium (LD) between markers and QTLs. The accuracy is higher with LD.
2. Size of training population. The accuracy is higher when the population size is large
3. Heritability of the trait in question. The accuracy is higher with higher heritability
4. Genetic structure of the trait. There is higher accuracy with a lower number of QTLs.

With greater heritability of a trait, fewer records are required (population size) in training a set for achieving high accuracy of GEBV in a target breeding population.

It is important to note that genomic selection models have different accuracy of prediction and so selection of a model to use is important. So far variable selection approach involving BayesB has shown a higher accuracy. It is important to note that over generations prediction accuracy of GS models decrease

For a successful use of genomic selection it is important to:

1) have a good understanding of the trait and accurate phenotyping of the trait
2) phenotype with special attention to genotype by environment interaction: appearance and performance in general, in particular, response to environment
3) carefully record and manage data

Unlike genetically modified organism (GMO) techniques used to manipulate a single gene that could also be easily manipulated using marker assisted (conventional) breeding, marker assisted breeding (MAB) can manipulate multiple traits simultaneously. The MAB approach can manipulate genetically complex “quantitative traits” with small effects - traits that are influenced by the environment and thus bring about directed changes (provided genetic variation exists for the trait of interest).

2.23 A Vision for Next Generation Sweetpotato Improvement in Africa: Modern Breeding Tools, Increased Potential

Craig Yencho

The importance and potential of sweetpotato is becoming widely recognized across the globe. Many public and private organizations recognize the superior nutritional value in sweetpotato compared to many other staple crops and investments are increasing. Implementation of the first phase of the SASHA project has been very successful given that through the project: four to six new sweetpotato breeding programs have been established; more than 18 new sweetpotato varieties have been developed and released; three regional sweetpotato support platforms have been established; breeding for better root quality has improved with the adoption of near-infra red spectroscopy (NIRS) technology; increased focus on the development of better seed systems; increased focus on improving the crop for virus resistance; and that additional effort has focused on value addition through proof concept projects among others. As such with the help of the SASHA project, sweetpotato is poised for significant growth in SSA.

However, despite the progress that has been made genomic resources for sweetpotato improvement remain noticeably lacking. To fully realize the crops true long-term potential, there is need to invest in modern breeding tools and integrate them with applied breeding efforts.

To move forward in this direction sweetpotato breeding pipeline investments should focus on:

1. Improving human resources by: continuing to assemble and develop dynamic teams of breeders and allied disciplines; training in the use of traditional and genomic breeding methods; putting in place effective communication and collaboration structures; and carrying out multi-institutional training and capacity development.
2. Improving genomic resources in areas such as: the development of markers that could be used in improving the crop; establishing a robust set of single nucleotide polymorphic markers; development of diploid and hexaploid mapping, training and test populations among other genetic resources
3. High-throughput phenotyping for virus resistance, drought tolerance, nutritional quality traits, and resistance to sweetpotato weevils
4. Bioinformatics and analytical resources
5. Data analysis and selection platforms
6. Use of cultivated and wild species for improvement of the crop
7. Developed country sequencing linked with developing country phenotyping and breeding activities

To make a contribution towards these needs a project titled Genomic Tools for Sweetpotato Improvement Project had been submitted to the Bill and Mellinda Gates Foundation for funding. The project aims to sequence sweetpotato and develop modern breeding tools for a food crop that sustains million of people in SSA. The ambitious four year project that is projected to cost 12.1 million US dollars brings together multiple institutions. The institutions are: Boyce Thompson Institute at Cornell; Michigan State University; University of Queensland, Australia; The International Potato Center, Peru; BioSciences East and Central Africa, Kenya; National Crops Resources Research Institute, Uganda; and Crops Research Institute, Ghana.

The targeted outcomes of the planned project are:

a) An effective breeding pipeline that utilizes up- and down-stream breeding methods
b) Genomic selection technologies integrated with the SASHA accelerated breeding program
c) A new generation of sweetpotato breeders, molecular geneticists and bioinformatics scientists capable of using the new tools to drive improvement.
d) Linkage of genomic-based breeding to address the demand of new varieties and “products” will yield maximum long-term research on investiment (ROI) on current SP investments in SSA.

2.24 Breeding sweetpotato for resistance to Alternaria blight in Uganda

Godfrey Sseruwu

The presentation was based on the outcomes of research that the presenter undertook as part doctoral thesis research at the University of Kwa Zulu Natal.

Alternaria leaf petiole and stem blight (commonly referred to as Alternaria blight) caused by *Alternaria* spp occurs in most of the major sweetpotato growing regions of the world. It is a minor disease in many parts of the world where sweetpotato is grown. However, in East Africa, it is a serious production constraint in some areas due to the presence of more virulent strains of the pathogen.

In Uganda, the major *Alternaria* species are *A. bataticola* and *A. alternata* with the former being more virulent. Yield losses of 25-54% attributed to the disease have been recorded in different parts of the country. The highest incidence and severity are experienced in the South-western highland agro-ecological zone while the Lake Victoria Crescent zone of the country is a medium disease pressure zone.

Some of the options for managing the disease include: planting disease free vines, rouging infected plants, spraying with fungicides, and planting of resistant varieties. Of these management options use of resistant varieties is considered more cost effective given the existence of considerable differences in reaction to the disease among sweetpotato genotypes. The differential reaction of sweetpotato genotypes to the pathogens offers an opportunity to develop varieties with resistance to the pathogen.

The reported study was aimed at establishing farmer preferred sweetpotato traits, production constraints and Alternaria blight awareness; studying the mode of inheritance of Alternaria blight resistance; and determining the stability of selected F_1 genotypes across environments.

The study on farmers' perceptions was carried out in Kabale and Luwero which respectively are high and medium pressure areas for the disease. The disease was ranked as the most important constraint by farmers in Kabale.

In the genetic analysis of resistance to Alternaria blight crosses were made between parents with known levels of resistance, and the resultant generation evaluated in replicated trials at two locations (Kabale and Namulonge). It was found that additive genetic variance contributed by both the female and male parents is very important in controlling the expression of Alternaria resistance. Additive gene action was found to be more important than non-additive gene action in conferring resistance to the disease.

Selected F_1 sweetpotato genotypes were also evaluated at three sites in Kabale, Serere and Namulonge. From this evaluation five promising genotypes were selected for further evaluation.

2.25 Sweetpotato combining ability and heterosis under drought stress

Benjamin M. Kivuva

The presentation was based on the outcomes of research that the presenter undertook as part of his doctoral thesis research

Drought is the main abiotic constraint in Sub-Saharan Africa. In Kenya drought is experienced in more than 80% of the land area. Depending on severity drought can cause up to 100% crop yield loss and hence the need for improving crops for tolerance to drought. The reported study sought to:

- to determine the ratio of general combining ability and specific combining ability to depict gene action
- establish the general combining ability mean performance of a parent genotype over several cross combinations; associated with additive gene effects,
- establish specific combining ability mean performance of crosses that perform better and is typically associated with non-additive gene effects (dominance)

A diallel mating design method II involving 24 parents, F_1's, no reciprocals was used. Plants were evaluated in the field (KARI Kiboko) and screenhouse (KARI Muguga) in Kenya. The field trials were carried out in a severe drought stressed environment where the plants were grown under severe water stress, moderate water stress and no water stress. The F_1 plants were also evaluated for heterosis. The data collected included root yield and vine weight.

The outcomes of the study indicated that genes for drought tolerance in sweetpotato are homozygous recessive; the susceptible parents were either carriers of the homozygous or heterozygous recessive. Additive gene action was more predominant than non-additive gene action. Further studies were recommended to confirm the inheritance of genes responsible for drought tolerance in sweetpotato. The study established that heterosis and specific combining ability effects should be considered for significant genetic gain in breeding sweetpotato for drought tolerance.

At the time of reporting multi-location on-farm participatory evaluation of the best 60 clones to select best 10 clones were planned. The best five clones would then be entered for national performance trials for release. These planned steps would be undertaken once funding was secured.

2.26 Development of high yielding multiple resistant sweetpotato germplasm

Gorrettie Ssemakula

The objective of the sweetpotato breeding program is to improve food security and human health and alleviate poverty thru development deployment of:

1. high yielding, pest resistant and adaptable sweetpotato varieties that meet consumer and market demands
2. Orange fleshed sweetpotato for combating vitamin A deficiency
3. Integrated pest and disease management strategies
4. Agronomic packages for optimal sweetpotato yields
5. Seed systems technologies

The important SP landraces in the country Dimbuka Bukulula, Ejumula, Semanda and Kakamega. The most important bred varieties NASPOT 1, NASPOT 8, NASPOT 10, NASPOT 11 and NASPOT 13. Among the landraces Ejumula is orange while fro the bred varieties NASPOT 8, 10 and 13 are orange.

During the 2013/14 period, the program had established a crossing block with 28 parents from which 513,049 open pollinated seed representing 28 families had been collected. An additional 5379 seeds representing some 34 families were collected from specific crosses. A total of 591,958 seeds were planted. In 2014 preliminary trials with 494 clones were established at two locations. Advanced yield trials with 49 clones (seven OFSP) were also established at two locations. Fifty on-farm trials were conducted across the country. Once a variety is ready for release and data is available it takes about six months to one year to go through the release process.

With respect to sweetpotato foundation seed system, the program has a tissue culture laboratory in which three varieties are maintained in tissue culture. Between 100,000-500,000 vines are distributed every year. The program also has linkage to vine multipliers for further multiplication. Linkage is with government institutions, including RwebiZardi, NgeZardi. There is linkage with NGOs including , Community Volunteer Effort for Development (COVOID), Voluunteer Effort for Development Concerns (VEDCO) and HarvestPlus (for OFSP). Linkage to farmer multipliers is with SOSPA, Basooka Kwavula. However, most vine multiplication takes place when there is a project that buys and distributes free to farmers.

The program's project proposal titled ''Development of Sweetpotato Varieties for Multipurpose Use in Uganda'' that was submitted to AGRA for funding was approved in early June 2014. Other sources of funding for the program are HarvestPlus $18,000 for one year; seed systems/net tunnel -$183,000 for three years; McKnight- Breeding (4years but this had ended); and Agricultural Technology and Agribusiness Advisory Services (ATAAS)/Government of Uganda (GOU)- variable amounts (50-80 million Uganda shillings every year + salaries).

In 2009 one non-orange variety was released while in 2013 two OFSP varieties were released. At the time of reporting eight non-orange and four OFSP clones were in the pipeline for release. The variety release documents for 2009-2014 were:

- Mwanga, R.O.M., B. Kigozi, J. Namakula, I. Mpembe, C. Niringiye, S. Tumwegamire, R. Gibson, and C. Yencho. 2009. Submission to the Variety Release Committee for the release of sweetpotato varieties. National Agricultural Research Organization (NARO) / National Crops Resources Research Institute (NaCRRI), Kampala, Uganda. Pp42.
- Ssemakula, G., C. Niringiye, M. Otema, B. Yada, G. Kyalo, J. Namakula, A. Alajo, B. Kigozi, R. Makumbi, C. Yencho and R.O.M. Mwanga. 2013. Submission to the Variety Release Committee for Release of Sweetpotato Varieties. NARO-NaCRRI Pp34

For the same reporting period the published papers were:

1) Rukarwa R. J., S. B. Mukasa, B. Odongo, G. Ssemakula and M. Ghislain. 2014. Identification of relevant non-target organisms exposed to weevil-resistant Bt sweetpotato in Uganda. Biotech. 4, (3): 217-226
2) Niringiye CS, Ssemakula GN, Namakula J, Kigozi CB, Alajo A, Mpembe I and Mwanga ROM. 2014. Evaluation of Promising Sweet Potato Clones in Selected Agro Ecological Zones of Uganda. Time Journals of Agriculture and Veterinary Sciences 2(3):81-88
3) Rukarwa R.J., Prentice K., Ormachea M., Kreuze J.F. , Tovar J., Mukasa S.B., Ssemakula G., Mwanga R.O.M. and Ghislain M. 2013. Evaluation of bioassays for testing Bt sweetpotato events against sweetpotato weevils. African Crop Science Journal. 21(3): 235-244.
4) Ghislain, M., Tovar, J., Prentice, K., Ormachea, M., Rivera, C., Manrique, S., Kreuze, J., Rukarwa, R., Sefasi, A., Mukasa, S., Ssemakula, G., Wamalwa, L. and Machuka, J. 2013. Weevil Resistant Sweetpotato through Biotechnology. Acta Hort. (ISHS) 974:91-98

5) Sefasi, A. J. Kreuze, M. Ghislain, S. Manrique, A. Kiggundu, G. Ssemakula and S. B. Mukasa. 2012. Induction of somatic embryogenesis in recalcitrant sweetpotato (Ipomoea batatas L.) cultivars. African Journal of Biotechnology 11(94): 16055-16064.
6) Sefasi A., M. Ghislain, A. Kiggundu, G. Ssemakula, R. Rukarwa, and S. B. Mukasa. 2013. Thidiazuron improves adventitious bud formation in recalcitrant sweetpotato. African Crop Science Journal 21(1):85-95.
7) Rukarwa R.J., Mukasa S.B., and Ssemakula G. 2013. Evaluation of progenies from crosses between Bt and non-transgenic sweetpotato (Ipomoea batatas). International Journal of Agronomy and Agricultural Research 3(3):28-37.
8) Mwanga, R.O.M. C. Niringiye, A. Alajo, B. Kigozi, J. Namakula, and I. Mpembe. 2011. 'NASPOT 11', a sweetpotato cultivar bred by a participatory plant-breeding approach in Uganda. HortScience 46(2):317–321. 2011.
9) Mwanga, R.O.M and Ssemakula, G. 2011. Orange-fleshed sweetpotatoes for food, health and wealth in Uganda. International Journ. of Agricultural Sustainability. 9 (1): 42-49.
10) Yada B., P. Tukamuhabwa, A. Alajo, and R.O.Mwanga. 2011. Field evaluation of Ugandan sweetpotato germplasm for yield, dry matter and disease resistance. South African Journ. Of plant and soil. 28(2): 142-146

Fifteen papers were also presented as part of conference proceedings. The conference details and number of papers presented were as follows:
1) 15th ISTRC Symposium (2009), Peru -2
2) 11th Symposium of ISTRC-AB, DRC (2010)-2
3) Global Conf. on Entomology, Thailand (2011) -1
4) ACSS Conf. (2011), Mozambique -1
5) 16th ISTRC Symposium (2012) Nigeria -3
6) 12th ISTRC-AB Symposium (2013), Ghana -2
7) APA (2013), Kenya- 4

There are two plant breeders and one entomologist all who have PhD degrees. There is one agronomist with a Masters degree, one BSc Biotechnologist and six technicians working in the program.

The program faces constraints including
1) Understaffing in relation to work magnitude
2) Under-funding
3) Lengthy procurement process
4) Most biotic constraints have a home in Uganda; they occur in Uganda

2.27 Update on sweetpotato breeding in South Africa: 2013-14

Sunette Laurie

The objectives of the sweetpotato (SP) breeding program in South Africa is to develop and release SP varieties which are sweet tasting, high in beta-carotene, high dry matter, high yielding, good storage root quality, and with resistance to Fusarium wilt, and virus diseases and drought tolerance.

Among the important landraces in the country are A2392, A35, A10, A2118, and A5799. The important bred varieties in the country are Blesbok, Beauregard, Ndou, Bophelo, Mvuvhelo, 199062.1, Monate, and A40.

During the 2013/14 period, the program had a crossing block with 20 parents. From these crossing blocks 340 seeds representing 55 families were obtained from controlled crosses. In the seedling nursery, 2076 seeds from 53 families were planted, 1538 successfully established. Observation trials were conducted at one location in which 70 clones were planted, 10 of which were checks. Preliminary trials with 305 clones (seven of them checks) were also planted at one location. There were also intermediate trials with 12 clones planted at three locations. Fourteen clones together with nine checks planted at three locations as part of advanced yield trials.

For sweetpotato foundation seed system, the program has a tissue culture laboratory in which 325 varieties are maintained under tissue culture. The program also has seven screenhouses. From the tissue culture lab 300 invitro plantlets are weaned every year. A total of 318 hardened vine cuttings are distributed every year while another 1200 are sold over the same duration. The program also has linkage to vine multipliers for further multiplication. Linkage to vine multipliers or producers from sweetpotato scheme: approximately 50% of the linkages are with government institutions that received 9548 seedling trays, 12 % with farmer multipliers (2450 trays) and 38% linkage with commercial producers. For cuttings from the base block at Roodepla at the program is linked 100% to 21 vine growers/farmers to whom 102750cuttings have been distributed.

During the 2009-2014, eight varieties (seven orange) were released. The information on variety release documents for 2009-2014 is as follows: Variety releases: 2009 (Isondlo, Purple Sunset), 2011 (Bophelo), 2013 (Mvuvhelo, ARC-SP1 to 5).

Published papers and manuscripts in proceedings during this period were:

Papers in peer-reviewed scientific journals:

1) Laurie, S.M., van den Berg, A.A., Tjale, S.S., MULANDANA N. S. and MTILENI, M.M., 2009. Initiation and First Results of a Biofortification Program for Sweetpotato in South Africa. *Journal of Crop Improvement* 23(3):235-251.
2) RAUTENBACH, F., FABER, M., LAURIE, S. & LAURIE, R., 2010. Antioxidant capacity and antioxidant content in roots of 4 sweetpotato varieties. *Journal of Food Science* 75(5): 400-405.
3) Laurie, S.M. & Van Heerden, S.M. 2012. Consumer acceptability of four products made from beta-carotene-rich sweet potato. *African Journal of Food Science* 6(4):96-103.
4) Laurie, S.M., Faber, M., van Jaarsveld, PJ, Laurie, R.N., du Plooy, C.P. & Modisane, P.C. (2012). β-carotene yield and productivity of orange-fleshed sweet potato (*Ipomoea batatas* L. Lam.) as influenced by irrigation and fertilizer application treatments. *Scientia Horticulturae* 142: 180-184.
5) Laurie, S.M., van Jaarsveld, P.J., Faber, M., Philpott, M.F. & Labuschagne, M.T. (2012). *Trans*-β-carotene, selected mineral content and potential nutritional contribution of 12 sweetpotato varieties. *Journal of Food Composition and Analysis* 27:151-9.
6) Laurie, S.M., Faber, M., Calitz, F.J., Moelich, E.I., Muller, N. & Labuschagne, M.T. (2012). The use of sensory attributes, sugar content, instrumental data and consumer acceptability in selection of sweet potato varieties. *Journal of the Science of Food and Agriculture* 93(7):1610-1619. DOI 10.1002/jsfa.5932

7) Laurie S.M., Calitz F.J., Adebola P.O., Lezar, A. (2013). Characterization and evaluation of South African sweet potato (Ipomoea batatas (L.) LAM) land races. *South African Journal of Botany* 85: 10-16.
8) Faber, M., Laurie, S.M., van Jaarsveld, P.J. (2013). Total *β*-carotene content of orange sweetpotato cultivated under optimal conditions and at a rural village. African Journal of Biotechnology Vol. 12(25): 3947-3951.
9) Adebola P.O., Shegro A., Laurie S.M., Zulu L.N. & Pillay M. 2013. Genotype x environment interaction and yield stability estimate of some sweet potato [*Ipomoea batatas* (L.)Lam] breeding lines in South Africa. Journal of Plant Breeding and Crop Science Vol. 5(9), pp. 182-186, September, 2013.

Scientific papers in proceedings:

1) LAURIE, R.N., DU PLOOY, C.P. & LAURIE, S.M., 2009. Effect of moisture stress on growth and performance of orange fleshed sweetpotato varieties. African Crop Science Conference Proceedings, Vol. 9. pp. 235 – 239.
2) Laurie S.M., Ntombela, S., Chiloane, N., A Gerrano, T Ramathavhana T, Tjale S & O Nyirenda, 2013. Sweet potato varieties with improved taste and yield for food security and health of resource-poor communities in Gauteng. Proceedings of the 5th GDARD research Symposium held on the 6th June 2012 at St George's Hotel, Irene. Jun 2013, Gauteng Province Department of Agriculture and Rural Development.
3) Beletse, Y.G., Laurie, R., Du Plooy, C.P., Laurie, S. & van den Berg, a., 2013. Simulating the yield response of orange fleshed sweet potato 'Isondlo' to water stress using the FAO AquaCrop model. Acta Hort.1007:935-941. http://www.actahort.org/books/1007/1007_112.htm
4) Zulu, L., Adebola, P.O., Shegro, A., Laurie, S.M. & Pillay, M., 2013. Progeny Evaluation of some Sweet Potato [*Ipomoea batatas* (L.) Lam] Breeding lines in South Africa. Acta Hort 1007: 247-254. http://www.actahort.org/books/1007/1007_25.htm
5) Laurie, S.M. and Thompson, A. 2013. Breeding and control strategies against Fusarium wilt, caused by *Fusarium oxysporum* f. sp. *batatas*, for sweet potato in South Africa, 22th Symposium of the Soil-borne plant diseases Workgroup, Stellenbosch, 17-19 Sept 2013.
6) APA submitted: S.M. Laurie, M.M. Mtileni, W.M. Mphela, A.A. Van den Berg, T. Ramathavhana, L. Sediane, T. Maraganedzha and C.P. du Plooy. Promotion of vitamin A-enriched sweet potato for production by small-scale commercial farmers in South Africa. 9th Triennial African Potato Association Conference, 30 Jun – 4 Jul 2013, Naivasha, Kenya.

Manual

1) Faber M, Laurie S, Ball A & Andrade M (2013). A crop-based approach to address vitamin A deficiency in South Africa. Medical Research Council, Cape Town / ARC-Roodeplaat, Pretoria, South Africa.

Dissertations

1) LAURIE, S.M., 2010. Agronomic performance, consumer acceptability and nutrient content of new sweet potato varieties in South Africa. PhD in the Department of Plant Sciences (Plant Breeding), Faculty of Natural and Agricultural Sciences, University of the Free State, May 2010. *etd.uovs.ac.za/ETD-db/.../etd.../LaurieSM.pdf*
2) Setumo M.P. 2013. A stochastic frontier approach to economics of production and marketing of orange-fleshed sweet potato at farm level: A case study of KwaZulu-Natal Province, South Africa. MSc Agric mini-dissertation, University of Limpopo, August 2013.
3) 3 MSc's submitted, 1 PhD in progress

Chapters in books

1) FABER, M & LAURIE SM, 2010. A home-gardening approach developed in South Africa to address vitamin A deficiency. In: Thompson B, Amoroso L (eds). Food Based Approaches (FBAs) for Combating Micronutrient Deficiencies. Food and Agricultural Organization (FAO) and CABI bookshop. Pg. 163-182. ISBN-13: 978 92 5 106546 4. *www.fao.org/docrep/013/am027e/am027e00.pdf*
2) Faber M, Laurie SM, Van Jaarsveld PJ. Critical issues to consider in the selection of crops in a food-based approach to improve vitamin A status – based on a South African experience. In: Thompson B, Amoroso L (eds). Improving diets and nutrition. Food-based approaches. CABI and FAO, pp 45 – 57, 2014.

Among the projects undertaken by the SP program in the country include:

a) Demonstration agronomy of OFSP – National Department of Science and Technology (2010-2013)
b) Collaboration with rural-based universities – National Department of Science and Technology (2010-2013)
c) On-farm trials in Gauteng – Provincial Department of Agriculture and Rural Development (2011-2012)
d) Mutation breeding – International Atomic Energy Agency (2009-2014). The work here targets yield and quality traits. So far only cream colors have been but with higher mineral nutrient contents.
e) Leaf and stem blight: causal agents, fungicide, screening (2012-2015)
f) Agro-processing strategy for sweetpotato – National Treasury (2012-2015)
g) Sweetpotato vine grower and grower enterprises – Department of Rural Development and Land Reform (2012-2017)

The program has 18 staff (with three PhDs one of whom is a plant breeder together with six MSc, two BSc and seven Diplomas. The program is constrained by slow procurement processes and lack of funding for breeding. Among the activities proposed for the future are PhD work to focus on vine nurseries, MSc on profitability of nurseries, and MSc work on Fusarium wilt resistance.

2.28 Sweetpotato breeding in Tanzania

Rahila Amour

The overall objective of the sweetpotato breeding program is to contribute to improved income, food and nutrition to the communities in Tanzania. The specific objectives are:

1) To improve sweetpotato production in Tanzania through participatory breeding.
2) To promote the new technology and improved varieties to Tanzanian communities.

Among the most important landraces in the Lake and Eastern zones of the country are Polista, Ukerewe, Mwanatatata, Kigambile nyoko, Umeme, Matege, Mayai and Sekondari. The most important bred varieties in the country are Mlezi, Carrot Dar, Carrot-C, Kakamega, Simama, and Jewel.

During the 2013/14 period, the program had a crossing block with 39 parents. From this crossing block 2520 open pollinated seed representing 224 families was collected. An additional 16716 seeds from controlled crosses were collected. The controlled cross seed represented 570 families. Of the seed collected, 16,696 seeds were planted in a seedling nursery with 2700 seedlings representing 120 families established. An observational trial with 317 clones was also established at two locations. A total of 72 clones were established in preliminary yield trials at three locations. Twelve clones were also established for advanced yield trials at six locations. A total of 150 on-farm trials were planted across the whole country. At the time of reporting the program had so far released seven varieties (five of which are orange) and another five varieties (one orange) were in the pipeline for release in 2014.

For foundation seed systems the program reported inadequate facilities. There were only three screenhouses which at the time of reporting needed repair. The program has linkage to vine multipliers. Linkage with government institutions account for 30% and is focused on primary nurseries. Linkage to NGOs is focused on secondary nurseries and account for 60% of the linkages. Farmer multipliers who are involved in tertiary nurseries account for 10%.

Since 2010 the program was supported by funding from AGRA (USD 185,000) and the government of Tanzania through Commission for Science and Technology (USD 5000) over a three year period. At the time of reporting the program had submitted USD 296,000 proposal to AGRA for renewed support but this was not yet funded. The program has eleven scientists (4 PhD, 7 MSc). There are also five BSc degree level staff and four Diploma level technicians.

Conference Papers

1. Mayanja, M. McEwan, Y.Obong, R.Manasseh , P.Ndolo, E.Lukonge. 2012. Building sustainable sweetpotato market linkages through Innovation Platforms for Technology Adoption: Case studies from Uganda, Kenya, Rwanda and Tanzania. *16th ISTRC, Nigeria 23 to 28 Sept 2012 S.*
2. Lukonge E., I. Ndyetabula, W. Kaswahili and J. Shigulu, 2013. Health and income improvement from OFSP value chain in the Lake *Zone*. *9th Triennial APA conference coming up June 30th - July 4th 2013 in Naivasha Kenya.*
3. Lukonge E., I. Ndyetabula, W. Kaswahili and J. Shigulu, 2012. Leaning and Innovative and Dissemination of OFSP Technologies in Tanzania, *FARA annual meeting, 1st-5th October, 2012. Mwanza, Tanzania.*
4. Lukonge E., Ndyetabura I., Mayanja S., McEwan M., Shigulu J., Kaswahili W., Bundala R., Kuliani L., Shumbusho E. 2012. Promoting OFSP utilization through the value chain: Lake Zone, Tanzania. Poster, 3rd Annual Technical Meeting for the SASHA project and the broader *SPHI 11th to 13th September, 2012 Nairobi, Kenya.*

Manuscript:

1. Release of 4 Sweetpotato varieties in Tanzania for food and nutrition improvement. Journal of The Science of Food and Agriculture.

Constraints

1) A combination of extended period of dry season and unpredictable rain have been affecting the breeding program in the country
2) Projects timeframe are shorter than the actual breeding activities
3) Virus pressure

Proposed future activities

1) Fast tracking the already released varieties within the East Africa countries and the available bred materials

2) Continue with participatory breeding activities

3. FIELD VISIT

On the second day of the meeting, the participants went out on a field visit to Mulanje area and were able to visit a sweetpotato market, farmers' production fields, participatory variety evaluation and demonstration site, a farmer managed processing facility, and Bvumbwe Research Station.

Marketing

At the market the participants took note of the large volumes of sweetpotato supplied to the market and also noted a number of market issues some of which were challenges especially to the growers. The observations and suggestions made concerning marketing were:

1) Packaging of the sweetpotato was in large bags. Packaging of roots for sale was not standardized and packing in big distended tended to favor the buyers more than the sellers. The lack of standardization of weights per bag leads to price variability.
2) Farmers brought produce to market at their own cost irrespective of quantity. Marketing was a tiresome activity when using bicycles. Farmers could organize themselves to do joint marketing and hire trucks to take produce to the market and get better prices
3) Marketing of sweetpotato can be improved to stabilize prices. The prices were very low (less than 5 USD per 70 kilogram bag.
4) Sweetpotato for sale sorted before delivery to buyer
5) Marketing is more on the open market
6) Potential to make formal markets exist due to large volume of produce
7) Good quality of roots delivered to the market
8) Fewer women were involved in selling. Bulkiness of roots may limit women participation in selling
9) Produce has to be marketed immediately after harvest since storage is a challenge
10) There is an imbalance in the supply and demand – high supply, low prices
11) High volumes delivered to the market indicated good production
12) There were many sweetpotato vendors in the market
13) There were women involved as intermediaries (middle women) in the market
14) Farmers involved in the marketing of their produce but the uncoordinated approach resulted in oversupply to the market
15) There was vibrant and organized rural market for sweetpotato roots. The markets could make a great entry point for OFSP
16) Unsold bags of sweetpotato were stored at a price
17) The roots offered for sale were graded or sorted before sale
18) One variety dominated the market. Zondeni though yields lower than Kenya was the most dominant variety in the market
19) Land owners at the market rented space to the root sellers. The charges were levied per bag.
20) There was uncertainty on the market for roots
21) Children of school going age were actively performing various services for a fee
22) Prices were low and ranged from 6-12 UD (2500-5000 kwacha) hence the need for better market research and linkages
23) Farmers produced sweetpotato based on existing market demand

24) The evident poor market for fresh produce made a case for processing of the roots into products that can be stored and sold at a different time or far away from the local markets


Picture 1. Sweetpotato being ferried on bicycles to the market

Seed systems and crop management

From a visit to the farmers' fields and also the research station, the participants made observations and suggestions and also took home useful learning points. These are summarized as follows:

1) Seed multiplication in the screenhouse was commendable given the rapid and continuous mass multiplication without disease infection. Vine multiplication conditions were satisfactory
2) Vine multiplication in plastic pots which involved putting fertilizer into the pots and harvesting the vines once grown was a commendable method that had potential to be used for more than three years. There is a good method for vine multiplication in the screenhouse using small polythene bags and potential to be used for a long time. This was an approach learning point for the participants
3) At the farmers' fields there was a good example of families working together and women's roles were clear
4) Field cultural practices were well done. Weeding was good. Fields were clean and free from pests
5) Farmers did not apply fertilizers but they still got good yield and big roots
6) It was not clear how vines at the farmers fields were preserved
7) There was sharing of vines by farmers. Farmers produced their own seed. Farmers seemed competent in managing their own seed – viruses did not seem to be a problem
8) Production was driven by the market
9) Community based seed systems and research station based seed systems were observed
10) The research institute was involved in production of quality planting material
11) Need to involve farmers in the seed systems

12) There is need to think about how seed systems can be integrated with marketing, storage and processing
13) Seed system not well developed
14) Seed system was informal. There was need to add new cultivars into it.
15) Many people produce seed in big areas
16) SP was grown on big ridges which improved yield
17) It was good to see how to conserve clean materials over a long period of time
18) There was support by biotechnology tissue culture, virus indexing and generally good research facilities to keep planting material clean
19) There was need to promote local level planting material production
20) There was need to strengthen breeding work to seed systems and also to increase farmers' awareness about new OFSP releases
21) Seed systems in Malawi: Where seed comes from- Farmer prepare nurseries at the dambo land, the vines are brought to the upland during the rainy season. This is for farmers who are not far from the dambo land. In November or December when the rains come, farmers grow maize as a priority crop for staple food but grow few SP vines within the rows of maize. In February sweetpotato is grown by most farmers. Irrigation has been introduced by the government through one of the policies (Agriculture Sector Wide Approach- ASWAp) to promote diversification of food crops. Through some of the irrigation infrastructure, farmers through irrigation clubs access water which they use to multiply SP vines
22) During the field trip, participants did not visit the CIP led project, Rooting Out Hunger in Malawi funded by the Irish Aid. This work has been recognized by Malawi government research services (DARS) and extension at high level
23) High production per unit area without fertilizer


A farmer and his wife speak to visitors about their well planted and managed sweetpotato field

Breeding

Among the key observations and suggestions made concerning the breeding work were:

1) The work was in good hands but continual improvement was needed
2) Good breeding work and appreciated large crossing block that was focused and also well maintained

3) Popular variety at farmers' field and market is Kenya (also known as Tanzania). The variety is high yielding, early maturing, good tasting and has high dry matter content
4) While it was evident that a lot of progress had been made in breeding, the observation that farmers' fields had only one variety was not encouraging. Orange fleshed varieties were yet to be adopted by farmers in the area. Promising OFSP clones were in the process of being released. Have identified three superior OFSPs, Chipika, Anaakwanire and Kadyaubwerere
5) Less apparent pests and disease problems observed
6) Need to collect more seed from the crossing blocks
7) The breeding team was efficient and effective
8) There was strong linkage between research and extension
9) The participatory evaluation of the new varieties at the Extension Planning Area (EPA) enables the farmers to learn about the new varieties
10) From the experience in the demo farm, farmers were still clinging to the old varieties (Kenya/Tanzania) relative to newly developed varieties. This trend can be reversed by more awareness about OFSP and its health benefits
11) Quite a number of crosses were generated
12) The breeding program needs to include OFSP in their objectives and incorporate into farmers' preferred varieties
13) More varieties needed to help farmers diversify and as a way of reducing risk associated with disease outbreak on the available single variety

Participants visiting a crossing block at that Bvumbwe Research Station. On the right is one of the OFSP clones most preferred by farmers at a participatory evaluation trial. The clone is in the pipeline for release in the country.

Processing

1) More technology was required to produce more products such as flour, biscuits.
2) Packaging material needed to be improved on
3) Need to link fresh root production into processing with demand /promotion
4) Level of processing was low but local women had been introduced to diversified product development.
5) Most of processing was done by women
6) Proximity of the processing facility to a school was good

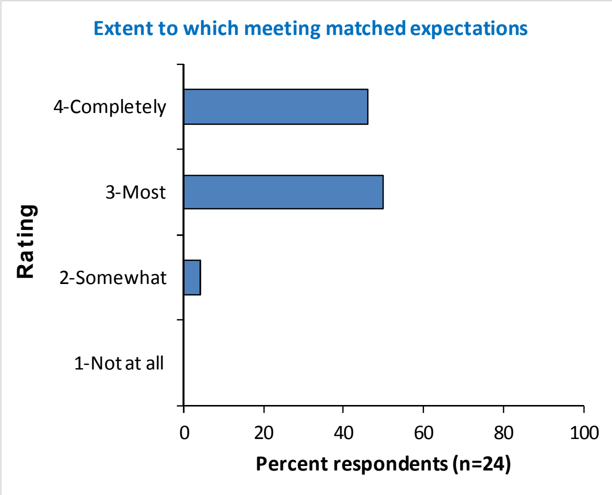
7) It was great to see locals having the knowledge on value addition
8) There was use of local technology in value addition. A case in point was the juice made from sweetpotato leaves
9) The group needs assistance to improve on their packaging
10) The baking facility seemed wider
11) Processed products ranged in variety from doughnuts to juice
12) Processing was done at a small scale
13) Processing seemed to be at infancy stage and needs more improvement to be able to utilize the surplus production
14) The bakery was good but too small
15) Different food forms should be included apart from drinks and cakes
16) There is need to promote processed products and upscale their production
17) The processing facility was underutilized
18) There was need for better storage facilities
19) Sanitary condition around the processing plant needed improvement
20) The farmer needed a company to oversee processing

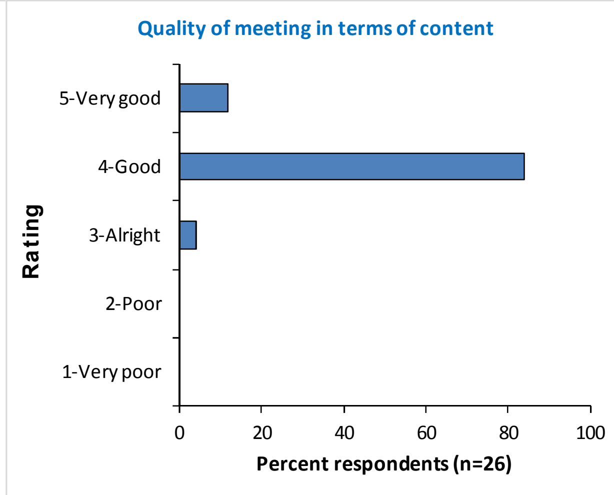
Women farmers displaying some of their processed sweetpotato products

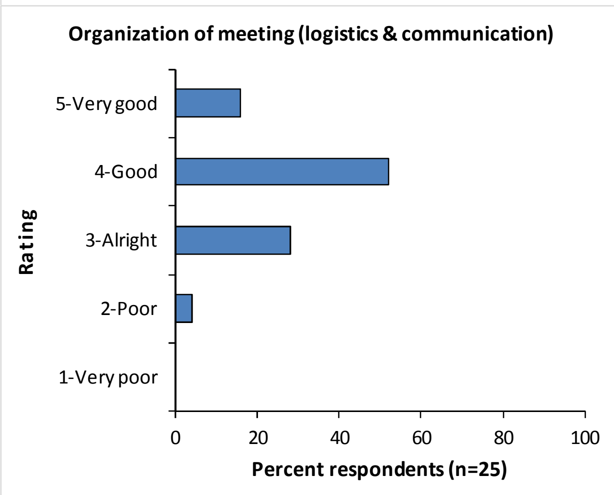
Meeting Evaluation

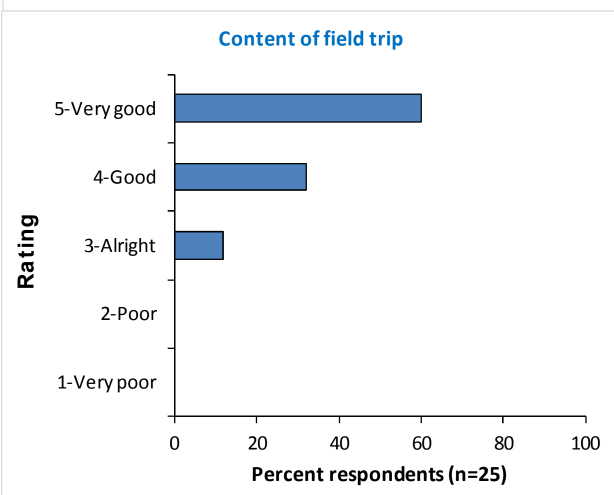
The majority of the participants (>80%) rated the meeting as good to very good in terms of fulfilling expectations, content of presentations, field trip, CloneSelector training, and field logistics (see Annex 1 for details0. The number of CloneSelector users increased compared to previous years (Annex 1).

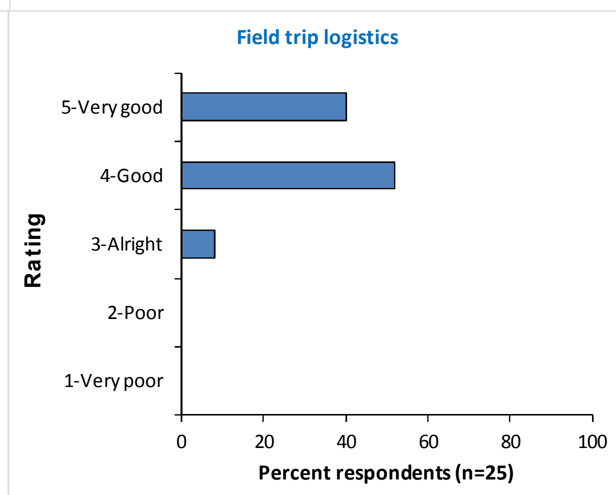
Annex 1: Evaluation of Speed Breeders Meeting held in Blantyre, Malawi June 17-20, 2014



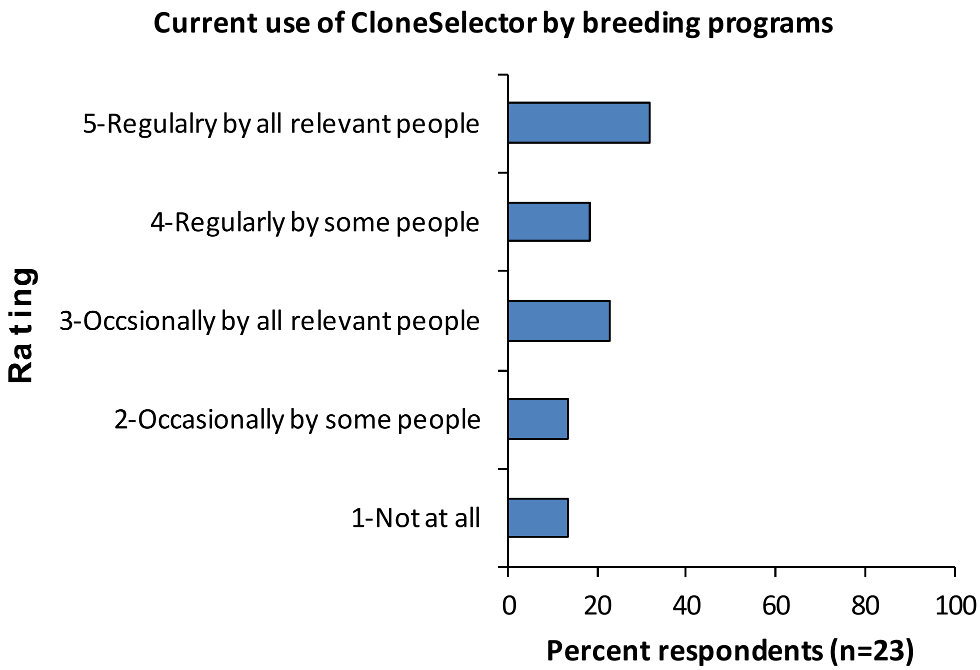








Annex 1 (cont)



Parts of the meeting that were considered most useful

1) Field visit and learning about many new things including use of small polythene bags for vine multiplication
2) CloneSelector training
3) Technical sessions
4) General and panel discussions
5) Current advances in research work
6) Presentation on looking forward to phase II of SASHA
7) Discussion on sweetpotato storage and processing
8) Heterosis and genomics
9) Systematic evaluation of elite clones
10) Presentation by Wolfgang on polycross versus controlled crosses
11) Presentation by Godgfrey of Alternaria blight
12) Invited papers
13) Thesis report
14) Use of selection index in CloneSelector
15) Presentation on genomic tools for sweetpotato improvement
16) Discussion sessions on seed systems, conservation of germplasm, germplasm fingerprinting
17) Overview of breeding programs and country reports
18) Interactions among participants
19) Presentations on new projects in the pipeline
20) Presentations on drought studies

Parts of the meeting that were considered least useful

1) Marker assisted breeding presentation was not well focused on sweetpotato
2) Trial types
3) Bred varieties
4) Landraces
5) Screening techniques for drought tolerance not clear
6) Too many presentations and no time to conclude the business
7) Some NARS only represented their programs and not the overall country effort
8) Panel discussion on seed systems was not well organized
9) Support platform presentations needed broader focus on countries they support

Suggestions on areas for improvement or topics for the next meeting

1) More time on CloneSelector and index selection
2) Statistical tools
3) Need for more clarity on usefulness of genomic tools in sweetpotato breeding work
4) Panel discussions need to be more structured. This could possibly be done by sending the purpose in advance to panel members and then each panelist makes a two minute presentation before opening for discussion
5) Participants should be accommodated at the same venue
6) Add focused topics on new breeding techniques for sweetpotato
7) Include a component on project management training (maybe one day)
8) More research work presentations by breeders
9) Sweetpotato storage and processing
10) Breeding of sweetpotato for resistance to weevils
11) Again discuss seed systems to see if there is progress
12) Agronomic management
13) Agroprocessing and utilization
14) More time should be allocated to breeding programs at CIP (Peru, Uganda and Mozambique)
15) Presentation of statistics need improvement
16) Drought tolerance breeding
17) More information about traits, environment and performance of new varieties in comparison to existing varieties
18) Control of time
19) Market component of vines and roots
20) Genetic dissection of complex traits needs to be simplified
21) Include private seed companies to share experience
22) Better venue
23) Continue with the same approach that includes technical and field visit components but solicit partner input in program for next year
24) How the community of practice if going to monitor genetic gain
25) Develop protocol for breeding programs on stability

Suggestions on how to manage country level reporting

More than 90% of the respondents felt that the use of a standard template was a good idea but made several suggestions that could be adopted to further improve reporting. The suggestions were:

1. Make provision for country teams to share additional information they wish to share with the CoP. In a presentation this could be on an additional slide or two. Alternatively allow expansion of the template to provide additional information
2. The standard slides could be varied in such a way that in some years country teams could just present highlights about their programs but in other years detailed presentations could be made
3. It may be better if columns on previously reported years are removed and only have presentations focus on work done in the previous year
4. Additional time should be allocated for presentations to allow for meaningful interactions and comments
5. Consider making a provision for baseline information and description of environment
6. Could additionally accommodate in the template a column where programs can indicate areas where they need assistance
7. Room should be provided for country specific issues to uncover new things
8. Guidelines on areas to be covered should be given but using a common template is not good. Country teams should be given room to innovate. The current approach has no room for creativity
9. Consider making a provision for information on introduced seed versus locally produced so as get estimates on variety adoption or dissemination
10. Include in the template information on foliage production

Other comments

1. No clarification made on payment of per diems and other expenses
2. The meeting was very good, informative and provided excellent opportunities for information exchange and group networking
3. CIP SASHA platforms and headquarters should improve communications on new developments to all NARS.
4. Discussion sessions were very good and need to be upheld in next meetings
5. Suggesting that the next meeting be held in Ghana and in the future another should be held at North Carolina State University
6. Hold meetings at venues where hotels have adequate accommodation facilities and internet. Pick up from the airport could be better organized so as not to delay participants
7. Feeling that countries at present are not equally represented so there is need to have all countries involved actively
8. Include two to three slots for key note speeches that country programs could apply for

Annex 2: List of participants

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Annex 3: Agenda

Sweetpotato breeders Meeting, Malawi Sun Hotel, Blanytre, Malawi, June 17-20, 2014 (Arrival date 16th, departure 21st)

Day/Time	Activity	Responsible
16 Mon	Arrival	Agnes Kachiwanda/Felistus
17 Tues	Arrival and Meeting Preparations	Agnes Kachiwanda/Felistus
8:00-8:30 am	Registration	Agnes Kachiwanda /Felistus Chipungu/Abidin Putri Ernawati
8:30-9:00 am	Welcome remarks/Self introductions	Felistus Chipungu/ Note taking Charles
9:15-9:45 am	Opening Address	Dr. Wilfred Lipita, Controller for Agricultural Research Services (CAS)
9:45-10:15 am	Looking Forward to Phase 2 of SASHA and the	Jan Low
10:15-11:00 am	Health Break and Group photo	Luka Wanjohi/Felistus Chipungu
	Chair: Sunette Laurie/ Platform/Country Reports	**Note taking: Charles Wasonga**
11:00-11:15 am	Sweetpotato Support Platform, S. Africa	Maria Andrade
11:15-11:30 am	Sweetpotato Support Platform, E. Africa	Robert Mwanga
11:30-11:45	Sweetpotato Support Platform, W. Africa	Ted Carey
11:30-11:45	Thoughts on breeding for storage and processing	Ted Carey
12:00-12:45 pm	Discussion on sweetpotato storage and processing	Kwadwo Adofo, Evarina Lukonge, Jean
12:45-2:00 pm	Lunch break	
	Chair: Maria Andrade	**Note taking: Godwill Makunde**
2:00-3:30 pm	SSA regional sweetpotato germplasm DNA fingerprinting Discussion	Awais/Wolfgang (Presentation from Dave Ellis -lead), Ted Carey, Some Koussao
3:30-4:00 pm	Health break	
	Chair: Awais Khan	**Note taking: Benjamin Kivuva**
4:00-4:15 pm	Malawi	Felistus Chipungu
4:15-4:30 pm	Rwanda	Jean Ndirigwe
4:30-4:45	Zambia	Martin Chiona

Day/Time	Activity	Responsible
19 Thurs	**Chair: Martin Chiona**	**Note taking: Solomon Afuape**
8:00-8:15 am	Mozambique	Jose Ricardo
8:15:8:30 am	Kenya - country report	Laura Karanja
8:15-8:45 am	Breeding of sweetpotato for resistance to Alternaria spp. in Uganda	Godfrey Sseruwu
8:45-9:00 am	Discussion	
9:00-10:00 am	Systematic evaluation of elite clones, seed populations and check clones	Wolfgang Gruneberg, Jean Ndirigwe, Laura Karanja, Sunette Laurie, /Panel
10:00-10:30 am	Health break	
10:30-1:00 pm	Data analysis CloneSelector /Review	Luka Wanjohi /Raul Eyzaguirre
1:00-2:00 pm	Lunch break	
2:00 - 5:00 pm	Analysis of quality trait data in CloneSelector, Index selection,	Luka Wanjohi/Ebenezer Obeng- Bio/Raul Eyzaguirre
20 Frid	**Chair: Gorrettie Ssemakula**	**Note taking: Charles Wasonga**
8:00-8:30 am	Polycross versus controlled cross breeding and advances in heterosis exploiting breeding schemes	Wolfgang Gruneberg
8:30-9:00 am	Genetic dissection of complex traits, crop improvement through marker-assisted selection and genomic selection	Awais Khan
9:00-9:30 am	Genomic tools for sweetpotato improvement and other projects	Craig Yencho
9:30-9:50 am	Screening techniques for sweetpotato drought tolerance	Robert Laurie
9:50-10:00 am	Discussion	
10:00-10:30 am	Health Break	
	Chair: Ted Carey	**Note taking: Sammy Agili**
10:30-10:50 am	Sweetpotato combining ability and heterosis under drought stress	Benjamin Kivuva
10:50-11:10 am	Madagascar	Rosoloniaina Bruno
11:10-1:00	Pre-breeding and Seed Discussion	Wolfgang Gruneberg, Maria Andrade, L. Karanja, M. Chiona,
1:00-2:00	Lunch break	
	Chair: Some Koussao	**Note taking: Ted Carey**
2:00-2:15 pm	Nigeria	Solomon Afuape
2:15-2:30 pm	Uganda	Gorrettie Ssemakula
2:30–2:45 pm	South Africa	Sunette Laurie
2:45-3:00 pm	Tanzania - country report	Rahila Amour Mohammed
3:00-3:15 pm	Discussion	
3:30-4:00 am	Health Break	
4:00-5:00 am	Wrap up	R. Mwanga/ Felistus Chipungu/Jan
21 Sat	**Departure**	Agnes /Felistus/ Abidin

Field Trip, June 18, 2014

Time	Activity/ Venue
7.45	Depart hotel for Mulanje
9:15–9:45	Farmer visit (challenges and success as presented by a producer)
10.00-11.30	Nsikawanjala EPA (Agric office)- sweetpotato harvesting with farmers (demo plot)
11.30-12:30	Visit womens bakery (within the area)
13.00- 14.00	Lunch either at Mulanje Boma or lunch on the way to Bvumbwe
15.30- 17.00	Tour of Bvumbwe Research Station
17.00	Depart for hotel