Annual SASHA Progress Report: Narrative for 1 July 2010–30 June 2011

Executive Summary

The Sweetpotato Action for Security and Health in Africa (SASHA) is a five-year project that serves as the foundation for the Sweetpotato for Profit and Health Initiative (SPHI) launched on 26 October 2009. SPHI aims to reduce child malnutrition and improve smallholder crop incomes in 10 million African families by 2020 through the effective production and expanded use of sweetpotato. SASHA seeks to directly improve the food security of at least 155,000 Sub-Saharan Africa (SSA) families by exploiting the untapped potential of sweetpotato and to create the conditions for going to scale. This requires (1) transforming sweetpotato breeding, (2) developing innovative seed systems, (3) strengthening partners' capacities, and (4) understanding how to link these components to market and food-based nutritional interventions while assuring gender equity. The project focuses on research supporting development outcomes coordinated through three sub-regional sweetpotato support platforms (SSP). Sweetpotato's image will be transformed from a poor person's crop to a healthy food preferred by all. The project comprises five program areas to achieve its objectives. In year 2 (1 July 2010–30 June 2011), the basis of this report, all year 1 partner contracts have been renewed, new year 2 partner contracts signed, and only the Biosciences eastern and central Africa (BecA) agreement remains unsigned (however, the facilities are being used.)

There have been some substantial revisions to the design and hence the milestones in Objective 2 in the Seed Systems Research Program (the Marando Bora project). Of the 55 milestones due to be completed by 30 June 2011, 45 have been completely achieved (82%). Among the remaining milestones, we are proposing five to drop, two are close to being achieved, and three have been rescheduled. Reasons for delay are provided in the main text and Appendix B (timeline and milestones). Appendix A provides an updated log frame of outputs.

Research Program 1 (RP1): Breeding and Varietal Improvement. The overall objective of RP1 is to establish efficient population improvement programs at a sub-regional level in SSA linked with participatory varietal selection at the national level. This objective enables short- and long-term production of new locally adapted varieties that significantly improve famer incomes and deliver nutritional benefits to consumers, especially women and children. Developing varieties with traits desired by consumers is fundamental to the success of the SASHA project; therefore, RP1 is the largest of the five research programs. Activities are conducted in SSA by International Potato Center (CIP) breeders at three SSPs and by the global leader of sweetpotato breeding at CIP headquarters (CIP-HQ) under six major activity areas, each with specific milestones. A major achievement of the Mozambique program was the release of 15 drought-tolerant orange-fleshed sweetpotato (OFSP) varieties. These varieties were developed using the new accelerated sweetpotato breeding approach, with work beginning prior to the inception of SASHA. They constitute a strong proof of concept of accelerated breeding, which has not previously been used in sweetpotato breeding in SSA and which will be used routinely by sweetpotato breeders under SASHA. A second significant achievement derives from analysis of a large experiment to evaluate heterosis in sweetpotato, with significant heterosis found for both biomass yield and storage root dry matter content. A further significant achievement was

the refinement of CloneSelector, an Excel-based program for conducting breeding trials, with the inclusion of R-based statistical package for various important analyses needed for sweetpotato breeding, including evaluation of multi-locational trials using analysis of variance and multivariate techniques, and selection indices which allow for simultaneous selection for multiple traits. Finally, much effort went into training, backstopping, and collaborative efforts to develop a strong community of practice among sweetpotato breeders in SSA. Of the six milestones due by the end of year 2, four have been completed.

Research Program 2 (RP2): Breeding Weevil-Resistant Sweetpotato (WRSP). RP2 aims at the development of weevil-resistant (WR) varieties of sweetpotato using biotechnology and the dossier needed for deregulation by national authorities by the end of the first phase in mid-2014. Three WR genes have been introduced into sweetpotato varieties amenable to genetic transformation, and they have produced close to a hundred transformed events (*transgenic plants*). We identified four of them as high expresser transformed events with a single WR gene. Thirty of the transformed events were transferred to BecA and Kenyatta University in Kenya. Fifty-six transformed events with two WR genes have been produced from other varieties, including the African variety Imby. More transformation experiments are underway out of which we expect about 20-30 transformed events to be harvested during the first semester of 2012. Unexpected delays in the transfer of WRSP events to the University of Puerto Rico (UPR) and National Crops Resources Research Institute (NaCRRI) in Uganda delayed testing for efficacy against weevils, but these are now being propagated at NaCRRI for storage root production. At UPR, nine transformed events are being multiplied *in vitro* while awaiting clearance from the US Department of Agriculture (USDA) quarantine service.

The molecular characterization of these transformed events has continued to focus on gene expression and protein accumulation in the plant. At laboratories in Peru and Kenya, the variety Jewel has been the source of storage roots for most of the transformed events. These are currently used to assess the efficacy of the WRSP technology against weevils as powder and fresh roots. Genetic transformation of African varieties remains the single most important bottleneck to bring this technology to Africa. Progress in screening for varieties with high regeneration efficiency has led to using Imby at the Applied Biotechnology Laboratory (ABL) facility (CIP-HQ, Peru) resulting in 33 putative transformed events. In Kenya and Uganda, the focus on the one or two best African varieties led to significant progress. These encouraging results confirming the possibility to transform particular African varieties support the continuation of the direct transformation of African varieties as a valid strategy: **our first "go/no go" decision is "go."**

The mode of action of the three proteins with activity against weevils continues to be investigated as it is an important element of the deregulation dossier. Our collaborator in Spain has obtained the *Bacillus thuringiensis* (Bt) strains for two proteins. The binding of one of these crystal proteins to weevil intestine was confirmed, but more research is needed to understand their mode of action. Another element of the dossier is the impact on the environment, namely on genetic diversity and non-target organisms. Both aspects have been discussed, and the meaningful research questions for the WRSP technology have been identified. Now, the final step of the proof of concept (efficacy) will constitute the most important result expected during the coming year. In 2010, African scientists had the opportunity to discuss genetically modified

(GM) product development and improve their science communication skills in a course organized by the Institute of Plant Biotechnology for Developing Countries (IPBO) Belgian partner at International Livestock Research Institute (ILRI) in Kenya. Of the 15 milestones due to be completed by the end of year 2, 14 have been completed.

Research Program 3 (RP3): Sustainable Seed Systems. RP3 focuses on developing and testing strategies to maintain and multiply quality planting material, efficiently supply vines following dry periods, and scale out variety dissemination cost effectively. Research capturing the nature of existing "seed system" practices in Uganda, Tanzania, and Rwanda was consolidated into an article accepted for publication. Validation of a technology which improved upon the existing practice of farmers to utilize volunteer plants from re-sprouting roots at the beginning of the rains was successfully undertaken in Tanzania. Dubbed the "Triple S" method (storage in sand and sprouting), a brochure was produced to encourage broad use of this technology. Results also indicate that use of simple net-covered tunnels to protect foundation material in high virus pressure areas is viable and should be tested in other settings and among progressive farmer multipliers. Regarding novel techniques for rapid multiplication within screenhouses, sand hydroponics produced more cuttings than conventional multiplication using soil substrates, and further testing is warranted.

Tremendous progress has been made in training national virologists and technicians in virus identification and indexing in Kenya, Mozambique, and Ghana and in RNA extraction in Kenya. Virus survey results from Mozambique are now available, and infrastructure improvement advanced in Kenya, Mozambique, and Ghana. A significant milestone to identify and validate the five most informative simple sequence repeat (SSR) markers that are capable of confirming whether two genotypes of African germplasm are the same has been fully achieved and documented. Progress towards developing a suite of novel diagnostic methods for sweetpotato-virus detection continues to be made. Using CIP small interfering RNA (siRNA) deep-sequencing technology, complete or partial sequences have been determined for 4 new sweetpotato viruses. The first iteration of ClonDiag tube array, designed to detect 15 viruses with 3-6 probes each, was developed, and two virologists were trained on its use and validation. Among the RP3 research milestones, all four milestones due by the end of year 2 have been fully achieved.

Large-scale dissemination of improved orange-fleshed varieties and "cleaned-up" local varieties are being tested in the Lake Zone area of Tanzania in a project named *Marando Bora* ("better vines" in Kiswahili), with a goal of reaching 150,000 households. Thirty trained decentralized vine multipliers (DVM) distributed quality planting material to a total of 9,989 households of which 72% were women beneficiaries. Each farmer received 200 cuttings in exchange for vouchers between February and March 2011. Major revisions in the methodology and end date for reaching the goal were made based on lessons learned to date, taking resource constraints into account. This necessitates some significant changes in some milestones, the rationale for which is provided in the report. Of the 10 milestones due by the end of year 2, 5 have been completed, and 5 we dropped due to design changes.

Research Program 4 (RP4): Proof-of-Concept Projects (PoCP). To cost effectively deliver benefits to the poor, RP4 examines (1) alternative institutional models to utilize OFSP to

combat nutritional deficiencies and (2) alternative market interventions to expand market opportunities for sweetpotato and improve access to urban consumers. Under RP4, there are two PoCPs: Mama SASHA project, which began in October 2009, and the Rwanda Sweetpotato Super Foods Project, which began in August 2010, and two feasibility studies: one on sweetpotato as an animal feed, which began in September 2009, and a market study in Nigeria, which began in June 2011. Mama SASHA is a social innovation that links knowledge about and delivery of OFSP with health care for pregnant women. It completed its pilot phase in December 2010; operation research findings concluded that the voucher-based intervention was feasible and acceptable but that some modifications were needed before going to scale in March 2011. An extensive baseline community-based survey was conducted from February to May 2011. To date, 6,202 vouchers have been issued to pregnant women and lactating mothers who attended antenatal clinics (ANC) for either antenatal or postnatal visits, and 72% of the vouchers were redeemed for OFSP vines.

The Rwanda Super Foods team began multiplying selected varieties with selected farmers and tested four potential sweetpotato processed products at a national fair in December 2010 with over 600 consumers participating in sensory assessments. The first product to be launched by the private-sector partner by September 2011 will be an orange-fleshed sweetpotato (OFSP) biscuit. The Animal Feed research program completed sweetpotato varietal trials in Kenya, with high interest among dairy farmers, and it recommended agroecologically specific forage and dual-purpose varieties. Dairy silage trials found that additives such as cassava meal, maize meal, and molasses could be used, but not poultry waste. Varietal trials began in Rwanda and will be completed in year 3, and preparations for on-farm dairy silage and pig silage trials were made. Ten out of the 12 PoCP milestones due by the end of year 2 were achieved; the remaining two were close to being achieved.

Research Program 5 (RP5): Management and Support Platforms (SSP). The SASHA project successfully held its first Annual Technical Meeting and Executive Steering Committee meeting on 28-30 September 2010. SSP meetings were held twice in each sub-region during the past year, with a major focus on information exchange and skill building in using the Sweetpotato Knowledge Portal launched in November 2010. Standardized modules for collecting data related to sweetpotato production and marketing systems were formulated and implemented with close attention paid to gender and adapted to specific settings for baseline studies in Tanzania, Kenya, and Malawi. A gender-aware monitoring system and draft communication strategy for SASHA were developed for full implementation in year 3. The Partnership Health Checkup tool, designed and tested with Mama SASHA in year 1, was implemented by all delivery system components (Mama SASHA, Marando Bora, Rwanda Value Chain, and Animal Feed) in year 2, and it was also adopted by non-SASHA projects in Ethiopia and Malawi. All eight milestones were achieved by the end of year 2.