Sweetpotato Breeders' Course on Modern Breeding Techniques for Improvement of Sweetpotato and Annual Meeting Held at Ghent University Belgium, October 19 – 30, 2012.

Summary Narrative Report

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Background and Objectives

The 2012 annual Breeders' meeting was the 10th in a row since 2003 and 4th in a row after inception of SASHA in 2009. This year, the meeting was joined with a refresher course for breeders on plant breeding techniques with emphasis on biotechnology breeding tools, a need that was identified during the previous year's annual breeders meeting. The course and the meeting objectives were: a) enable breeders to refresh in breeding methods aware of the increasing demand for biotechnology based tools in plant breeding; b) continue to harmonize breeding approaches in SSA and c) to review the progress of SASHA and affiliated NARS breeding programs funded by AGRA; d) allow cross learning between breeding programs in SSA and other areas like China, America, Europe and India. Up to 41 participants **(Annex 2)** from different countries (**Africa**: Uganda, Kenya, Tanzania, Malawi, Mozambique, South Africa, Zambia, Ethiopia, Ghana, Rwanda, and Burkina Faso; **Asia**: India, Indonesia, and China; **Europe**: Belgium; and **America**: USA, Peru) attended the meeting/course. Details of the course and meeting can be accessed at http://www.sweetpotatoknowledge.org/

Summary of the proceedings

Day 1: Formalities and official opening

The session helped the participants and meeting organizers to introduce themselves and to begin to know each other. The session was also used to clarify on the program **(Annex 1)** and different activities, as well as the logistics for the meeting. The session ended with a welcome drink for the official opening.

Day 2: Basic concepts and nomenclature in plant breeding. The session was facilitated by Prof. Dirk Reheul in three sub-sessions. He has 30 years of experience in practical plant breeding and research. He set up the faba bean breeding program at University of Gent in 1982 and has been teaching plant breeding at the university since 1996. He is a member of Community Plant Variety Office (CPVO) Board of Appeal and has released 40 varieties listed and commercialized in several European countries.

In sub-session 1: A review of the basic principles of plant breeding, definition of key concepts, different breeding methods (pedigree method, single seed descent method, bulk method, modified pedigree method, hybrid breeding method, reverse breeding method, and backcross breeding) was made. The session also discussed variety protection.

In sub-session 2: He reviewed breeding cross pollinating crops

Sub-session 3 discussed hybrid breeding. A hybrid is a cross between two genetically different (homozygous) inbred lines. Such a cross is also called a "F_1-hybrid" or a single cross. Hybrid breeding is advantageous because it is possible to fix the action of favourable genes in a cross pollinator in a repeatable way (i.e. a cross-pollinator offers advantages of a self-pollinator), the crop is vigorous (hybrid vigour or heterosis), the crop is uniform, and the variety is biologically protected.

Sub-session 4 discussed backcross breeding. A backcross (BC) is a cross between F_1 and one of its parents - can be done once or repeated. The BC decreases drastically the number of genotypes,

theoretically facilitating the discovery/detection of the wanted genotypes. Repeated BC to the same recurrent parent P_r gradually leads to recovery of the genes of the donor parent (P_d). The success factors for BC include: a) an excellent P_r which could be elite line, elite inbred, elite variety; b) the genotype of P_r should be recovered after a reasonable number of BC; c) the traits of interest in P_d should have a high heritability. BC provides the breeder with a high degree of control, is repeatable, does not require extensive field trials, and few records are involved. It is possible to have marker assisted BC – where one does not have to wait for phenotypic expression of traits. Marker assisted BC has the potential to improve the reliability and speed of the selection process, and thus possible to achieve the breeding goal with less back crosses.

The sub-session discussed variety protection and patents. This is necessary because: a) Variety seed is a product and a means of production; b) breeders have no biological exclusivity on the production of seed; and c) there is need to realize return on investments of plant breeding. Variety protection is achievable through three different systems, namely: a) by simply preventing multiplication; b) ensuring that the variety characteristics get lost during multiplication; and c) by the legal provisions.

Day 3 and 4: Molecular Markers for breeding and genetic diversity assessment. The topic was facilitated by Dr. Isabel Roldan-Ruiz. She handled the session in four sub-sessions.

Sub-session 1 introduced participants to molecular breeding basic concepts and definitions. Molecular markers have different applications for breeding, namely: a) selection using markers linked to genes of interest, b) marker assisted gene introgression, c) investigation of biological processes (mating system, pollen or markers and breeding seed dispersal), d) paternity analysis, e) identification of specific genotypes (e.g. plant varieties), f) quantification of genetic diversity and relationships within and between (agricultural) species and populations. Some of the concepts discussed included genome – chromosome – gene, mutation, Locus – Allele – Homo/Heterozygous, Dominant – Recessive – Co-dominant, Mendel's laws of genetics, linkage and recombination, linkage and association, DNA polymorphism, and DNA markers.

Mutation, defined as changes in the DNA-sequence and structure, create genetic variability which is a primary requirement for natural or artificial selection. Mutations can occur in coding and non-coding regions of the DNA. There are different forms of mutation, namely: a) point mutation due to errors in DNA replication and repair; b) chromosomal sequence alternations as a result of translocations, inversions, or transpositions; c) chromosomal additions and deletions and d) chromosomal number changes (aneuploidy = one or more chromosome are absent or present in excess, haploidy = half of the normal chromosome set, and polyploidy = more than two sets of homologous chromosomes).

A DNA maker is a sequence of DNA, found at a specific location of the genome, which can readily be detected and whose inheritance can be monitored. It is the variation or the polymorphism of molecular makers that can be used. The 'DNA marker' is not a synonym of 'gene' as most DNA markers are located in the non-coding regions and they do not have any biological function.

A DNA marker techniques are tools to detect DNA-polymorphisms between chromosomes within the same individual (homozygous / heterozygous) or between individuals.

DNA-polymorphism is when there is one of two or more alternate forms (alleles) of a chromosomal locus that differ in nucleotide sequence or have variable numbers of repeated nucleotide units. To know whether a chromosomal locus is polymorphic, we need to compare genomes (for example, the two haploid genomes of a diploid organism or the two diploid genomes of two diploid organisms). DNA-polymorphisms can be found in coding and in non-coding regions.

Different DNA-marker techniques (procedures) differ in protocol, kind of data obtained (e.g. information content, resolution), number of loci (markers) which are analyzed simultaneously, field of application as well as technical and financial requirements. The different DNA markers that have been developed and used include a) RAPDS, b) SSRs, c) ISSR, and d) AFLP. Refer to the link of meeting/course presentations for more details of the discussion of each of the marker systems.

Sub-session 2 drew on sub session 1 and considered the strategies for identification of markers of interest i.e. Trait/DNA marker associations. A trait of interest should be defined and the suitable germplasm identified. Markers linked to the trait of interest can only be found by comparing plants with and without the trait. For more details refer to the meeting/course presentations link.

Sub-session 3 was practicals on SSR markers in the laboratory. The participants were divided into 5 member groups and taken through protocols of DNA extraction, quality testing, PCR and sequencing.

Sub-session 4 discussed the use of molecular markers to assess the genetic diversity in crops. Genetic diversity is the foundation of biodiversity without which adaptation and evolution cannot occur, and occurrence of natural populations and selection are impossible in breeding populations. The sub-session specifically addressed: i) genetic variation and population genetics, ii) concept of population, iii) Hardy-Weinberg principle, iv) questions addressed by population geneticists and breeders, v) forces that act on genetic diversity in natural and selected populations, vi) quantifying genetic variation (Within populations: polymorphism and heterozygosity; Among populations: genetic differentiation), vii) F-statistics, viii) calculating genetic distances (between genotypes and between populations), and ix) displaying genetic relationships of a group of individuals or populations. For more details refer to the meeting/course presentations link.

Day 5: The following presentations were made:

a) **Basic Concepts in Plant Biotechnology:** The session, facilitated by Prof. G. Gheysen, focused on DNA as functional unit of breeding and discussed what happens to the DNA during breeding. It was also made clear that genetic engineering is not breeding but rather a tool in breeding.

Genetic engineering is often seen as unnatural in contrast to breeding whereas breeding is often seen as something that spontaneously happens in nature, but it is a man driven process.

b) Excursion 1: The participants visited the private potato processing plant and ILVP food pilot potato field trial. At the potato processing plant, participants viewed the machinery, the process and the different products made by the company. The products are sold world-wide.

Day 6: The following presentations were made:

a) Advanced Breeding Methodologies by Dr. Wolfgang Grüneberg.

Sweetpotato is one of the clonally propagated crops (all roots and tubers, all forages, all fruits and ornamentals, and forest trees).

The three major components of breeding include:

i. setting of breeding objectives which can be a) yield stability and adaptation, specific and wide; b) taste - there are two clear distinct groups namely OFSP moist sweet and WFSP non-sweet; c) biotic systems or pests and diseases.

ii. Creation of genetic variation in the base material. One can chose from the existing variation or generate crossings. Parent selection is always difficult as it requires moving away from the population mean. Parent off-spring correlations are low in sweetpotato.

iii. Selection of types meeting the objectives over all traits. Accelerated breeding scheme (ABS) demands rapid multiplication of planting materials so that one tests more than one (2 – 3) site early in the breeding stages. In year 1, crossing and seedling multiplication are done while in year 2 all clones are evaluated in different locations to cover the GxE interaction effects.

The efficiency of ABS depends on: a) Heritability (h^2) levels in early breeding stages. At least $h^2 = 0.5$ is go decision in Lima; b) Estimate h^2 when you apply ABS in early breeding stages with a check clone and plant the selected fraction again with the check for one further breeding stage to estimate the observed response to selection; and c) Estimate h^2 when you apply ABS in early breeding stages with a plot replication (2 plots per location) and replant all clones in year 2 without selection.

Wide adaptation is the most desired but specific adaptation is important for marginal environments.

For more details refer to the meeting/course presentations link.

b) Improvement of sweetpotato: Opportunities for transgenic sweetpotato by Dr. Marc Ghislain.

Non-GM approaches for crop improvement are limiting in several ways: a) It is difficult to find useful alleles within the own crop gene pools, b) it is possible to introduce genetic modification not available for gene of interest (mutations, silencing, ectopic and over-expression), c) breeding systems of clonally-

propagated crops cannot introgress useful alleles into existing varieties, d) many integrated crop management practices are knowledge intensive and site-specific, and e) biological controls require products from local suppliers rarely available.

Direct gene transfer (transgenesis) can be achieved through: i) Biolistic/Gene Gun/particle bombardment where high velocity DNA-coated particles are bombarded into cells or embryos; ii) Agrobacterium-mediated transfer - this is natural gene transfer between *Agrobacterium tumefaciens* and plant cell – modified to transfer only genes / DNA of interest.

Gene /ome editing (TALE) is another approach of transgenesis where transcription activator-like effectors (TALEs) proteins are used to provide highly specific and adaptable DNA binding modules which can then edit DNA (genes), knock off genes, add DNA (resistant alleles):

Direct gene transfer studies have been done with African varieties

i. Organogenesis (ABL and BecA): Out of 31 African varieties, 6 had regeneration efficiencies higher than 40% [Mugande, Imby, Luapula, Kawogo, Zambezi and Mafutha]– Ukerewe and Luapula have so far generated 2 putative transformed events using pCIP85. It can therefore be concluded from this study that: a) approximately 20% of African sweetpotato cultivars are amenable to transformation by organogenesis; and b) the yield is still too low to be considered as the transformation method of choice for commercial product development
ii. Somatic embryogenesis (s.e) at ABL and Kawanda: At ABL, the variety Imby from Burundi produced 31 independent events through s.e after 8 to 12 months. At Kawada, out of 11 Ugandan cvs established *in vitro* and regenerated through s.e. 6 produced embryogenic callus, and 4 of them roots from callus. It is therefore possible to conclude that: a) A large number of independent events can be produced but better African varieties need to be identified; b) Test in liquid culture following Chinese protocols. For more details refer to the meeting/course presentations link.

c) Purple-fleshed sweetpotato for health and other benefits by Dr. Craig Yencho. In the US, new sweetpotato products are leading to increased production. The products range from household foods to ornamental plants. There are four major producing states, Misisipi, North Carolina (NC), Louisiana and California.

The goals of the breeding program at NC State University are: a) develop new sweetpotato varieties for table stock, processing, industrial and ornamental types. The new varieties must be high yielding, have exceptional appearance and/or processing qualities, and have appropriate disease and insect resistance; b) conduct genetic and breeding research focused on INNOVATION IN ACTION incorporating important and/or new traits into germplasm; c) train and develop professional future plant breeders; and d) provide new opportunities for farmers today and tomorrow.

The primary traits to improve sweetpotato for processing quality are: a) Yield and disease resistance, b) Improved storage (~10 months), c) Dark orange flesh color, including lower reducing sugar content or on-browning; d) High sucrose levels “green” and “instorage”, Good taste, f)

Improved size, shape and uniformity, g) Resistance to skinning for mechanical harvest and bulk storage, h) dry matter content, and i) lower acrylamide potential

The Purple-fleshed sweetpotatoes are rich in anthocyanins: cyanidin and peonidin. The physiological functions of anthocyanins include: a) strong radical scavenging activity, b) antimutagenicity and anticarcinogenesis, c) antihypertension activity, d) reduction of liver injury, and e) Antidiabetic effects, f) higher antioxidant capacity than other sweetpotato types, g) Health food in Asia, especially in Japan - processed products: paste, flour, noodles, soups, beverages, natural colorants, h) Might there be great potential for functional foods and as a natural colorant in the US markets?

Research work on pruple-fleshed sweetpotato at NCSU aims at: a) analyzing the anthocyanin composition of a diverse group of purple-fleshed sweetpotato genotypes from Asia and South America; and b) determine the effects of thermal processing on antioxidant activity and anthocyanin components of these genotypes.

Ornamental sweetpotato breeding is part of NCSU activities and diversity in sweetpotato leaf colour and shape is being exploited.

d) Understanding Storage Root Development: classical and molecular by Dr. Arthur Villordon

Storage root development is dependent on: a) morphology and anatomy; b) environmental factors; c) hormonal control and more anatomy; and d) genes involved in root formation. Storage roots develop from adventitious roots depending on the growing conditions. Ninenty (90) percent of storage roots harvested between 100 – 120 days can be traced directly to adventitious roots at 3 – 7 days. Storage roots are characterized by a polyarch xylem ray pattern compared to other roots that are not going to develop into storage roots. Lignification stops the process of storage root formation. For more details refer to the meeting/course presentations link.

Day 7: 'CloneSelector 3.0' training. The session was jointly facilitated by Mr. Raul Ezyragurie and Mr. Luka Wanjuhi. 'CloneSelector 3.0', was installed on each participant's laptop at the beginning of the session. CloneSelector 3.0 is an updated version and is able to handle data analysis of different experimental designs including multi-location trials to generate the GxE analysis outputs. Through the session, the participants learnt how to use the software starting with generation of germplasm list, creation of designs and seed labels, creation of field books, data entry/export, data cleaning for analysis and actual data analysis. More time was taken to discuss the analysis output of the GxE and stability analysis plots.

Day 8:

a) Introduction to Intellectual Property related to Plant Biotechnology – by Dirk Iserentant.
The session covered the following: patents, plant variety rights, data base protection, copy rights, trade mark and service mark. For more details refer to the meeting/course presentations link.

b) AGRA/SASHA complementary experiences from partner countries

i) In Rwanda two projects are on-going. First is the sweetpotato breeding project funded by AGRA. The focus is on improving root yields, root quality, especially dry matter and beta carotene content, resistance to pests and diseases, as well as specific or widely adapted varieties that meet farmers' preferences. The program obtains genetic variation from: a) germplasm collections within the country, b) introduction of improved lines from other countries and c) polycross improvement by the program. So far, the program has up to 154 accessions of germplasm and a 60 parent polycross block. Also a number of trials at different stages (observation trial, preliminary trials, advanced trials, and on-farm) of selection were accomplished in the past year cycle.

Under SASHA, Rwanda is also implementing a proof of concept sub-project evaluate the best way to build a value chain for sweetpotato processed products that assures profitability for both farmers and processors *and* is gender equitable. Two organizational models for processed product value chains have been tested. The first is based on firm (SINA) contracted farmers. The second is based on farmer groups organized by an NGO (Catholic Relief Services) delivering to bakeries in urban centers. Both scenarios offer opportunities to establish sweetpotato seed systems on a commercial basis under contrasting agro-ecologal zones and two value chain models. Over the two years the project has: a) established a system to multiply and deliver sweetpotato clean planting materials to farmers, b) set up farmer cooperatives aimed at producing for processing, c) developed different products and tested for their acceptability in Rwanda and d) have conducted a rapid market survey on sweetpotato.

ii) In Zambia, with funding from AGRA, the focus has been to expedite the process of releasing some promising OFSP cultivars to farmers. Thus, the project conducted rapid on-farm evaluation of five OFSP cultivars in five districts of Zambia using the revised protocols. Both development (NGO or CBOs) and farmer partners were identified and involved in the process. Monitoring as well as final evaluations were conducted for farmers to identify the best cultivars both for field and palatability performance. Of interest were taste test evaluations of sweetpotato leaves for vegetable. Also the project conducted on-farm validation/ demonstration trials and trainings for triple S system for vine conservation and multiplication.

iii) In Malawi, the breeding program is project funded by AGRA and is responding to rising sweetpotato production (in area and acreage) trends for the nearly past 20 years. The desire is to develop varieties that are adapted to a wide range of environments in Malawi. The main traits are root yield and its components (size, shape, and number of roots), field weevil resistance, SPVD resistance, dry

matter as well as palatability attributes. Up to seven sweetpotato varieties have been released and are currently being disseminated to farmers in different parts of the country.

c) Panel Discussion: Using biotechnology to capture the full potential of sweetpotato and the way forward.

Dr. Godelieve Gheysen introduced and moderated the panel, which consisted of Dr. Motangu (as a lead panelist), Dr. Robert Mwanga, and Dr. Marc Ghislian. The last two were assistant panelists. On the other hand the audience comprised of sweetpotato breeders (experienced and young) from Africa, India, Bangladesh, USA and Peru. Until now, use of biotechnology in the developing world, especially Africa, is still a challenge and at the starting point. The panel's main question was the contribution of biotechnology to help realize the full potential of sweetpotato. Biotechnology has already been used to harness full potential of some crops such as maize, rice and potato. In sweetpotato research, the persistent main problems to productivity are sweetpotato weevils and virus disease (SPVD). Efforts [in USA at North Calorina University, Charleston, different national programs in Africa, vegetable research centre in Taiwan and IITA] to breed for resistance to sweetpotato weevils have not been successful.

Dr. Motangu drew on his experience and indicated that it was possible through biotechnology to get solutions to sweetpotato productivity problems and realize its full potential. He dismissed the safety questions and claims against biotechnology products in the field as mere society perceptions with no scientific basis and proof. Over his 30 years of experience, he noted that he has not found scientific basis for against field trials. He castigated the breeders to appreciate the problems of hunger and poverty and the need to solve them. He observed that wherever the farmers (e.g Brazil and Indonesia) have been allowed to test the technology, they have ended up adopting. He recommended for urgent collaboration between molecular biologists and plant breeders to identify areas (properties to work on) of intervention for a funding proposal to any of the foundations that support this type of work.

Dr. Ghislain urged breeders to stay away from negative ideology of biotechnology safety. He asked breeders to always be source of right scientific information to the authorities (policy and regulators) and the public that are seeking clarification. He attributed the significant progress in use of GMO by Burkina Farso to a former minister who understood the relevance of biotechnology and pushed for positive policies to allow use of GMOs in the country. Therefore scientist's opinion and counsel is important to demystify the society perception of biotechnology safety.

The participants raised the following questions and comments to the panel.

- We need to be convinced about GM while aware that conventional breeding is needed along. We should not substitute biotechnology for conventional breeding.
- Not sure that all has failed for conventional approaches to improve some of the sweetpotato productivity bottlenecks. It is possible there are sources of genes for the traits we want to improve (e.g. for weevil resistance).

- GM technology is not straight forward, the techniques are delicate. There is need to be strategic and honest on the workable techniques.
- There is great deal of problems in using biotechnology in sweetpotato. Transformation is not easy and stability of resistance of transformed plants has not been satisfactory.

The following were points of wrap-up from the panel

- There is need for information for policy makers on biotechnology, particular genetic engineering relevance
- Normal/conventional plant breeding requires patience and needs time.
- Both biotechnology and conventional breeding need time
- Weevils are a menace for sweetpotato research and production, thus the need to combine the two approaches to overcome the problem.
- Dynamics in Africa are different compared to Europe and America in terms of food, multinational companies (interest in seed and production businesses of the crops).
- Need to be united for funding opportunities to do research using both approaches

Day 9: Adapting agriculture to climate change: collecting, protecting and preparing crop wild relatives. [Sweetpotato crop wild relatives (CWR) for breeding]. There was a special workshop organized by Dr. Hannes Dempewolf of Global Crop Diversity (FAO), Rome (but at Ghent led by Prof Robert Scotland of Oxford University and Dr. Rick Millar of Southeastern Louisiana University, Department of Biological Sciences, USA. The trust has funds to link with partners in different countries). The trust focuses on 13 major crops, sweetpotato inclusive. It is possible to exploit the evolutionary relationships among the morning glories and the wild relatives of sweetpotato to identify the potential gene pools relevant to *I. batatas*.

In china, the sweetpotato wild relatives have been useful to improve starch content of cultivars. Also 10 species of sweetpotato WR have been involved in improvement of nematode resistance, drought tolerance, and dry matter content in China. For more details refer to the meeting/course presentations link.

Day 10: Excursion 2: In two groups, the participants visited two different private crop breeding programs. Crop Design is a private rice breeding and seed company. They breed better rice varieties and sell seeds of the varieties. On the other hand Devgen is a private company focusing on mainly genetic engineering.

Closing Remarks

Dr. Jan Low on behalf of CIP appreciated the tremendous work done by Prof Godelieve Gheysen and her team at University of Ghent for organizing and holding this course. She as well thanked the breeders for

their full participation into the course, and challenged them to put into use of the knowledge and skills gained during the course. On behalf of the young generation of breeders, Bernard Yada, thanked the organizers for allowing them chance to interact with the experienced breeders, from whom they have benefited immensely. Each participant received the certificate of participation and the course ended with a closing cocktail.

Annex 1: Timetable for the Sweetpotato Breeders' and Annual Meeting Held at Ghent University Belgium, October 19 – 31, 2012.

Date	Time	Course	Lecturer	Location
Sun 19/08		Arrival of the students, register student home		Stalhof 6
Mon 20/08	14:00-14:30	Formalities for scholarship students only		Coupure Links 653 Room E1.003
	14:30-14:45	Official opening of the training course Practical Information	Godelieve Gheysen Director. IPBO Danny Geelen Ugent	Coupure Links Room E2.009
	14:45-17:00	Participants' presentation (what is your background, why do you follow the course, what do you expect from the course e.t.c.)		Coupure Links Room E2.009
	17.00	Welcome drink		Coupure Links: Agora
Tue 21/08	9:00-10:45	T: Basic concepts and nomenclature in plant breeding	Dirk Reheul (UGent)	Coupure Links Room E2.009
	10:45-11:00	Coffee break		
	11:00-12:45	T: Basic concepts and nomenclature in plant breeding	Dirk Reheul (UGent)	Coupure Links Room E2.009
	12:45-13:45	Lunch break		Coupure Links Room E2.009
	13:45-15:15	T: Classical breeding continued	Dirk Reheul (UGent)	Coupure Links Room E2.009
	15:15-15:30	Coffee break		
	15:30-17:00	T: Classical breeding continued	Dirk Reheul (UGent)	Coupure Links Room E2.009

Wed **22/08**	09:00-10:45	T: Molecular markers for breeding and genetic diversity assessment	Isabel Roldan-Ruiz ILVO	Coupure Links Room E2.009
	10:45-11:00	Coffee break		
	11:00-12:45	T: Molecular markers for breeding and genetic diversity assessment	Isabel Roldan-Ruiz ILVO	Coupure Links Room E2.009
	12:45-13:45	Lunch break		
	13:45-15:15	T: Molecular markers for breeding and genetic diversity assessment	Isabel Roldan-Ruiz ILVO	Coupure Links Room 2.009
	15:15-15:30	Coffee break		Coupure Links Room B0.004
	15:30-17:00	T: Molecular markers for breeding and genetic diversity assessment	Isabel Roldan-Ruiz ILVO	Coupure Links Room E2.009
Thu **23/08**	09:00-13:00	P: Molecular markers	Isabel Roldan-Ruiz ILVO	ILVO, Melle Bus transport Departure: Ledeganck 8.30am
	13:00-14:00	Lunch break		ILVO, Melle
	14:00-	P: Molecular markers cont.	Isabel Roldan-Ruiz ILVO	
Fri **24/08**	08:30-10:30	T: Basic concepts in plant biotechnology	Godelieve Gheysen	Ledeganck Room 2nd fase, 3rd floor
	10:30-16:00	Excursion: Potato processing company ILVO Food pilot: Potato field trial	Godelieve Gheysen Ine Pertry	Bus transport Departure: Ledeganck 10.30am Lunch during the day
Sat **25/08**	10:00-12:00	Excursion Ghent: Historical City Center	IPBO	Ghent, city center

Mon **27/08**	8:30-10:15	CS: Advanced Breeding Methodologies	Wolfgang Grüneberg CIP	Coupure Links A1.015
	10:15-10:30	Coffee break		
	10:30-12:15	CS: Improvement of Sweetpotato: opportunities for transgenic sweetpotato	Marc Ghislain CIP	Coupure Links A1.015
	12:45-13:45	Lunch break		Ledeganck Room 1.3.39
	13:45-15:15	CS: Purple-fleshed sweetpotato for health and other benefits	Craig Yencho, North Carolina State University	Ledeganck Room 2nd fase, 3rd floor
	15:15-15:30	Coffee break		
	15:30-17:00	CS: Genetics and phenotyping root development	Don Labonte Louisiana State University	Ledeganck Room 2nd fase, 3rd floor
Tue **28/08**	09:00-10:45	T: CloneSelector	Luka Wanjohi Raul Eyzaguirre	Ledeganck Room 2nd fase, 3rd floor
	10:45-11:00	Coffee break		
	11:00-12:45	T: CloneSelector continued	Luka Wanjohi Raul Eyzaguirre	Ledeganck Room 2nd fase, 3rd floor
	12:45-13:45	Lunch Break		Ledeganck Room 1.3.39
	13:45-15:15	P: CloneSelector	Luka Wanjohi Raul Eyzaguirre	Ledeganck Room 2nd fase, 3rd floor
	15:15-15:30	Coffee break		
	15:30-17:00	P: CloneSelector continued	Luka Wanjohi Raul Eyzaguirre	Ledeganck Room 2nd fase, 3rd floor
Wed **29/08**	09:00-10:30	T: Molecular markers for breeding and genetic diversity assessment	Isabel Roldan-Ruiz ILVO	Ledeganck Room 2nd fase, 3rd floor
	10:30-10:45	Coffee break		

	10:45-12:15	CS: Legal Issues	Dirk Iserentant, VIB	Ledeganck Room 2nd fase, 3rd floor
	12:15-13:30	Lunch break		Ledeganck Room 1.3.39
	13:30-14:45	CS: AGRA/SASHA complementary experiences and use of CloneSelector	M. Chiona-Zambia; D. Shumbusha-Rwanda; F. Chipungu-Malawi	Ledeganck Room 2nd fase, 3rd floor
	14:45-15:30	CS: Discussion of sweetpotato breeding protocols based on experiences	Ted Carey, Silver Tumwegamire, CIP	Ledeganck Room 2nd fase, 3rd floor
	17:00-18:30	Round table discussion: Capturing the benefits of sweet potato: the way forward	R. Mwanga M. Ghislain M. Van Montagu G. Gheysen : moderator	Geuzenhuis Trappenzaal Kantienberg 9, Gent
	19:00-22:00	Dinner	All participants	Het Pand Onderbergen 1, Gent
Thu **30/08**	9:00-10:45	T: Sweetpotato Crop Wild Relatives (CWR) for Breeding	CWR Team	Ledeganck Room 2nd fase, 3rd floor
	10:45-11:00	Coffee break		
	11:00-12:45	T: Sweetpotato Crop Wild Relatives (CWR) for Breeding	CWR Team	Ledeganck Room 2nd fase, 3rd floor
	12:45-13:45	Lunch Break		Ledeganck Room 1.3.39
	13:45-15:15	T: Sweetpotato Crop Wild Relatives (CWR) for Breeding	CWR Team	Ledeganck Room 2nd fase, 3rd floor
	15:15-15:30	Coffee break		
	15:30-17:00	T: Sweetpotato Crop Wild Relatives (CWR) for Breeding	CWR Team	Ledeganck Room 2nd fase, 3rd floor

Fri **31/08**	9:00-10:45	T: Sweetpotato Crop Wild Relatives (CWR) for Breeding	CWR Team	Ledeganck Room 2nd fase, 3rd floor
	10:45-11:00	Coffee break		
	11:00-12:45	T: Sweetpotato Crop Wild Relatives (CWR) for Breeding	CWR Team	Ledeganck Room 2nd fase, 3rd floor
	12:30-13:30	Lunch break		Ledeganck Room 1.3.39
	13:30-17:00	Excursion: visit Crop Design (max 25 p.) OR visit Devgen	Godelieve Gheysen (Cropdesign) Ine Pertry (Devgen)	
	17:00-19:00	Closing reception (distribution of course material, evaluation form)		Ledeganck Foyer McCleod

Annex 2: List of Participants

First Name	Second Name	Country	Organization	Email address
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