Briefing for EPSO representatives and supporting scientists, 22.10.2012

Topic: **3 Pilot Initiatives resulting from the EPSO-FAO Workshop June 2012**

Action for you: **Reply** to Karin.Metzlaff@epsomail.org **by 9.11.2012 which experts from your institution would be interested to contribute to which of the three pilot initiatives**

EPSO, FAO and developing countries would like to work on the three pilot initiatives with Sub-Saharan Africa:

	Pilot initiative	**Lead (Small Committee) by EPSO & FAO/ developing countries**	**Status**	**EPSO members**
1	Underutilised fruits and vegetables	Brian Thomas, Eckhard George; Ian Graham (t.b.c.) & Enoch Achigan-Dako, Remi Nono Womdin	2 pages	Provide **input** and contacts of **experts** who -already collaborate on this with developing countries -are not yet involved, would like to get involved in future
2	The cassava value chain	Willi Gruissem, Valerie Verdier & Alfred Dixon, Christian Nolte	2 pages	
3	Maize and associated legume crops	t.b.a. (interim Jean-Christoph Glaszmann & Bruce Osborne) & Mulugetta Mekuria, Joyce MulilaMitt	2 pages	
4	Other plant research & training topics/areas in partnership with Developing countries (especially in Sub-Saharan Africa)	Jean-Christophe Glaszmann, Charlie Spillane	Charlie Spillane will assemble these from your replies to see which future acreas could be relevant for EPSO to support	

Step 1: Small committees developed briefing papers
Step 2: Discussion of these and more issues at the EPSO-FAO workshop in June 2012
Step 3: Small committees provide update of 1-4 pages each
Step 3: EPSO members provide names of experts that already are working on these topics with developing countries / or not yet and would like to get involved in future
Step 4: Small Committees bring identified experts together to agree on next steps and start first activities

More information on the EPSO-FAO Workshop: http://www.epsoweb.org/sustainable-crop-production-fao-epso-rome-it-june-2012

Summary
The Food and Agriculture Organization of the United Nations (FAO) and the European Plant Science Organization (EPSO) are organised a workshop to increase plant science and development interactions for strengthening food security. The two and a half day workshop in Rome on June 25-27, 2012, brought together stakeholders from academia, networks, institutions as well as public and private sectors from both Europe and developing countries with a focus on Sub-Saharan Africa. The expected outputs are: (i) a shared view for opportunities and building partnerships; (ii) the development of three coordinated project proposals focused on the cassava value chain, maize and associated legume crops, underutilized and local fruit and vegetable crops ; and (iii) a white paper on establishing a long-lasting partnership platform between Europe and developing countries. Through these projects, the goal is to facilitate bilateral and multilateral partnerships for scientific collaboration, capacity development and technology transfer to strengthen sustainable production based on plant sciences.

2-pagers per pilot initiative developed during and following EPSO-FAO Workshop June 2012
Regional focus is on Sub-Saharan Africa

1 – Underutilised (indigenous) fruits and vegetables

Current status of indigenous fruits and vegetables in developing countries:

- For many people in the tropics, the daily food diet is made up of cereals, starchy root crops, and a source of lipids (seed plant oil).
- Food and nutrition security policies have largely ignored fruits and vegetables, which are a more diverse and abundant source of nutrients.
- Fruits and vegetables have a crucial role to play in combating food and nutrition insecurity, especially the so-called "hidden hunger" caused by micronutrient deficiencies.
- The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) recommend a dietary intake of more than 400 g of fruits and vegetables per day to prevent malnutrition. To address this, we need to put in place sustainable mechanisms to improve the diets of rural and urban poor.
- For fruits and vegetables, modern varieties dominate the seed systems, crop fields and commercial orchards.
- Vegetables and fruits accounts for less than 13% of the total number of accessions in all *ex situ* collections in the world. With few exceptions, phenotypic and molecular characterization of these accessions is also low.
- For plant breeding to play a more useful role in developing indigenous fruits and vegetables, efforts are needed to characterize, evaluate and further develop both cultivated and wild germplasm for nutritionally related traits etc.
- Nevertheless, fruits and vegetables are key commodities on the international market and represent almost 80 percent of the world horticulture market. According to FAO, the value of all fruits and vegetables traded globally is more than double that of cereals.
- In Sub-Saharan Africa, greater public awareness of the importance of crop diversity, especially of formerly neglected and underutilized species is a continuous need. Positive awareness and recognition of traditional vegetables and fruits, would be expected to stimulate and expand market opportunities, and strengthen cooperation among producers.

Ongoing large scale initiatives

- The World Vegetable Center (AVRDC) and Bioversity International have a current focus on the use of indigenous vegetables and fruits. Both centres are part of the CGIAR system and support the EPSO-FAO initiative.
- At the continental level in tropical Africa, FAO and PROTA-Africa are engaged into a collection of success stories on 40 indigenous fruits and vegetables.
- At sub-regional level CORAF/WECARD recently (March 2012) invites proposals on non-staple crops including leafy vegetables.
- A selected number of indigenous fruits and vegetables are involved in the GRP 1 programme of ICRAF where research activities on domestication are underway.
- Initiatives such as "Food for the Future" and the Global Horticulture Initiative (GlobalHort) promote research on and the improvement of underutilized crops.

Key constraints facing indigenous fruits and vegetables in developing countries

- An estimated 1,500 fruits and vegetables species are listed amongst the approximately 8000 useful plants in Africa. These plant genetic resources are subject to continuous degradation caused by population pressure, industrialization, and unsustainable use. Detailed information on these plant resources is often lacking or not widely available.
- Fruits and vegetables, especially traditional and locally used varieties, accounts for a relatively small proportion of the germplasm accessions stored in genebanks around the world. Characterization and utilization of this material is also relatively low, according to the SoWPGR-2 (2010). Efforts in breeding and improvement of fruit and vegetable crops are therefore limited.
- Indigenous fruits and vegetables have largely been neglected by research, policy makers and extension services and consequently these species/crops are subject to 1) poor quality of planting material seedlings 2) inappropriate production technologies, lack of adequate capacity in management of horticultural nurseries 3) poor handling techniques which lead altogether to low productivity.
- The education system has for a long time focused on exotic species for which more information is available. Detailed curricula on indigenous fruits and vegetables are lacking. ''PROTA 2 Vegetables'' can serve in some instances to fill this gap.
- Indigenous fruits and vegetables are not able to meet requirements of the market because of the limited capacity in compliance to the marketing standards. Also, there is a lack of reliable statistics (production,

yield, and commercialization data) on indigenous horticulture species, which limits prospects for investment. When the information is available it is dispersed and not focused.

Current plant science opportunities for improving impact of indigenous fruits and vegetables on poverty and food security in developing countries

Biological limitations

- Development of a sustainable mechanism that will facilitate access to quality seeds and planting material of improved varieties by small holder farmers
- Development and promotion of appropriate crop variety production and protection technologies
- Development of efficient and effective postharvest systems including commercialization and promotion of consumption

Environmental issues including climate change

- Biodiversity of indigenous fruit and vegetables (IFVs) for the mitigation of the impact of climate change
- Understanding on the role of IFV biodiversity for resilient food systems and ecosystems

How does Europe fit in:

- Work with African Scientists to identify and prioritize major constraints to the development of IFVs value chain.
- Work with FAO to develop an action plan.
- Assist in monitoring and assessing progress.
- Develop long-term partnerships with African Research Teams.
- Co-ordinate with European initiatives in Horticulture.

Lead:

EPSO:	Brian Thomas, Warwick University, UK
	Eckhard George, Leibniz Inst. vegetable and ornamental crops, Grossbeeren, DE
	Ian Graham, CNAP, York University, UK (t.b.c.)
FAO / DevCos	Enoch Achigan-Dako, Plant resources of Tropical Africa, Benin
	Remi Nono Womdin, FAO

Current status of cassava value chain in Sub-Saharan Africa (focus area)

- Cassava is a major staple crop in Sub-Saharan Africa for many smallholder farmers. For about 40% of Africans, cassava is a major source of calories.
- The crop is capable of producing some yield even in degraded soils, it is relatively drought resistant, and it can be stored easily in the field. In Africa, cassava production is mostly without fertilizer and irrigation.
- Cassava processing is a major source of income for women in Sub-Saharan Africa. However, subsistence farming does by far not tap the yield potential of the crop.
- Improved varieties, more efficient production and commercialization of cassava have enormous economic potential for African countries.
- To increase the commercial production of cassava requires a re-orientation of production along a value chain approach.

What is needed to build an economically viable cassava value chain?

New disease-resistant, drought-tolerant and higher-yielding germplasm and varieties.

- More efficient distribution of improved planting material.
- Better pest and disease management techniques.
- Reducing post-harvest losses.
- More intensive but sustainable cropping system management focused on food security.
- Efficient use of ecosystem services and external inputs, such as fertilizers.
- Access to markets and information.

On-going initiatives on cassava production

IFAD has funded large root-and-tuber projects with focus on germplasm improvement and dissemination in several countries of West and Central Africa.

- In 2000, FAO and IFAD initiated a Global Cassava Development Strategy in collaboration with IITA, CIAT, CIRAD, and NRI (Nigeria).
- In 2003, NEPAD and IFPRI launched a Pan-African cassava initiative in Nigeria, Uganda and Malawi. Nigeria in particular intends to double its production in the next 4 years by increasing cassava yield from ~12 t/ha to ~25 t/ha and to become a major national and international supplier to industry.
- The African Development Bank is financing a large project on strategic crops, including cassava.
- The new CGIAR research programs (CRP) address cassava problems in different CRPs. Within CRP 3.4, cassava will receive the largest investment of the program with ~54 million USD, representing 29% of the total program budget for 2011-2013.
- CRP 1.2 is focused on the development of intensive and sustainable cassava production systems.

How does Europe fit in?

- Europe is a major trading partner of Sub-Saharan Africa and potential market for cassava.
- Strong support of CGIAR research programs - IITA, CIAT – CRP RTB
- African champions of cassava research and value chain prefer interactions with European research laboratories.
- Long tradition of cassava research and biotechnology in Belgium, Denmark, France, Germany, Netherlands, Sweden, Switzerland and United Kingdom. - IRD, U.Gottingen, UCLouvain, ETH, U Bath
    - Long tradition of cassava research in France (IRD, CIRAD) in collaboration with African partners. New partnership recently developed with INERA Burkina, U.Bamako FAST LBMA and IER Mali, ITRA Togo, Crops Research Institute Ghana ,RD Congo, IITA Nigeria and Tanzania, also under discussion with institutions in Congo, Gabon, Uganda, Nigeria
- Cassava research in Europe addresses major constraints of building a cassava value chain (diseases, post-harvest storage, breeding, product development)
- European laboratories have developed efficient cassava transformation technologies and have been instrumental in successfully transferring the technology to African laboratories.
- Swiss researchers have developed a virus-resistant cassava cultivar that is preferred by farmers and consumers.
- French and Colombian researchers have developed genomics tools and identified R genes for Cassava Bacterial Blight control- IRD

Why is Europe not a major contributor to cassava value chain development?

- European cassava research and development is not well supported at national and European levels.
- No political and economic incentives to invest in cassava as a food and feed crop for Europe.
- Lack of interest in building partnership programs to focus on effective cassava value chain development.
- General resentment of plant biotechnology and application to cassava.

Which types of projects to develop and fund in the future and of interest for both Europe and Africa
Because cassava constitutes one of the most important food crops in the developing world providing the principal source of calories for more than two third of the population, any factor reducing yields will have critical societal issues and should be addressed. A major limitation of crop production is imposed by a suite of abiotic (drought) and biotic (virus, bacterial) stresses resulting in important cassava yield losses globally each year. Below some examples of actions that may be discussed further within EPSO-FAO initiative:

- ✓ Ongoing (ie cassava double haploids, cassava genomic selection, Harvest+, Cassava brown streak virus project*, BC*+) projects: the next challenges will be to accelerate them and ensure their success. One of the challenges is to develop cassava products deliverable on site in developing countries. Toward that objective we need for example to build or use existing platforms in Africa managed by African partners and farmers by investing not only in infrastructure but also in training in developing countries.
- ✓ We need to establish support systems that enable national programs and civil societies (association of farmers, individuals farmers, NGOs), to select the more productive varieties with greater adaptability to the environmental and socioeconomic contexts. We need to encourage state governments, as they distribute the plant materials to other channels for large-scale multiplication, to also disseminate the materials directly to farmers in target areas. Farmers, stakeholders need not wait for a couple of years for mass distribution.
- ✓ Particular attention should be paid on the effects of climate change by supporting projects which goals are to understand how changing climatic conditions will affect for example the distribution of diseases in Africa. We need to supply information on existing and re-emerging diseases (ie bacterial blight) to improve control strategies and to develop new ones (i.e. targeted genome editing using site-specific nucleases).
- ✓ To facilitate the international exchange of improved cassava, we need to support projects that aim to develop rapid and sensitive techniques to detect diseases that will permit large-scale testing of seeds, cuttings for culture indexing at relatively low costs and little equipment in developing countries (i.e. LAMP for virus and bacterial diseases)
- ✓ Following the completion of one cassava genome sequence, efforts need to be put into larger genome projects for MAS application, characterization of genetic variation in cassava. As the costs of high throughput sequencing plummet, the possibilities for using a cost effective genotyping-by-sequencing (GBS) strategy for cassava is becoming more feasible and may be of interest for Europe and Africa.
- ✓ We need to build the next generation of young scientists in developing countries. As example the bioinformatics skills required to interpret GBS data are still not accessible to cassava breeders in local facilities, and this will limit adoption in the near term. Projects to develop human resources and capacity building in-house are needed and this could be achieved through allocating funds for bioinformatics courses, post-degree research.
- ✓ Support projects that will help in conserving, storing the genetic resources not only in international centers but directly with farmers, NGOs
- ✓ We need to encourage the development and creation of small businesses in developing countries (encourage the creation of new cassava products), creating new markets and incomes for the next generations.

Who?
Europe: Past or current expertise/interest: IRD France (Verdier), CIRAD France, U.Gottingen Germany (Wydra), UCLouvain Belgium (Bragard), ETH Switherland (Gruissem), U Bath England (Beeching)
Other partners who expressed interest U. Halle, Germany (Boch); NUI Galway (Spillane)
Africa: INERA Burkina, U.Bamako FAST LBMA and IER Mali, ITRA Togo, Crops Research Institute Ghana ,RD Congo, IITA Nigeria and Tanzania, also under discussion with institutions in Congo, Gabon, Uganda, Nigeria

Lead:
EPSO Wilhelm Gruissem, ETH Zurich, CH
Valerie Verdier, IRD, FR
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Christina Nolte, FAO, IT

3 – Maize and associated legume crops for Sub-Saharan Africa

Background

Both maize (*Zea mays*) and legumes are critically important crops for sub-Saharan Africa, with a long history of improvement for the particular conditions of this region. Globally, maize is, with rice and wheat, regarded as one of the 'big three' cereals on which much of the human population currently depends, and will continue to depend, on. The global emphasis on maize production, in particular, has also resulted in a the establishment of important genetic information, both on the evolution of the crop and its response to abiotic and biotic factors, making further more targeted breeding possible. Of future importance is an improvement in the quantity and quality of grain protein if we are to enhance the nutritional status of these crops. Despite some success in sub-Saharan maize breeding programmes the yields that are currently achieved are still well below the potential that could be realised, due to a range of management, environmental and genetic constraints.

Whilst a number of legume species exist and are grown extensively throughout sub-Saharan Africa they have often been neglected in breeding programmes and yet they could, given their higher protein content, compensate for the low protein concentration of maize grain. Potentially they could also contribute to soil fertility, through their ability to fix atmospheric nitrogen as well as supporting the N demands of the maize crop. Based on this it is perhaps not surprising that maize and legumes are often grown together as mixtures (intercrops), particularly by subsistence farmers in sub-Saharan Africa. However, a demonstrated benefit in terms of improved nitrogen utilization by the maize crop has proved difficult and there may be a range of other benefits associated with the intercropping of these two species. Intercropping maize with legumes is, however, an attractive system to use for improving the consistency and quality of the crop yields obtained. Mixtures may also be more resilient to a range of abiotic and biotic factors. A significant obstacle to improvements in intercropping is, however, a lack of understanding of interactions, including mutually-beneficial ones and their genetic basis, to maximise yields under a range of conditions. Current breeding programmes are directed at the two crops in isolation and fail to account for inter-plant interactions that could impact on yield. What is required to improve the performance in mixtures is a co-selection programme involving maize and legumes and the subsequent development of dedicated intercropping species and mixtures.

Proposed research programme; arguments for the participation of plant scientists in Europe and in developing countries

1. Currently, competition tolerance, considering both inter and intra-specific interactions, is an area of active research. Improvements in yield without any significant increases in land area demands a better understanding of interactions both between individuals of the same crop and between individuals of different crops species (intercrops) and associated weeds. Intercropping could also have potential for the development of more ecologically safe, sustainable, systems if we can expand on any mutually beneficial effects between the species used. Breeding for improved intercrop species will have to take into account traits, such as canopy structure, leaf display and root architecture that have not been routinely used as breeding targets, but could be open for marker-assisted selection. Not only could this improve maize bean intercrops it could also lead to the development of a wider range of intercrops using other agriculturally important crops, such as wheat and provide new directions and new revenue streams for plant breeding enterprises.
2. Research on the genetic basis of competition tolerance, the application of new phenotyping technologies as they relate to mixtures and the establishment of field trial sites in different geographical areas, will provide excellent opportunities for regional involvement and the training of European and African scientists in state of the art technology, for addressing both basic and applied research questions.
3. The proposed programme, focussed on two staple crops, clearly has a wider objective-improved global food security. This initiative would facilitate the development of a large research programme with complementary bottom-up (from farmers, growers) and top down (scientists, breeders) approaches being required. This would ensure that the results have practical significance for the farmer/producer/breeder. Importantly, mutually-beneficial links would be established between personnel from both developing and developed countries. In the future many of the problems experienced by farmers in developing countries are likely to become more common in the developed world as a consequence of climate change. The experiences of developing countries are, therefore, likely to be important in contributing to the strategies needed for maintaining and improving crop yields in the developed world.

Lead:

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