Briefing for EPSO representatives and supporting scientists, 30.8.2012

Topic: **9 Focus Areas of the Global Plant Council chosen at GPC meeting June 2011**

Action for you: **Reply** to Karin.Metzlaff@epsomail.org **by 30.9.2012 which experts from your institution would be interested to contribute to which of the nine focus areas**

The Global Plant Council is working on 9 focus areas

	Focus area	**Advocat**	**Status**	**EPSO members**
1	The digital seed bank	Willi Gruissem	½ pg + list participants to help for 2 pages + generating seed funds for Workshop	Provide **input** and contacts of **experts** to help develop two pagers / join workshop
2	The metagenome	Mel Oliver	½ pg + works on list fo part (Missouri CF May'12)	
3	Biofortification	Barry Pogson	½ pg	
4	Developing Perennial Rice , Wheat and/or Maize	Barry Pogson	½ pg	
5	Development of medicinal plant-based products	Barry Pogson	½ pg	
6	Local-level Diversity and Yield Stability	Suk-Ha Lee; Choon-Hwan Lee	Rational only	Indicate **experts** (see above)
7	Increasing/Enriching Agricultural Diversity	Ricardo Bressan-Smith	Rational only	
8	Species information for sustainable adaptation capability to climate change	Song Ge	Rational only	
9	Sharing Information and Resources	Mel Oliver	Rational only	All to promote and apply

Step 1: half-pagers → GPC members will suggest participants to generate the two page proposals

Step 2: GPC members to present the half–pagers to their societies for input and contacts

- Start with 1-5 already → input from GPC societies to Mel, to advocates

Step 3: Two-page GPC Challenge Workshop proposals

- Advocates develop this as draft plan for a workshop with a list or potential expert participants as well as potential workshop sponsors (two pages max) by September 20th.
- Executive Board briefly review the documents (within two weeks) and the collated material will be sent to all GCP members on October 10 in preparation for the GPC member meeting.
- Will be used to raise funds for the GPC workshops on each of the eight topics we decided upon in Qingdao.

Step 4: Workshops

Example of what may be generated at a workshop: position paper generated by the Crop Science Society of *America (kindly provided by Henry Nguyen)*

More information on the GPC: http://globalplantcouncil.org/

The GLOBAL PLANT COUNCIL

Rationals per focus area from GPC meeting June 2011

1 - Digital Seed Bank

Issue: Humans have cultivated more than 7,000 plant species since the beginning of domesticated agriculture. But now only 150 species are agronomically relevant. And only 10 plant species provide more than 95% of the calories consumed by humans! Too few species, with minimal allelic diversity, supplying too many calories and essential nutrients to the human population. The allelic diversity necessary for crop species to adapt to changing climates and respond to biotic challenges is preserved in ancestral lines. Much of the world's genetic resources are kept in germplasm centers in sealed boxes with no guarantees that viability will be maintained until needed. In some centers the inventory is largely unknown to the community. It is important to preserve germplasm in ways that it remains available for the foreseeable future. **GPCs role:** To raise global awareness of the problem; to articulate the logistics of a global project that would address the problem while integrating on going projects in various species in various countries. To facilitate exchange of germplasm and data globally. **What needs to happen:** Identify core collections for major crops and characterize each genotype by resequencing genomes, establish expression databases, other omics, and chronicle phenotype information. Identify and engage with current projects of pertinence. Ensure that data are globally accessible. Make sure scientists and breeders are on board. **Workshop 1 participants:** Scientists, Breeders, CGIAR, Seed banks, Funding reps (as observers) (Farmers at a subsequent workshop?). **Stakeholders:** Too many to list!

GPC Advocate: Prof. Gruissem Half page description available

2 - The Plant Environment Metagenome

Issue: Plants exist within a larger population of (micro) organisms, which are important for the health and vitality of the plant. But we know little about how these organisms actually affect plant growth and development or the ways in which these populations change as local conditions (soil/climate) change. **GPCs role:** Advocating exploration of this grand challenge topic; facilitating an initial workshop to articulate the issues, the questions, and the most appropriate next steps. **What needs to happen:** Bring together relevant stakeholders (and potential funders). **Workshop 1 participants:** BGI Shenzhen scientists; soil microbiologists/microbial ecologists; plant-microbe scientists; (funders); JGI; EBI-Sanger; plant molecular biologists/physiologists. **Stakeholders:** Plant scientists.

GPC Advocate: Mel Oliver Half page description available

3 - Biofortification

Issue: Malnutrition is a major global problem, in addition to hunger, that affects all nations. Despite the many efforts underway to improve the nutritional qualities of foods, biofortification supplement efforts often do not reach the people that would most benefit. (DSM approach). **GPCs role:** Advocate for development new crops that are more nutritious so that people receive the nutrients directly from unprocessed foods. Articulate what can be accomplished by breeding and what has to happen via GMO. Identify gaps in current programs. Advocate for open sharing of data and information regarding biofortification efforts. Increasing global support. Bring to the local level/bring crops to the market. **What needs to happen:** Gap analysis, compare what is needed with on-going efforts (crops, critical investment, access and marketing), Biofortify local varieties. **Workshop 1 participants:** nutritionists; food scientists; breeders; molecular biologists/transformation; social scientists; economists; representatives of current programs. **Stakeholders:** company scientists; farmers; seed agents; WHO; FAO; foundations; food distribution chains; consumer organizations.

GPC Advocate: Prof. Pogson Half page description available

4 - Developing Perennial Rice/Wheat/Maize

Issue: Environmental sustainability of agricultural ecosystems; lowering inputs – human, nutrient, energy; maintaining yields. **GPCs role:** Encourage a vision; Convene experts. **What needs to happen:** Consult with experts first; make go/no go decision. If the decision is "go", then there is a need to identify perennial-associated genes; cold tolerance/over-wintering; agricultural practices; carbon and nitrogen allocation/yield assessment. **Workshop 1 participants:** plant physiologists. **Stakeholders:** seed companies, environmental groups?

GPC Advocates: Prof. Pogson Half page description available

5 - Development of medicinal plant-based products

Issue: Some research, but no avenue for commercialization/product development, especially in the developing world. A major issue is the innovation gap. **GPCs role:** Advocating ethnobotany research; natural product R&D; studying metabolic pathway; **What needs to happen:** Define the problem. Do we really need to run with this? **Workshop 1 participants:** unsure**. Stakeholders:** Universities?

GPC Advocate: Prof. Pogson Half page description available

6 - Local-level Diversity and Yield Stability
Issue: Maintaining yield under all/changing environmental conditions. Breeding efforts targeted to specific environmental conditions, utilizing germplasm that is being characterized around the world. Communication gap between research scientists and breeders. Linking local breeding efforts to digital seed bank. National/local scale versus global. **GPCs role:** Raising awareness of the issue; facilitating connections among plant scientists to breeders; supporting local/regional germplasm banks (including in natural history museums and herbaria); advocating for training of plant molecular breeders. **What needs to happen:** Develop an open global platform for information exchange and training; identification of yield constraints in local environments. **Workshop 1 participants:** breeders; plant production scientists; seed company representatives; soil scientists; molecular geneticists; herbaria scientists/systematicists/taxonomists. **Stakeholders:** CGIAR; seed banks/germplasm centers; national breeding programs Working group: Masahiro Yano; Suk-Ha Lee; Hanyia A. El-Atripy; someone from CSSA?); Nagib Nassr (gene conservation/cassava).
GPC Advocate: Prof. Suk-Ha Lee; Prof. Choon-Hwan Lee.

7 - Increasing/Enriching Agricultural Diversity
Issue: Promoting underutilized seed and root crops/cropping systems that might have nutritional and environmental benefits, as well as a return to the farmers that are growing them (starch/oil/protein; seeds/tubers/grains). **GPCs role:** To facilitate the first workshop; to identify participants; to develop a list of potential crops to be discussed; (devise and assess strategies for deployment of crops for which future markets are deemed realistic). **What needs to happen:** A technical/analytical workshop. What are these crops; what are their benefits? Were they abandoned for agronomic, financial, or cultural reasons? Or because there was no market for them (i.e., no one wanted to eat them)? Can we develop a punch list of promising crops/cropping systems, with an associated list of anticipated benefits (e.g., nutritional, water usage, perennial)? **Potential examples:** Quinoa, Amaranthus, potato varieties, acai. **Workshop 1 participants:** FAO, growers' organizations, agronomists, farmers' cooperatives; traders; anthropological botanists; socio-agriculturists/ag extension agents; molecular plant scientists; seed banks; nutritionists. **Stakeholders:** seed and food companies; FAO; environmental groups; national/regional governments; farmers' organizations; commodity groups.
GPC Advocate: Prof. Bressan-Smith

8 - Species information for sustainable adaptation capability to climate change
Issue: How to ameliorate impacts of climate change on natural and managed ecosystems by understanding species phenology and geographic and climatic ranges. **GPCs role:** Convene a panel to explore/develop an approach toward facilitating ecosystem adaptation to changes that are already taking place. **What needs to happen:** Need to know more about plant invasion; capability of individual species to adapt; gene flow; seed dispersal/migration at local and regional levels. Need to integrate this information and put in an ecosystem perspective. Establish/facilitate mechanism for bringing together species genome information together with ecosystem knowledge. **Workshop 1 participants:** ecologists; ecophysiologists; botanists; systemacists; phylogenomicists; population biologists; natural resource managers; climate change scientists. **Stakeholders:** people in general; WWF; gene/seed banks; national parks; botanical societies/gardens; ecological societies; governments/ministries for the environment (EPA).
GPC Advocate: Prof. Song Ge

9 - Sharing Information and Resources
Issue: Research success and agricultural progress to alleviate global concerns for food security and germplasm development is hindered by the difficulty in accessing relevant phenotype and genotype data as well as germplasm. **GPCs role:** GPC advocates the global free exchange of information, data, and resources (including germplasm) that are in the public domain [Approved by vote of GPC]. **What needs to happen:** Continuously reiterate statement above. Like IPCC does, outline the consequences of NOT finding ways to reach agreement on these issues. **Drafting group:** Mel, Dr. Taylor, Prof. He.
GPC Advocate: Mel Oliver
Final document should be formally approved by member societies and signed by their presidents

Half-pagers per focus area developed following GPC meeting June 2011

1 - The Digital Seed Bank

An Initiative of the Global Plant Council

Securing crop diversity for food security worldwide must be among the highest priorities of human society. Agriculture today depends on only a few crops that are cultivated on a large scale, most notably the cereal crops maize, rice and wheat that supply 60% of the world's food energy intake. After thousands of years of breeding, these and other crops show an enormous local and environmental diversity. Efforts are underway in germplasm banks around the world to protect this crop diversity for future generations, such as storing their seeds in the Svalbard Global Seed Fault that is managed by the Global Crop Diversity Trust (http://www.croptrust.org). But little is known about the molecular and biochemical basis of this diversity and how it can benefit modern day varieties. More work is therefore needed to understand crop diversity and how best it can be utilized in the future by breeders and in molecular breeding programs to improve current and develop new varieties that can tolerate adverse climate conditions and defend diseases while maintaining their yield. This knowledge must include detailed information on the molecular and biochemical basis of genotype x environment interactions, allelic diversity, and the gene networks that control quantitative traits for yield and quality performance. The molecular characterization of crops is no longer a bottleneck, and technologies exist today for resequencing crop genomes at low cost. When combined with quantitative information about the expression of genes, proteins and metabolites from crops growing in environmental conditions that reflect their diversity, this will give breeders unprecedented new and valuable insights that can be exploited for crop improvement programs. Complementing germplasm preservation by capturing such molecular and biochemical information of our crops for future generations requires an international effort and cooperation for selecting hundreds or thousands of varieties for characterization that represent the broadest possible span of crop diversity. The digital crop information will grow in a well-managed database (i.e., the Digital Seed Bank) that is freely accessible to scientists and breeders around the world. Such global effort must be coordinated and supported by strong financial and open access commitments from the international community.

Wilhelm Gruissem
ETH Zurich
Member, Global Plant Council

2 - The Plant Metagenome.

An Initiative of the Global Plant Council.

If agriculture is going to deliver on its task to feed the burgeoning world population and if we are to understand the effects of global climate change on plant communities. To improve and maintain and sustainable agricultural system, it is fundamental to accelerate our understanding of how plant ecosystems respond to environmental changes. Plants interact with a host of other living organisms, from the seed to the mature flowering plant, on a continuous basis. These organisms, from bacteria to invertebrates (and on occasion organisms from the more complex taxa), along with the plant form a complex biological system that functions as a whole, with each component impacting all of the anthropological measures of productivity and the fecundity of the plant. This "whole plant" system has been described as The Plant Metagenome a comprehensive term describing plant-microbial-invertebrate diversity and interactions. Understanding the complexities of what organisms constitute a Plant Metagenome, how Plant Metagenomes change in natural and agricultural systems, what are the driving forces for changes in Plant Metagenomes, and how Plant Metagenomes change with climate, are all critical questions to address.
This multidisciplinary proposal will also examine the three core issues that have a direct impact human welfare and health. 1. The effect environment on plant and microbial diversity. The main goal is to establish critical practical changes in our agricultural practices and protect (or manage) ecosystems.2. Plant ecosystems as a source of opportunistic pathogens. The main goal is to examine the contribution of plant ecosystems to generate and spread of potential pathogens for humans and livestock. 3 . Establish standards and uncover challenges in the field of plan metagenomes to initiate a well documented debate on how science policy and funding influences progress in this area.

Mel Oliver

3 - Biofortification

An Initiative of the Global Plant Council

Malnutrition is a major global problem resulting in massive social and economic costs to developing and developed economies. Impacts include increased mortality, impaired learning, greater susceptibility to disease and infection, with consequential economic and societal impacts.
Biofortification refers to the development of new and existing crops that have improved nutritional value, be it via traditional agronomic technologies or genetic modification. There are a number of initiatives underway funded by a range of governmental and private organisations to improve the nutritional value of staple foods, such as rice, cassava, wheat and maize. Stakeholders include, but are not limited to: The Bill and Melinda Gates Foundation, HarvestPlus, GoldenRIce.ORG, WHO and FAO.
The Global Plant Councils role would be to:

- Advocate for development new crops that are more nutritious so that people receive the nutrients directly from unprocessed foods.
- Articulate what can be accomplished by breeding and what has to happen via GMO.
- Identify gaps in current programs.
- Advocate for open sharing of data and information regarding biofortification efforts.
- Increase global support and participation in current and new initiatives.
- Facilitate the early release of improved crops to local communities

We propose that the first step in the development of these priorities is to bring together key stakeholders to undertake an analysis of current projects and their delivery time frames, determine if investments into R&D are sufficient for delivery and undertake a gap analysis to ensure major nutritional needs will be met in a coordinated approach.
Stakeholders include: nutritionists; food scientists; breeders; molecular biologists/transformation; social scientists; economists; representatives of current and proposed programs; and representatives from relevant National, Industrial and NGOs involved in biofortification. The outcome would be the development of strategies for furthering research, development and release of biofortified crops

Barry Pogson
Member, Global Plant Council

4 - Developing Perennial Rice, Wheat and/or Maize

The three major crops that required more land, water and potentially nutrients than all other crops put together are wheat, maize and rice. The world faces diminished resources, be it land, water or fertilizer. There are also pressures to maintain yield under more variable and stress full environments. Thus, for the three crops we propose a grand challenge to promote greater environmental sustainability of agricultural ecosystems by lowering inputs (human, nutrient, energy), while maintaining yields.
A possible way to achieve such a goal would be the development of perennial crops, that is, rather than complete harvesting of the crop each season the root stock is maintained for two or more seasons. The reduces costs and inputs for cultivation and fertiliser, ensures a root stock deep enough to better uptake nutrients and water in marginal ecosystems or seasons.
The problem is none of the major grain crops have commercial perennial varieties. However, all have wild relatives that are perennials and advances in genetics and breeding enable relatively rapid breeding programs that were not possible a decade ago. The primary strategies are: introgress genes for perennialism from wild-relatives into current grain crops, either via accelerated breeding and/or GM, evaluate the potential of non-domesticated perennials for development as crops.
There are small scale efforts underway across the globe, but there is no large scale, coordinated effort to develop perennialism. We propose bringing together stakeholders, included agronomists, plant geneticists and breeders for rice, wheat and maize to develop a proposal for each crop, considering its potential for perennialism or for a wild relative to be developed as an alternative. The group would estimate likely of success, time frame and resources required and the benefits and risks associated with each proposal. The initial outcome would be the development of a discussion paper. Subsequent to this would be the development of programs of research and discussion with stakeholders and funding agencies.

Barry Pogson
Member, Global Plant Council

5 - **Development of medicinal plant-based products**

There are numerous examples of plant-derived products having significant medicinal value, including the anti-cancer agent, Taxol from the pacific yew tree, Artemisia, the key drug in the war against malaria, drugs from Madagascan periwinkles that have increase remission rates from 10 to 95% for childhood leukemia suffers. It is also well known that plants are an ideal source of novel drugs due to the diverse and complex secondary metabolism of the plant kingdom. Drugs and medicines have been identified by ethnobotanical studies, targeted discovery, systematic chemical analyses of plants, and scientific scrutiny of traditional medicines to validate efficacy and identify the active compound(s).

The challenge for plant scientists is to evaluate ecosystems that are under threat for medicinal value, liaise with local communities and test the efficacy of plant-based treatments, determine opportunities and pathways for the development of new drugs, be it provision of knowledge to local communities for low cost medicines or liaising with the pharmaceutical industry to undertake the testing and development of new medicines. A question for the GPC is to what extent needs being met by current global efforts and would global coordination improve outcomes. We recommend a meeting of key research and development groups and individuals to discuss the issues facing them and determine if there is a role for the GPC.

Barry Pogson
Member, Global Plant Council