EU-China expert seminar

Brussels, 27 October 2016

Report from the thematic session on

"**Plant Genetic Resources Management, Pre-Breeding and Bioinformatics**"

Participants

China

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Overview of relevant running Horizon 2020 projects and/or topics

Work Programme 2014

- Topic SFS 7A: "Traditional resources for agricultural diversity and the food chain" (focus in-situ); budget 10m€
  Projects: DIVERSIFOOD, TRADITOM, TREASURE

Work Programme 2015

- Topic SFS 7B: "Management and use of genetic resources" (focus ex-situ); budget 20m€
  Projects: G2P-SOL; GenTree; IMAGE

Work Programme 2016

- Several topics to increase interspecific species diversity; budget 30m€
- EU-China cooperation on mutual access to genetic resources; budget 5m€

Work Programme 2017

- Topic SFS 4: "Improving capacities for in-situ conservation"; budget: 2m€

Overview of challenges from the EU and China

Challenges raised by experts from China

Experts focused on challenges related to the use of plant genetic resources (PGR) for breeding with a focus on *Brassica* and wheat. These include the need to :

- increase genetic diversity of crops by developing new germplasm, in particular

hexaploid and other artificially synthesized Brassica oilseeds and synthetic hexaploid wheat to overcome current limitations for rapeseed and wheat breeding and production, notably in relation to yield and oil content, tolerance to biotic and abiotic stresses, mechanisation of the fixed heterosis in and the use efficiency of inputs (e.g. fertilisers)

- increase genetic diversity of crops by developing new germplasm, in particular hexaploid and other artificially synthesised *Brassica* oilseeds and synthetic hexaploid wheat
- enhance evaluation (phenotyping) of crop germplasm(e.g. rapeseed and wheat) to increase knowledge on candidate genes
- further invest into functional genomics and better understand trait development, e.g. the genetic components of yield potential and dough quality
- further invest into genome based breeding; create genome selection breeding platforms
- develop more efficient and shared platforms to exchange genotypic and phenotypic data; and enhance evaluation (phenotyping) of crop germplasm (e.g. rapeseed and wheat) to increase knowledge on candidate genes.
- better integrate breeding strategies with farming systems design and management

2. Challenges raised by experts from the EU

Experts addressed a number of challenges in relation to the management, access and use of PGR, including:

- Long-term financing of systems for *in situ* and *ex situ* conservation including for pre-breeding. The need to support funding of core resources was particularly highlighted
- Phenotyping was considered as the main bottleneck and challenge to mobilise PGR, in particular: the lack of effective tools for High Throughput Phenotyping and image analysis, reliable phenotypic data (e.g. vocabularies and data standards), standardization of procedures, protocols, trait ontologies. The standardisation of phenotyping protocols for complex traits was considered as particularly relevant
- National and international policies and the regulatory framework (e.g. Nagoya protocol, ITPGRFA) may hinder access to PGR
- Considerable differences exist in the quality of genebank management and there is a need for increased collaboration across countries to tackle e.g. issues related to data and seed storage, redundancies and description of PGR (e.g. lack of single genotyping system)
- Access to resources and data is often hampered by lack, quality or reliability of information
- Develop pre-breeding programs and exchange material and strategies
- Pre-breeding under climate change is a moving target and requires amongst others better integration of climate models with crop models and untangle GxE-interactions
- Better use of CWR, neglected and underutilized species (NUS) is key to find adaptation traits and genes

- Conversion of *ex situ* genebanks into biodigital resource centres with a single genotyping system and reliable phenotypic data
- Develop models of pan-genomes and graph based representations of complex genome landscapes.
- Need to maintain reference databases to provide access to integrated genomic and associated phenotypic information

Common challenges and role of R&I; potential areas for cooperation

Collaboration in the field of PGR management, pre-breeding and bioinformatics was considered of highest importance to both the EU and China in view of supporting crop improvements to 'feed the world', adapt farming to environmental changes and to changing consumer demands.

Participants agreed that collaboration can increase the efficiency of individual activities in Europe and China. Examples include the standardisation of access to genome sequence protocols, allowing exchange and comparison of the analytical results, access to environments for phenotyping, combining efforts in the research on e.g. *Brassica* and wheat, and most importantly access to each other's PGR and research material. All this was seen as crucial in view of widening and enriching breeding material and giving access to references used in research.

Finally it was observed that collaboration between PGR actors will strengthen conservation of the PGR, and thus contribute to their long term availability.

Three major themes were identified as a basis for further exploring EU-China collaboration:

<u>Theme 1 - Genebank-bioinformatics</u>
Cooperation on bioinformatics was the first priority identified. It has significant potential to improve the availability, exchange and analysis of large amounts of data that are currently being generated on genebank material. More specifically, experts highlighted openings for cooperation in the areas of

a) Data exchange and the development of standards: Examples included the possibility to promote the collaboration of China with the EU ELIXIR infrastructure project, and inclusion of Chinese data in Genesys. In addition, it could be foreseen to organise joint development and management of phenotyping methodologies and ontologies and the establishment of shared recommended checks and/or (mini) core collections.

b) Interfaces between genebanks and their users: These interfaces would provide access to the classical (passport and phenotypic) data and the various associated -omics data. Experts suggested that specific use-case oriented applications are developed allowing genebanks to improve their services to potential PGR users exploiting new types of data, built upon generic data repositories.

<u>Theme 2 - Adding value to genebank material</u>
The second theme suitable for collaboration is the pipeline of generating and analysing data about PGR and thereby adding value to genebank material.

a) Generation of data: Cooperation would be particularly relevant on high-throughput approaches for geno- and phenotyping and the development of joint protocols and methods. Experts also suggested exploring the possibility of sharing geno- and phenotyping facilities.

b) Analysis of the big data generated: New methods need to be created and implemented in analytical tools. Analyses could extend to genomic selection / breeding value, GWAS / QTL-mapping, gene identification and ultimately allele mining.

Theme 3: Widening genepools

Experts shared a mutual interest in developing innovative methods to broaden the genetic basis of important crops, i.e create new material. This could include research on synthetic varieties using fixed heterosis of allo-ploidy (in *Brassica* and wheat). In addition cooperation could help improve the use of wild relatives in plant breeding by improving understanding of basic biological processes.

Comments:

Although not under the remit of the Horizon 2020 programme, experts highlighted the importance of facilitated access to PGR and associated data. Based on the experience of the participants it appeared that the in- and export of PGR to and from China is quite difficult.

To improve this situation it was suggested that Chinese PGR data (initially passport data only) are included in Genesys, the global PGR documentation system. This was considered a relatively simple step that would create a view on Chinese PGR to the rest of the world and help start collaboration and exchange.

Experts also raised the legal and bureaucratic obstacles hindering exchange. While recognising that H2020 projects could not resolve this issue, they found it important to flag these as a major factor potentially affecting future research and application.