On Monday 10th and Tuesday 11th August 2015, the newly started BEAN_ADAPT Collaborative Research Project has its ‘kick-off’ meeting that will be held at the Global Crop Diversity Trust in Bonn (Germany). The project is funded through the 2nd ERA-CAPS call, ERA-NET for Coordinating Action in Plant Sciences, which is entitled “Expanding the European Research Area in Molecular Plant Sciences II”. The aim of this new European Collaborative Research Project is to identify the genes in bean plants that are responsible of adaptation to new environments and to different environmental conditions. This is to be achieved, according to the researchers, through the study of the introduction of the bean into Europe from the centres of domestication in the Americas, and then its further expansion throughout Europe, which represents a recent and historically well-defined event of rapid adaptation.

“Crop diversity and genetic variability are key aspects for plant breeding, and there is the increasing need to develop incisive strategies for sustainable agriculture in the context of climate change,” explained Roberto Papa, Professor of Agricultural Genetics at the Università Politecnica delle Marche and Project Leader of BEAN_ADAPT. Prof Papa is coordinating this new European project in collaboration with two prestigious US Universities, the University of California, Davis, and the University of Georgia, Athens, USA, and two eminent German research institutions, the Max Plank Institute of Golm, and the Leibniz Institute of Plant Genetics and Crop Plant Research of Gatersleben, Germany.

“Moreover” Prof Papa stated “beans are very important crops for global food security, as they represent a crucial source of protein for poor farmers in Latin America and eastern Africa.” In Italy, beans are also known as the “poor man’s meat”, and they have had an important role in the diet of the underprivileged from European rural areas, particularly for the prevention of malnutrition. “Along with other legumes, beans are a key crop in sustainable agriculture, as in most agricultural settings the primary source of biological fixed nitrogen, at about 80%, is through the soil bacteria Rhizobium–legume symbiosis, which therefore reduces the use of fertilisers” Prof Papa explained. “Beans also have very high nutritional quality and contain many compounds that are known to have health benefits, such as fibre and antioxidants, which also have important roles in the prevention of several diseases.”

BEAN_ADAPT is the acronym of a three year Collaborative Research Project that is entitled “Evolution in a changing environment: the genetic architecture of adaptation outside centres of
domestication of *Phaseolus vulgaris* and *P. coccineus*. The Principal Investigators from the three European organisations and two US Universities that have formed this consortium are:

(i) Roberto Papa (Coordinator), Department of Agricultural, Food and Environmental Sciences, Polytechnic University of Marche, Ancona, Italy;

(ii) Alisdair R. Fernie, Central Metabolism Group, Max-Planck-Institute of Molecular Plant Physiology, Potsdam-Golm, Germany;

(iii) Andreas Graner, Genebank Department, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben, Germany;

(iv) Paul Gepts, Department of Plant Sciences, University of California, Davis, USA; and

(v) Scott A. Jackson, Center for Applied Genetic Technologies, University of Georgia, Athens, USA.

*Phaseolus* spp., and in particular the common bean, *Phaseolus vulgaris* L. (2n=2x=22; Pv), represent the most important grain legumes for direct human consumption worldwide. Furthermore, there is increased interest in grain legumes as an alternative source to animal products for food protein, and also for the health benefits that are related to regular legume consumption. In Europe, the common bean is the main crop grown for plant protein for food, and in 2012, the European Union imported 501,058 t. *P. vulgaris* is also an economically important crop in the USA, where 1.7 million acres of dry beans were planted in 2012, with a farm-gate value of $1.4 billion. Along with other legumes, *Phaseolus* spp. have important roles in sustainable farming systems, because of their association with bacteria that ‘fix’ atmospheric nitrogen, thereby enriching the soil.

The main aim of BEAN_ADAPT is to dissect out the genetic basis and phenotypic consequences of the adaptation of the common bean to new environments, along with its sister species, the runner bean (*Phaseolus coccineus* L.). A large collection from three major genebanks that will include 11,500 accessions of both of these species will be characterised by genotyping-by-sequencing, a technique that identifies single nucleotide polymorphisms for genetic analysis. This will allow the definition of the population structures of these species, and provide subsets of genotypes for phenotyping and for deeper genomic–transcriptomic–metabolomic characterisation. A multidisciplinary approach will be used here, including genomics (e.g., whole-genome sequencing, RNA sequencing), population/quantitative genetics, biochemistry, and plant physiology. Differential expression analysis, analysis of co-expression patterns, and genome-wide association studies will be used to identify genes and metabolites that are putatively associated with adaptation. The genotypic information obtained from genotyping-by-sequencing, whole-genome sequencing, and RNA sequencing will be used to test for signatures of selection.

One of the main outcomes of the project will be the development in *P. vulgaris* of haplotypes of all 10,000 accessions (‘HapBean’), along with the associated information and new seed stocks, which will represent a unique tool for plant scientists and crop breeders. For *P. coccineus*, we will also have a well-defined set of information that will constitute the foundation for the development and application of its genomic resources.

Over 20 representatives from European and international research institutes and organisations will meet in Bonn for this BEAN_ADAPT kick-off meeting. One of the aims will be to disseminate BEAN_ADAPT to the public and to the bean research community. The programme for the event includes a reception on the first day, followed by introductory presentations, and a
second day of workshops and open meetings with other scientists and parties interested in participation and collaboration within the ERACAPS BEAN_ADAPT project.

On the first afternoon of the meeting, the introductory presentations will be given by researchers from the Global Crop Diversity Trust (the host institution), from the Crop Trust, and from IBG-2, Plant Sciences Forschungszentrum Jülich, and also by the representatives of DivSeek and the International Treaty on Plant Genetic Resources for Food and Agriculture initiatives.

The second day of the meeting will include the BEAN_ADAPT project presentation, given by the project Coordinator and by the four Principal Investigators. These talks will detail the scope and activities that will be covered during BEAN_ADAPT. Moreover, there will be time for other scientists and delegates who are interested in participation and collaboration within BEAN_ADAPT to present their work and outline their potential contributions to the project.

BEAN_ADAPT will provide very useful contributions to further legume research and production. Furthermore, considering the importance of protecting the environment, promoting greater use of systems that involve legumes represents cheaper and more sustainable alternatives to conventional practices, due to the symbiotic capture of atmospheric nitrogen, which will thus reduce the use of industrially produced nitrogen. This project is particularly relevant for the future challenges of plant breeding, to identify genes/quantitative trait loci for important agronomic traits. These will be crucial for plant breeding and to obtain new varieties to contribute to food security in a world that is in demographic expansion, and in the context of climate change.

BEAN_ADAPT aspires to work with existing organisations/institutions/stakeholders/research groups to form a wide collaborative network within BEAN_ADAPT. This should include ‘bean research community’ members, gene banks, plant breeders, plant and crop scientists, and database and computational experts, all of whom can contribute to this project while also benefiting from the data produced and from the outcomes reached.

ERACAPS BEAN_ADAPT website
BEAN_ADAPT Bonn event program

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