

Formation of PeaGRIC: An international consortium to co-ordinate and utilize the genetic diversity and agro ecological distribution of major collections of *Pisum*

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Pisum ranks fourth among the grain legumes worldwide with a total dry pea production of over 11 million tons and green pea production of over 9 M tons (1). In spite of its global importance, there is no CGIAR mandate for *Pisum* improvement and conservation, although the International Center for Agricultural Research in Dry Areas (ICARDA), Syria houses a major collection of field pea (*Pisum sativum*) and contains a number of accessions from its center of origin and domestication. Important collections are also housed at the Western Regional Plant Introduction Station, Pullman, WA, USA (USDA/ARS); the N.I. Vavilov Research Institute of Plant Research (VIR), Russia; the International *Pisum* Genetic Stock collection located at the John Innes Centre (JIC), UK; the Australian Temperate Field Crops Collection (ATFCC), Department of Primary Industries (DPI-Victoria), Australia; the Nordic Gene Bank (NGB), Sweden; the Crop Genetic Resources Institute (CGR) within the Institute of Crop Sciences CAAS, Beijing, China; the Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben, Germany; and the Germplasm Institute (GIBARI) at Bari, Italy. Together, these collections provide a wealth of exploitable genetic diversity, much of which has yet to be discovered.

In addition, a number of bilateral and multilateral initiatives in *Pisum* genetic resources conservation, utilization and improvement are underway. These include:

- The European Cooperative Program for Crop Genetic Resources (ECP/GR) includes a working group for grain legumes (<http://www.ecpgr.cgiar.org/>)
- GLIP (Grain Legumes Integrated Project (EU FP6; <http://www.eugrainlegumes.org/>))
- GERMINATE (Generic database for plant genetic resources) (<http://www.germinate@scri.sari.ac.uk>)
- IPIS (International Pea Information System based on ICIS - based at ATFCC)
- GRIN (Germplasm Research Information Network; USDA/ARS; <http://www.ars-grin.gov/npgs/index.html>)

Here we propose to develop a multi-institute genebank consortium to facilitate international collaboration and utilization of *Pisum* genetic resources

- to elucidate and utilize the existing genetic potential in the major *Pisum* collections available to the scientific community,
- to develop commonality and shared genetic resources objectives,
- to promote, deliver, and exchange resources and expertise to the *Pisum* research, breeding and conservation communities, including
 - *Pisum* germplasm resources
 - wild and weedy relatives
 - landraces
 - cultivars
 - cultivar reference collections
 - breeding lines
 - mutant collections
 - mapping populations
- standardization of molecular marker technology and expertise

- potential for marker-association for traits of interest
- eco-geographical referencing
- computational resources
- a global pea genetic resources portal for phenotypic characterization and evaluation, and for molecular characterization.

To ensure utilization of these invaluable genetic resources, a thorough investigation into the genetic structure of individual collections is required. The strength of the consortium will be the complementation and synergy of expertise and resources and their links to ongoing research and breeding initiatives. With accessions and markers in common across various research initiatives, a basis for comparability will enable leverage of research into a wider context, add value to both past and current research across organizations, and add to the totality of information on pea germplasm world wide

The objectives of this project include:

1. To create a portal for the *Pisum* research community with a database of *Pisum* genetic resources and links between *Pisum* databases by participating with and delivering into on-going database initiatives
2. To develop an international reference collection of *Pisum* to help elucidate the genetic and agronomic diversity available to the scientific research, conservation and breeding community
3. To facilitate agronomic and molecular characterization of the reference collection
4. To study genetic diversity in relation to ecological diversity and land use in order to predict future diversity and selection of sites for collections, target the mining of current diversity, in-situ conservation, and crop improvement emphasis utilizing GIS technology

Methodology:

Objective 1:

All available reference collection data will be fed into existing database initiatives (e.g., GERMINATE, IPIS, GRIN, etc.). The combined data will result in a virtual global collection and provide a portal for the international *Pisum* research community to interactively search and query germplasm as desired by the breeder/researcher with a) required expressions across multiple traits, b) specified countries of origin, c) choice as per distribution maps of climate/abiotic stresses corresponding with GIS data of collection sites.

Objective 2:

A dispersed international reference collection will be developed by consortium genebanks based on single plant selections from accessions. Each individual reference subcollection will be determined based on taxonomic, passport and characterization data, ecological and geographical representation, and special interest accessions and will include where available, valuable trait data such as resistance to lodging, abiotic and biotic stresses (e.g., 2,3,4).

Objective 3:

Agronomic and morphological characterization of accessions will be carried out on individual reference sub-collections at the participating institutes to obtain data on important agronomic traits, pest and disease resistances, tolerances of abiotic stresses and adaptation traits, nitrogen fixation, seed quality, food and nutritional properties. Molecular characterization will be carried out using mapped, polymorphic and transferable genic SSR-based neutral molecular markers already available in the public domain to provide a comprehensive genetic diversity analysis of accessions. This will be undertaken in partnership with other groups within member institutions (eg. ICARDA, JIC, DPI, ICGR, IPK and NGB) and with other interested organizations who have sufficient expertise, marker resources and facilities and the results made available in the public domain.

Objective 4:

Appropriate GIS software will be utilized to study the collections on an eco-geographic level. This will enable i. study of the structure and patterns of genetic diversity within the wider *ex-situ Pisum* germplasm resources, ii. help to establish the distribution of specific agronomically important traits, and iii. identify important gaps in the collection by eco-geographic area. This information will also be

used, in partnership with others, to help define areas for in-situ conservation of landraces and wild relatives, as well as predict the affects of climate change on future diversity in order to identify areas of focus for crop improvement of the species.

Potential outcomes

The development of an international reference collection for *Pisum* will fill a gap and addresses a need by the research and breeding communities for a coordinated and structured germplasm resource for *Pisum* at the international level. The associated DNA stocks and data sets derived from the work will become key reference sources for future investigations. Information obtained above will be utilized to study and compare the development of gene pools in very different agro-climatic zones, land use and crop production systems as well as to develop a more detailed understanding of any resulting changes in genetic structure. One important outcome will be to identify and address gaps in information (morphological, agronomical, eco-geographical, molecular, passport, etc.). The utilization of common SSR markers in addition to agronomic characterization will allow the creation of a virtual characterized global germplasm collection. Molecular characterization based on single plants will provide added value to breeders for potential association studies. Such information will enable a world database to be assembled, with increments from each successive study. The database and the information it will hold will provide a portal for the global *Pisum* research community. A world database can facilitate; improved utilisation of pea germplasm at a global level, more strategic targeting of accessions for breeding / germplasm enhancement programs, sharing of germplasm maintenance, identification of unique germplasm - a priority of the Global Crop Diversity Trust associated with the PGRFA treaty, and increased synergies with the sharing of evaluation data.

The Executive Committee will organize a PeaGRIC workshop at the 6th AEP meeting (Lisbon, Portugal November 2007) and invite all interested in joining the consortium to participate.

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