



Molecular Markers for Allele Mining

Proceedings of a workshop, 22–26 August 2005, MS Swaminathan Research Foundation, Chennai, India

**M. Carmen de Vicente, Jean-Christophe Glaszmann,
editors**

International Plant Genetic Resources Institute, Generation Challenge Programme



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The International Plant Genetic Resources Institute (IPGRI) is an autonomous international scientific organization, supported by the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to advance the conservation and use of genetic diversity for the well-being of present and future generations. IPGRI's headquarters is based in Maccarese, near Rome, Italy, with offices in another 19 countries worldwide. The Institute operates through three programmes: (1) the Plant Genetic Resources Programme, (2) the CGIAR Genetic Resources Support Programme and (3) the International Network for the Improvement of Banana and Plantain (INIBAP).

The international status of IPGRI is conferred under an Establishment Agreement which, by January 2001, had been signed and ratified by the Governments of Algeria, Australia, Belgium, Benin, Bolivia, Brazil, Burkina Faso, Cameroon, Chile, China, Congo, Costa Rica, Côte d'Ivoire, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Greece, Guinea, Hungary, India, Indonesia, Iran, Israel, Italy, Jordan, Kenya, Malaysia, Mauritania, Morocco, Norway, Pakistan, Panama, Peru, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Sudan, Switzerland, Syria, Tunisia, Turkey, Uganda and Ukraine.

In 2000 financial support for the Research Agenda of IPGRI was provided by the Governments of Armenia, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, F.R. Yugoslavia (Serbia and Montenegro), Finland, France, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Republic of Korea, Latvia, Lithuania, Luxembourg, Macedonia (F.Y.R.), Malta, Mexico, the Netherlands, Norway, Peru, the Philippines, Poland, Portugal, Romania, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Uganda, the UK and the USA and by the African Development Bank (AfDB), Asian Development Bank (ADB), Center for Development Research (ZEF), Center for Forestry Research (CIFOR), Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica (CATIE), Common Fund for Commodities (CFC), Technical Centre for Agricultural and Rural Cooperation (CTA), European Environmental Agency, European Union, Food and Agriculture Organization of the United Nations (FAO), Food and Fertilizer Technology Center for the Asia and Pacific Region (FFTC), Future Harvest, Global Forum on Agricultural Research (GFAR), Instituto Colombiano para el Desarrollo de la Ciencia y la Tecnología (COLCIENCIAS), Inter-American Drug Abuse Control Commission (CICAD), International Association for the Promotion of Cooperation with Scientists from the New Independent States of the former Soviet Union (INTAS), International Development Research Centre (IDRC), International Foundation for Science (IFS), International Fund for Agricultural Development (IFAD), International Service for National Agricultural Research (ISNAR), Japan International Research Centre for Agricultural Sciences (JIRCAS), National Geographic Society, Natural Resources Institute (NRI), Programme on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (PGRA), Regional Fund for Agricultural Technology (FONTAGRO), Rockefeller Foundation, Taiwan Banana Research Institute (TBRI), Technova, United Nations Development Programme (UNDP), UNDP Global Environment Facility (UNDP-GEF), United Nations Environment Programme (UNEP), UNEP Global Environment Facility (UNEP-GEF), United States Department of Agriculture (USDA), Vlaamse Vereniging voor Ontwikkelingssamenwerking en Technische Bijstand (VVOB) and the World Bank.

The Generation Challenge Programme (GCP) is a research and capacity building network that uses plant genetic diversity, advanced genomic science, and comparative biology to develop tools and technologies that enable plant breeders in the developing world to produce better crop varieties for resource-poor farmers.

The GCP is one of four Challenge Programmes established by the CGIAR to make high impacts in the short term through thematic approaches involving a multitude of research, development, health, and delivery organizations.

The Generation Challenge Programme brings together three sets of partners—the centres of the Consultative Group on International Agricultural Research (CGIAR), advanced research institutes (ARIs), and national agricultural research systems (NARS) in developing countries—to deliver the fruits of the Genomics Revolution to resource-poor farmers.

The Generation Challenge Programme has five subprogrammes that span the spectrum of research in germplasm, genomics, bioinformatics, and molecular breeding for agricultural development:

Genetic Diversity of Global Genetic Resources

Comparative Genomics for Gene Discovery

Trait Capture for Crop Improvement

Genetic Resources, Genomic, and Crop Information Systems

Capacity Building and Enabling Delivery

The geographical designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of IPGRI, the Generation Challenge Programme or the CGIAR concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries. Similarly, the views expressed are those of the authors and do not necessarily reflect the views of these organizations.

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Session VII: Perspectives

The need for allele mining: perspectives of the System-wide Genetic Resources Programme (SGRP)

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The SGRP is a consortium of all CGIAR gene banks. These banks aim to (1) conserve diversity efficiently, including and especially rare alleles and genotypes; (2) ensure efficient use of collection by delivering appropriately selected subsets of germplasm to users, maximizing the chance of giving users the set of alleles or genotypes that they need; and (3) ensure that the entire collection remains available for use. The SGRP exists to ensure a consistent, integrated, system-wide approach to the efficient achievement of these goals.

At this meeting, the SGRP, represented by five CGIAR centres —ICARDA, ICRISAT, IITA, IRRI, and WARDA—considered the following main topics:

1. Data, especially issues on publicizing standardized data through SINGER.
2. Policy on conservation and use of germplasm in terms of, for example:
 - i. Germplasm exchange and the intellectual property aspects of genetic resources,
 - ii. The Convention on Biological Diversity,
 - iii. The International Treaty on Plant Genetic Resources for Food and Agriculture, and
 - iv. Protection against the unintentional presence of transgenes in gene banks.
3. Generic methodologies for improved efficiency of conservation and use of genetic resources, for example, GIS technologies and molecular technologies for characterizing genotypes.

In particular, molecular tools are seen as vital for improving the efficiency of conservation and use of genetic resources. Molecular characterization represents the biggest scientific advance in PGR concepts since the 'Green Revolution', and it is an opportunity to revolutionize the way we operate. For this reason, the SGRP strongly supports the GCP and, since the inception of the idea, was involved in planning the GCP (then GRCP or Genetic Resources Challenge Programme). We expect the GCP's results to enable a major improvement in the way CGIAR gene banks operate.

An issue of particular interest to CGIAR gene banks is, what about the rest of the CGIAR collections? SP1 has defined, and is now characterizing, diversity in representative composite collections of the major crops, combining germplasm from as many gene banks as possible. These composite collections contain a large percentage of crop gene pools, and the information will be used to understand the ecogeographic distribution of diversity in each crop. Refining the composite collections to smaller reference samples will further facilitate the discovery of new functional genes and, once the functional genes are identified, we can discover the range of alleles included in the composite collections. The value of this information is exceptionally great.

Yet, as for rice, only about 2% of the germplasm held in the gene bank at IRRI is included in the composite collection; and only 0.2% is in the reference collection. The collection at IRRI contains many accessions that are of interest to our users but are not included in the composite collection. We must not forget that breeding is a 'numbers game', and finding the

rare valuable alleles or genotypes can involve screening many more accessions than are included in the composite collections. We need to find a way forward from genotyping the composite collections to true 'allele mining'—efficiently screening other accessions outside the composite collections to discover new valuable alleles.