Genetic resources

Genetic resources became a subject of public policy towards the end of the 1970s, when Mexico was the first country to raise this question with the FAO, even though researchers had been travelling throughout the world for many decades to collect these resources in their natural environments and exchange them with colleagues, or even farmers.

Thus in 1855, de Candolle published "Reasoned Geographical Botany" (*La géographie botanique raisonnée*), which was supplemented in 1883 by his famous work on the origin of cultivated species. Other publications subsequently broadened the investigation of living resources, particularly those by Vavilov (1926) and Harlan (1975).

Two main points arise from this simple introduction: firstly, the management and preservation of natural genetic resources must follow common, international rules, and secondly, the cost of genetic resources to a public sector research agency never ceases to rise. Each agency must therefore comply with national and international policies, before defining its own policies and then organising the means appropriate to this work.

Despite its high costs and constraints, the management and preservation of genetic resources is more than ever an essential activity for agricultural research agencies, because several contextual elements have enhanced the importance of these resources :

- advances in biology have enabled the more exhaustive, more rapid and less complicated exploration of living organisms, leading to the discovery of genes of interest, markers, and new processes for physiological and genetic regulation.
- changes to climatic conditions, the spread of diseases to hitherto unaffected regions or the development of emerging diseases, and reductions in biodiversity due to human activities will further reinforce the essential need to exchange genetic resources.
- Finally, there is no point in a research agency developing biotechnological programmes if it does not, at the same time, endow itself with the means to

explore the natural variability of species, which constitutes the bedrock of genetics.

However, in order to perfect their policies, research agencies must better comprehend the changes which have affected the international status of genetic resources.

In 1967, Frankel developed the concept of genetic resources in support of the Green Revolution advocated by the FAO and CIRA. For this reason, international agricultural research centres were immediately mandated to conserve local, traditional cultivars. The IBPGR was finally set up on 1974. In 1983, the FAO published the International Undertaking on Plant Genetic Resources which endowed these resources with the status of being the common heritage of mankind which should consequently be available without restriction. In order to harmonise and clarify its actions, France set up the Bureau for Genetic Resources (*Bureau des Ressources Génétiques)* in 1983.

As soon as this debate on the status of genetic resources was closed, that concerning biodiversity moved to the forefront. Indeed, in 1986, Wilson put forward the concept of biodiversity which gradually shifted the problem of genetic resources towards the protection of natural environments and species. This concept of biological diversity is evidently broader than that of genetic resources, because it covers :

- Strategies concerning the preservation of our current heritage,
- The mechanisms underlying the evolution of organisms and populations,
- The exploitation of biological diversity.

This concept reached its apogee in 1992 in Rio, and led to the Convention on Biological Diversity which was ratified in 1993. This constituted a major turning point because the CDB acknowledged the sovereignty of states and their "rights of property" over their biodiversity. It gave preference to conservation *in situ* in natural habitats and, if relevant, using traditional practices. If *ex situ* conservation was essential, then preference would be given to the country of origin.

In this context, France drew up a national charter for the management of these resources in 1998, and founded the French Institute for Biodiversity (*Institut Français de la Biodiversité)* in 2000.

There is thus a major contradiction between the FAO concept (= common heritage of mankind) and that adopted by the CDB which lays greater emphasis upon the sovereignty of states.

Furthermore, the CDB concept is poorly compatible with the collective conservation and breeding activities which have recently developed. To settle this conceptual conflict, in 2001 the FAO published an international treaty laying down common rules to manage exchanges of species resources referenced on a restricted list of cultivated plants deemed essential to the production of food.

The final problem concerns the biotechnologies which have opened the door to the patenting of living organisms. International regulations are weak and tensions are increasing between continents, despite advances achieved by the WTO (1993) concerning the protection of varieties by patent or COV. In 1998, the European Union, disturbed and divided by the debate on GM organisms, laid down the criteria for biotechnological inventions :

- no patents on breeds and varieties,
- protection of varieties by a COV,
- patents possible on sequences and genes with known functions,
- protection extended to products containing the protected gene.

Despite these guidelines, the divergences increased. As an example, a growing number of patents are being granted in the USA for genetic markers, but their patentability is not allowed in Europe.

To conclude this rapid and macroscopic analysis, we would suggest that biotechnologies themselves will again both strengthen and overturn the notion of genetic resources. With the development of association genetics and the use of markers, needs for the phenotyping and molecular genotyping of resources will increase. High-throughput technologies in bioinformatics and mathematical modelling will be inevitable and essential. In parallel, the cost of lineage analyses will fall. In the longer term, the storage of computerised data will be as strategic, if not more strategic, than holding the biological resource itself.

In contexts which are evolving so markedly from the technological and regulatory points of view, it is not simple to define the future role of research agencies.

INRA intends to pursue its policies concerning :

- the collection and exchange of cultivated and related wild-type resources under conditions of transparency and with the countries of origin,
- the development of heritage resource centres accessible to all via their websites and ensuring the most appropriate health protection measures,
- the initiation of a Genomic Resources Centre, including: BAC databanks, EST clones, BAC terminal clones, collections of insertion mutants and Tilling collections. The species to be targeted by these centres will be the subject of stringent and strategic selection, and as far as possible form part of international efforts by consortia,
- methodological developments for the conservation of resources, molecular genotyping, association genetics, and marker-assisted breeding,
- participation in international consortia to ensure the sharing of tasks, resources and results.

Abstract

The production, management, conservation and exploration of genetic resources are essential activities for any agricultural research agency.

However, these activities are currently carried out in an international context which is not stabilised with respect to the equality of exchanges in scientific contexts which are seeing rapid change because of advances in biology, ecology, human and social sciences, and food sciences. Furthermore, the ecological and health changes brought about by forecasted changes to the climate, or the inevitable growth of globalisation, will also increase the exchange of resources.

We shall be reviewing the different questions raised by genetic resources and which lie at the heart of the mission of public-sector agricultural research agencies, despite continuing uncertainties arising both from conceptual divergences between states and evolutions in scientific techniques, both of which inevitably precede any changes to status.