Plant Genetic Resources in the Czech Republic

Ladislav DOTLAČIL, Iva FABEROVÁ and Zdeněk STEHNO

Crop Research Institute, Prague-Ruzyně, Czech Republic

Abstract: The study and conservation of plant genetic resources (PGR) in the Czech Republic has a long tradition. Since 1993, the efforts on PGR have been concentrated within the National Programme on Plant Genetic Resources. Twelve institutions hold a total of 50 000 accessions; 18.4% of which are vegetatively reproduced species. The Crop Research Institute (CRI), Prague, has overall responsibility for coordinating the Programme, holds more than a half of all accessions in the Czech collections, runs the national information system on PGR, and provides long-term storage for all seed-propagated species (inclusive the routine cryo-bank for selected vegetatively reproduced crops). All of the Czech collections are fully documented with passport data. Evaluation data sets (based on National Descriptor Lists) are available for 65% of the accessions. Intensive characterization and evaluation of genetic resources is performed to facilitate their use in breeding and agriculture. Each year, between 2400 and 5500 samples of PGR are provided to users. We make efforts to extend users' access to genetic resources. The collecting missions within the Czech territory, including the conservation and monitoring of valuable resources in situ, contribute to the preservation of valuable local resources. International collaborations operate on global, regional and bilateral levels; a guaranty of the international exchange of genetic resources is a fundamental policy. All Czech institutions dealing with plant genetic resources are involved in the European Cooperative Programme on Plant Genetic Resources (ECPGR).

Keywords: plant genetic resources; National Programme; international collaboration

Soil, water, and air are traditionally considered as the basic resources for the existence and development of humankind. In addition to these resources, the fourth basic resource for development of life on the Earth is the germplasm; characterized by self-reproduction, inheritance of characteristics, and development. The complex of living organisms can be designated as biodiversity. The term "biodiversity" covers the totality of existing living organisms on the Earth. It is estimated that approximately 6–10 million species of living organisms exist; but only about 1.5 million have been described until now (Novotny *et al.* 2002). Plant species are only a small part of global biodiversity; with estimates running from 310 000 to 422 000 species (Pitman & Jorgensen 2002), among these about 270 000 represent the vascular plants (UNEP-WCMC 2004). Today, only 150 plant species are widely cultivated; 12 of which provide approximately 75% of our food, and four of which produce over a half of the food we consume (FAO 1998). Even though this is a tiny portion of the existing biodiversity, the genetic diversity within cultivated plants has an extraordinary impact. Through natural evolution, and later by breeding, a huge genetic diversity has appeared, particularly in the important agricultural crop species. This diversity has become a unique and irreplaceable source for further genetic improvements of crops, i.e. by breeding, and more recently also by biotechnology. The genetic diversity existing within particular agricultural crops is gathered into collections; these usually comprise bred registered or restricted cultivars, landraces and primitive cultivars, experimental lines (car-

rying desired genes), as well as the wild relatives of these crops. Genes and gene complexes which originate from these genetic resources are used for the breeding of new better-adapted cultivars with higher yields, better quality of products, plus greater resistance to stresses.

The value of plant genetic resources has been recognized since the early 1900s. From this period onwards, some of the first worldwide collecting expeditions were carried out by N.I. Vavilov and H.V. Harlan to find, conserve, and use plant genetic resources for research purposes as well as in breeding programmes. N.I. Vavilov and his colleagues continued to organize collecting expeditions during the 1920s and 1930s, when the Russian seed collection then contained 250 000 samples from over 50 countries (Plucknett *et al*. 1987). Plant materials obtained from collecting expeditions, breeders, and farmers provided the basis for developing the first germplasm collections. In the mid-1930s it became evident that traditional crop varieties and adapted landraces were being replaced by new improved varieties; thus, the first conservation activities to prevent losses of locally adapted materials, were begun (Harlan & Martini 1936).

Systematic germplasm conservation activities were first initiated in some European countries in the 1940s, and especially in the 1950s. With recognition of the importance of plant genetic resources for food security around the world, *ex situ* collections were promoted by international institutions in the 1970s; particularly by both the Food and Agriculture Organization of the United Nations (FAO) and the International Board for Plant Genetic Resources (IBPGR), later the International Plant Genetic Resources Institute (IPGRI) and presently Bioversity International. During this period, international gene banks were established at International Agricultural Research Centres (IARCs). Today, there are approximately 1500 gene banks or germplasm collections worldwide, holding some 6 million accessions (FAO 1998). Of these, more than 500 gene banks and other germplasm collections are situated in Europe, with combined holdings of about 2 million accessions (FAO WIEWS 2005).

Besides the conservation of plant genetic resources for the needs of future generations, it is important to organize them for effective utilization in breeding. While agriculture has developed rapidly in the last decades, many of its practices and methods hitherto used can hardly be applied in sustainable agriculture. At the same time, one of the principles of sustainable development in agriculture is the more effective use of gene pools. The cultivars grown should have sufficient resistance (tolerance) to both biotic and abiotic stresses, combined with high and stable yields, good quality of their products, and efficient response to fertilizers (they should do so even with lower inputs of agrochemicals). The widening of diversity of cultivars and crops to achieve a better stability of the whole agro-ecosystem will be of equal importance. To meet this demand, a sufficiently broad range of suitable crops and cultivars has to be available for agricultural practice. Furthermore, since this diversity will also contribute to social stability (food, income of rural societies, and employment) as well as to the quality of the environment, it clearly will become one of the factors influencing humanity's quality of life.

MATERIAL AND METHODS

The article provides a brief history and review of the current status of care of plant genetic resources (PGR) in the Czech Republic. The information presented is based on the analysis of available data and other relevant information on the following activities:

(1) Gathering of PGR (collecting, donations, exchange), and augmentation of the collections
(2) Documentation of PGR, the information system, and its services
(3) Characterization and evaluation of PGR
(4) Conservation of PGR
(5) Access to PGR, and services to users of PRG
(6) International collaboration on PGR

The data for analyses were provided by all stakeholders within the Czech Republic. Principally, those participants in the National Programme on Plant Genetic Resources handed in most of the data, processed in regular Annual Reports and other publications. Available data on the above activities were analyzed, and the results are aimed toward the characterization of the current status of PGR in the Czech Republic, as well as further prospects for it. The status of the National Programme on PGR is characterized, and recent efforts on PGR are discussed. The methodology of the National Programme is available on: http://genbank.vurv.cz/genetic/nar_prog/dokumenty/ramcova_metodika.pdf.

RESULTS AND DISCUSSION

History

The Czech Republic was one of the countries where the importance of PGR was recognized early on (Bareš & Dotlačil 1998). Various research and breeding stations within the Czech territory have been gathering cultivars since the beginning of the last century. Collections of the widest range of species were gathered in three institutions:

– Agricultural-Botanical Research Station in Tábor (founded in 1880; abolished in 1919); barley had been tested there since 1899, and wheat and other crops since 1903.
– Chemical Physiological Research Station of the Czech Technical University in Jeneč, near Prague (founded in 1898) tested various species and cultivars. In 1920 it was moved to the Uhříněves Experimental Farm, which belonged to the newly founded Agricultural Research Institutes in Prague. This Experimental Farm also took over the collections of the Agricultural Botanical Research Station in Tábor after it was abolished. In 1948 this institution moved to Doksany, and then in 1952 to the newly established Research Institute of Crop Production, Prague-Ruzyně (RICP). At that time, the collection of the Institute consisted of 2847 cultivars of cereals, legumes, oil crops, and (in part) of fodder crops.
– Moravian Land Research Institutes in Brno were founded in 1919; they also collected and utilized landraces (mainly in the 1930s). Similarly, the Moravian Land Institute for Crop Improvement in Přerov was very active (acclimatization experiments, including introductions and breeding). A large flax collection was assembled during World War II at the Research Station for Fibre Crops at Šumperk-Temenice. The collections of the Moravian Institutes were moved to several (then newly founded) institutions in the years 1951–1954; mainly to the Cereal Research Institute, Kroměříž; Research Institute for Fodder Plants, Troubsko, and the Research Station for Grasses at Rožnov pod Radhoštěm.

In the collections of the above institutes, old landraces and obsolete cultivars from the beginning of the century have been preserved. From the same period, obsolete cultivars of grapevine have been saved at the Research Institute for Viticulture and Oenology, Bratislava, and also of fruits and ornamental plants from the old plantations held or documented in the research institutes.

From the 1930s on, original domestic and foreign cultivars of other agricultural crops were maintained at the pre-war research and breeding stations. These were at various levels of breeding, since they were introduced to the cultivation practices of that time. Due to a good level of breeding in many crops, the oldest original Czech cultivars are represented as selections (lines, strains) from landraces (wheat, barley, oats, legumes, flax, hops, self-pollinating fodder crops, and vegetables) or as populations (maize, oil crops, fodder crops, vegetables, and ornamental plants). The greatest part, however, are Czech cultivars that originated by combination crosses.

A systematic study on PGR has been possible since the early 1950s, when several commodity-oriented research institutes were established. By 1990, 25 research and breeding institutions participated in the maintenance of collections which had gathered 42 000 accessions (Figure 1). At the same time, the Research Institute of Crop Production, Prague (RICP) provided coordination. Beginning in the 1970s, a cooperation network within COMECON countries operated (1971–1990); and since the 1980s cooperation with EUCARPIA, FAO, and IBPGR/IPGRI has evolved. The IBPGR's cooperative network for Europe (European Cooperative Programme for Plant Genetic Resources – ECPGR) in which our country has participated since 1981 became the basis for still more effective collaboration (Bareš & Dotlačil 1998).

Problems in plant genetic resource study and conservation arose in the early 1990s, due to budget cuts for agricultural research, privatization, the abolishment of institutes holding collections, as well as through the splitting of former Czechoslovakia into the Czech and Slovak Republics. Due to the separation of the collections and their subsequent revisions (duplicates, non-viable items), the number of PGR accessions decreased to 37 865 (1992). These problems were overcome when the National Programme on Plant Genetic Resources Conservation and Utilization was launched in 1993 by the Ministry of Agriculture of the Czech Republic. This project covered all of the basic activities on plant genetic resources; specifically gathering (including collecting expeditions), documentation, characterization, evaluation, conservation of PGR, as well as services to users of PGR. At the time, the Programme secured an effective coordination and rationalization of the work on PGR (Dotlačil *et al.* 1999). In the early

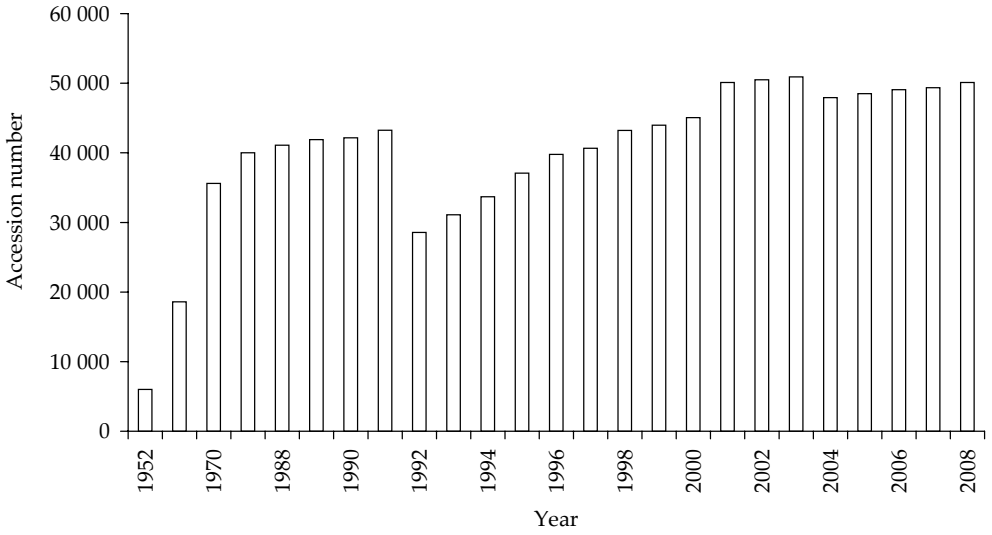

Figure 1. Development of accessions in Czech collections of PGR (1952–2008)

2000s, a legal framework for PGR was passed. The Convention on Biodiversity, which came into force in the Czech Republic in 1994, stimulated work on PGR; especially when the Convention was adopted into the Czech legal system as Act No. 134/1999. Consequently, the Czech Republic set up Act No. 148/2003 on the Conservation and Utilization of Genetic Resources of Plants and Microorganisms Important for Food and Agriculture, as well as Regulation No. 458/2003, implementing this Act. Both these documents have aroused the attention to PGR and agro-biodiversity in this country. As a consequential step, the Ministry of Agriculture updated the National Programme on PGR in 2004. An extended mandate for PGR (National Programme on Conservation and Utilization of Plant Genetic Resources and Agro-biodiversity) now also includes the study and use of agro-biodiversity, as well as international collaboration and the guaranty of international treaties signed by the Czech Republic.

To coordinate all the efforts, National Board on Plant Genetic Resources was created by 1955. Since the 1960s, this body has provided informal scientific and technical advice and has supported cooperation of all the stakeholders. The Board was established in accordance with Act No. 148/2003; however, it traditionally includes all stakeholders, scientists, as well as representatives of state administration. The Statute of the Board can be found on the url: http://genbank.vurv.cz/genetic/nar_prog/dokumenty/statut_rgz_04.pdf.

In the Czech Republic, large-scale farming since the middle of the last century has resulted in a significant loss of biodiversity (Stehno *et al.* 1999). The once wide diversity of crops, local cultivars and landraces has been replaced by a narrow spectrum of crops and cultivars. Some local genetic resources were lost. However, many valuable landraces and ecotypes were saved; some of them can still be found in remote areas (Dotlačil *et al.* 1998, 2000). A rich diversity still exists in ecotypes (grasses, fodder legumes) which can be found in some regions of the country; selected valuable genotypes can be used to increase the diversity of meadows and pastureland or to provide new forms of fodder plants. Additionally, some valuable landraces of fruit trees (especially apples, cherries, plums, and pears) can be found in several regions of the country (Bareš & Dotlačil 1998).

National Programme on Conservation and Utilization of Plant Genetic Resources and Agro-biodiversity

As mentioned above, the Programme covers all essential work on PGR. At the present time, twelve institutions in the Czech Republic participate in this project, including three public research institutes, one agricultural university, and eight private companies (Table 1). The gene bank in the Crop Research Institute (CRI) in Prague-Ruzyně coordinates the project and the Czech Board on Plant Genetic Resources provides advice and expertise (Dotlačil *et al.* 1999).

Table 1. Genetic resources of the collections held in the Czech Republic (November, 2008)

Institution (company) and location	Crop collections	No. of accessions
CRI Prague – Department of Gene Bank, Prague-Ruzyně	wheat (including wild species), winter barley, triticale, buckwheat, millet, sorghum, maize, beet, amaranth, other alternative crops	15 710
CRI Prague – Department of Vegetables and Special Crops, Olomouc	vegetables; spicy, aromatic and medicinal plants	9961
CRI Prague – Research Station of Viticulture, Karlštejn	grapevines (part of collection)	272
Agricultural Research Institute Ltd., Kroměříž	spring barley, oats, rye,	5607
AGRITEC, Ltd., Šumperk	pea, vetch, broad bean, lupine and other legumes, flax and other fibre crops	4938
OSEVA PRO Ltd., Grassland Research Station, Zubří	grasses including wild ecotypes, phytocoenoses of flowering meadows	2099
OSEVA PRO Ltd., Research Institute for Oilseed Crops, Opava	rapeseed, mustard, poppy, other oilseed crops	1413
Research and Breeding Institute of Pomology, Ltd., Holovousy	cherries, sour cherries, plums, apples, pears, and other fruit trees, berries	2298
Mendel University, Brno, Faculty of Horticulture, Lednice na Moravě	apricots, peaches, almonds, grapevines (part of collection), selected perennial vegetables and ornamental plants	1213
Research Institute for Fodder Plants, Ltd., Troubsko	lucerne, clovers, other fodder plants (including wild forms)	2551
Research Institute for Potatoes, Ltd., Havlíčkův Brod	potatoes (including wild and related species), "*in vitro*" collection	2272
Hop Institute, Ltd., Žatec	hops	341
Research Institute for Landscaping and Ornamental Gardening, Průhonice near Prague	ornamental plants	1723
AMPELOS, Ltd., Vrbovec	grapevines (part of collection)	286
Czech Academy of Sciences, Institute of Botany, Průhonice near Prague	*Iris* sp.	326

The institutions holding collections are responsible for the maintenance and augmentation of those collections (in co-operation with the gene bank) as well as the characterization, documentation, evaluation and regeneration of PGR. In vegetatively reproduced species, the institutes holding the collections are also responsible for the long-term conservation of plant genetic resources. The gene bank at CRI Prague provides the long-term storage of seed samples for all seed-propagated species, as well as services of the National Information System on Plant Genetic Resources (EVIGEZ) for all co-operating institutions. All institutes and companies have a close partnership with their users within the country and abroad, and provide them both samples of genetic resources and information, in accordance with international standards and the International Treaty on Plant Genetic Resources (IT).

The structure of the Czech PGR collections is shown in Table 2. There were over 49 500 accessions gathered in the various Czech collections by January 2008; 18.4% of them vegetatively reproduced species, and 81.6% were of seed-propagated species. These accessions belong to 388 genera and 1162 species. Flowers are represented by a broad spectrum of genera and species (104 and 187, re-

Table 2. Crop Genetic Resources in the Czech Republic – January 2008

Crop, group of crops	No. of genera	No. of species	Status of accessions					Total No. of accessions
			unknown	wild	landraces/ local cv.	advanced cv.	genetic stock	
Aromatic and medicinal plants	69	145	43	684	40	93	51	911
Beta and other seed root crops	1	1	2	5	4	163	37	211
Cereals	21	165	1306	1442	952	11831	3936	19 467
Flowers	104	187	137	23	50	1309	19	1538
Rhododendron, rosa	2	40	4	0	0	627	0	631
Fruit woody plants	22	59	147	29	484	1777	514	2951
Grasses	53	148	6	587	3	1374	60	2030
Vegetables	33	126	1731	749	758	3566	127	6931
Food legumes	9	52	121	265	233	3700	415	4734
Miscellaneous, spec. of flowering meadows	21	32	104	0	0	0	0	104
Oil plants	9	13	78	19	34	1070	283	1484
Potatoes	1	30	283	126	22	1145	650	2226
Fodder plants	24	93	7	568	13	795	239	1622
Grape	1	12	32	7	10	515	231	795
Ornamental woody plants (leafy)	2	16	0	16	0	39	0	55
Industrial plants	4	9	58	6	561	1385	535	2545
Zea sp. and alternative cereals	12	34	397	6	104	188	619	1314
Number	388	1162	4456	4532	3268	29577	7716	49549
%			8.99	9.15	6.60	59.69	15.57	100.00

spectively). Grasses (53 genera and 148 species) also form a botanically rich group; equally true for both fodder plants (93 species of 24 genera) and aromatic and medicinal plants (145 species of 69 genera). The botanical diversity of the latter three groups within the collections of crops results from the fact that many species and ecotypes were (and still can be) collected in the Czech territory. Also, a range of species applies with vegetables (126) and cereals (165); in cereals mainly due to the extensive collection of wild relatives.

Quite large collections of cereals have been gathered, especially of wheat (11 594 accessions including 1450 accessions of primitive and wild *Triticeae*) and also of barley (4653 accessions) and oat (2081 accessions). Extensive collections are available in vegetables (9049 accessions), grasses (2030 accessions), grain legumes (2726), fodder legumes (1209), fruit plants (2912 accessions, including 1093 apples). Additionally, collections of flax (2056 accessions), potatoes (2230 accessions) and hops (335 accessions) are among the more important within Europe.

Most accessions preserved in the collections are advanced cultivars (59.7%), with the predominant share of European cultivars. Additionally, breeders' materials and other lines are extensively represented (15.6%); most of them are potential donors of agronomical characters obtained from international nurseries and local breeders. Wild relatives (9.2%) and landraces (6.6%) account for only small portions of the collections.

Besides the materials included in these collections, some institutions regenerate and evaluate ma-

terials acquired on collecting expeditions (2810 such accessions were planted in 2007); parts of which will be implemented into regular crop collections in future. Approximately another 4200 accessions are in working collections in several institutions.

The gathering of plant genetic resources and augmentation of collections are aimed at both the conservation of existing genetic resources and the building-up of a broad base of genetic diversity for improvement of crops in order to meet the demands of present and future users. We pay primary attention to the materials of local origin, including domestically bred cultivars, old local cultivars, landraces, and wild relatives (Stehno *et al.* 1997).

The annual combined increase of all Czech collections is about 1000–1500 samples, with a slight decreasing tendency in the last 2–3 years (904 accessions in 2008). Important sources of new materials are collecting expeditions, local donors, and the exchange of materials with partner gene banks, as well as exchanges with other institutes abroad (Roudná *et al.* 2006). In 2008, there were 488 samples acquired through international exchange and another 416 samples were provided by local donors. Collecting missions contributed 357 new samples. The expeditions are important tools to augment the collections by new, original diversity; and also to save materials which could be endangered in nature or in agricultural practice. Earlier efforts at collecting within the Czech territory were made, especially since 1993, when the project on Gathering, Collection and Conservation of Wild Genetic Resources and Landraces was launched. A similar project continues up to the present.

Recently, attention has been paid to a purpose-oriented augmentation of the collections, aimed mainly at donors of important characters (in response to breeders' demands), sources of new diversity, and at filling gaps within the collections. Moreover, the range of the crop collections has become broader, now comprising 1162 species. The coverage of crop species diversity in the collections of the Czech National Programme has been extended, mainly due to the increasing interest in local species and ecotypes of fodder and medicinal plants; and also because of newly established collections of neglected crops, catch crops, and other specific crops.

Documentation of plant genetic resources, as well as services to collection curators, gene bank managers, and users of the genetic resources are provided by the National Information System (EVIGEZ). The system has been used by all collection holders in the country since 1995; responsibility for both its development and services rests with the gene bank, CRI Prague. EVIGEZ consists of three conjoined databases (passport, characterization/evaluation, and gene bank storage documentation) which use a common unique identifier – the national accession number.

The passport database comprises 33 descriptors which are common for all species and provide general information on the materials (accession number, accession name, origin, status, year of release, etc.). The characterization/evaluation database is, on the contrary, crop-specific and can cover up to 110 descriptors. Evaluations are done according to the national descriptor lists (simple sets of descriptors), using a 1–9 scale and comparisons with check cultivars. Descriptor lists were published for 30 major crops; 20 smaller collections have used simpler descriptor lists. All of the published descriptor lists are available at the web page of the National Crop Catalogue EVIGEZ (http://genbank.vurv.cz/genetic/resources/documents/documents_cz.htm). Monitoring of the gene bank seed store provides complex information on viability, origin, quality, other features of seed samples, as well as data on the seed stock and distribution of samples to users. The passport data are available in all accessions, and the seed store documentation is also complete; there exists now evaluation data on 65% of accessions, and it is increasing with the systematic evaluation of the collections. For most crops we evaluate 20–40 characteristics. All information is available in the central documentation office in the gene bank, CRI Prague, where the databases are updated once or twice per year. Passport data are accessible on the url: http://genbank.vurv.cz/genetic/resources/.

Recently, we have also paid greater attention to the characterization and evaluation of collections, aiming to improve the management of the collections, as well as to increase the effective use of their genetic resources. The good characterization and evaluation of the genetic resources, under conditions similar to those of their origin, can provide breeders with valuable information on the genetic resources for their possible use in breeding programmes (Stehno *et al.* 1997, 1999; Dotlačil *et al.* 2000, 2007). In this way, an evaluation substantially increases the value of PGR collections for breeders and other users.

Characterization concerns the morphological characteristics and the protein and DNA markers. The evaluation of PGR includes data on plant growth and development, characteristics of the plant stand, analysis of yield, responses to biotic and abiotic stresses, and qualitative characteristics of the products. The importance of the characters for breeders and researchers is a significant indicator for their systematic evaluation (Stehno *et al.* 1997). An evaluation in field trials is usually carried out for 2–3 years (in vegetatively reproduced species, for even more seasons) and it is then completed by laboratory tests (i.e. quality, specific resistance).

Safe and effective conservation of genetic resources for the needs of future generations, avoiding genetic erosion and other hazards, are key measures in the care of genetic resources. In principle, we apply two basic approaches to this conservation:

– *In situ* conservation is based on the protection and monitoring of genetic resources within ecosystems, at the site of their natural occurrence (wild relatives and ecotypes of species). With landrace conservation, we can use their growth under conditions and agricultural practices close to those of their origins (on-farm conservation). In the Czech Republic, efforts aimed at *in situ* conservation are linked to the collecting missions and cooperation with those involved with nature protection. This type of conservation is also used to a limited extent with fruit trees, grasses, and some other species.

– *Ex situ* conservation is generally used, and is based on the long-term maintenance of plant genetic resources outside of their original locations. Samples of seed-propagated species are maintained in a gene bank; vegetatively reproduced crops are kept in field collections, *in vitro* culture (and lately also in cryopreservation). Vital and healthy seed samples (tissue cultures) are a precondition for successful conservation. If such material is not available, regeneration of genetic resources is necessary. It is estimated that about 13% of accessions in the Czech collections need regeneration in the nearest future.

Collections of vegetatively reproduced species are, in most crops, maintained in field collections (fruit tree orchards, hop gardens, vineyards) or in tissue culture (potatoes, selected ornamentals). Cryo-conservation methods are applied for selected fruit trees, potatoes, hops, and *Allium* sp. (mostly tissue cultures are conserved). All seed-propagated collections are regenerated by the institutes (companies) holding such collections; long-term maintenance of seed samples is provided by the Czech Gene Bank in CRI Prague. The gene bank now stores over 38 000 accessions representing 94% of all seed-propagated accessions (Figure 2). We now utilize over 85% of the gene bank's capacity. Due to this, and the necessity to replace amortized technology after 20 years of operation, CRI Prague started the reconstruction of the gene bank in 2008.

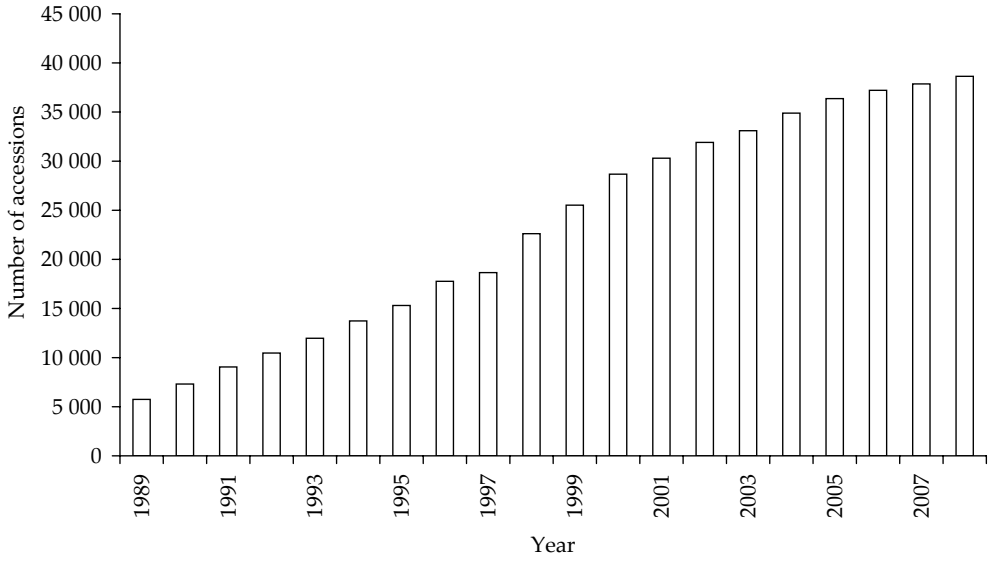

Figure 2. Increase of accessions maintained in the Gene Bank in CRI Prague (1989–2008)

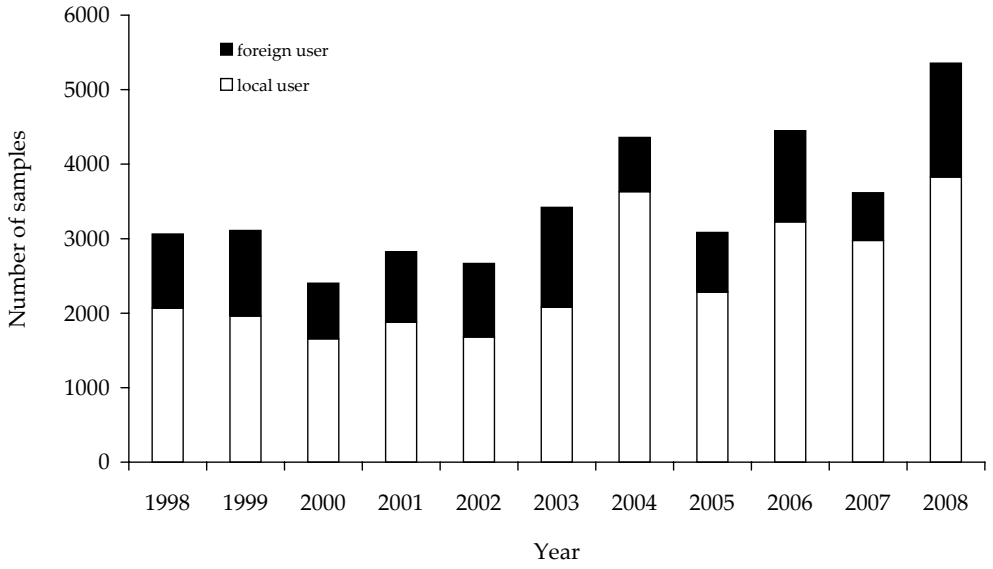

Figure 3. Number of samples of plant genetic resources provided to local and foreign users by all institutions cooperating within the National Programme (1998–2008)

The present gene bank procedure of seed preparation is based (after viability and health control) on seed drying (to 5%–8% moisture content) and storage of the seeds in vapour-proof sealed glass jars under cool conditions. In the active collection we preserve most species below –5°C (selected species, showing faster deterioration, are stored at below –18°C). In the base collection, we maintain all species below –18°C. In order to act as "safety duplicates", we store materials of local origin, as well as other selected valuable genetic resources in the Slovak Gene Bank in RIPP Piešťany.

Yearly, 2400–5500 samples of genetic resources are provided to users (Figure 3). In 2008 we provided 5356 samples to users (mostly researchers, breeders, education); of these, 1531 samples were sent abroad. We provide these services (for the needs of breeding, research, and education) free of charge, in compliance with national legislation and in accordance with the International Treaty on PGRFA.

The genetic resources supplied to breeders were often used to develop new cultivars or breeding materials. Recognized co-authorship by collection curators in the released cultivars demonstrates the close and successful cooperation between breeders and researchers (Bareš & Dotlačil 1998). We evaluate selected materials (especially neglected crops, minor crops, or newly cultivated species) and we recommend promising genotypes for use in agricultural practice to increase agro-biodiversity.

International cooperation

The Czech Republic participates in global, regional, and bilateral levels of international cooperation. Global cooperation is mainly realized through FAO guidelines and the Global Plan of Action (FAO 1996a, 1996b). The Czech Republic has also joined the FAO Global Network of Base Collections, as well as the FAO Early Warning System on PGRFA (FAO 1998). Bioversity International (formerly the IPGRI) is another key institution with a global mandate; Czech institutions dealing with plant genetic resources profit from cooperation with this institute.

All Czech institutions sharing in the National Programme take part in the European Cooperative Programme on Crop Genetic Resources (ECPGR), which is the regional programme of Bioversity International for Europe (Gass *et al.* 1999). Many Czech institutes share in the international responsibilities within ECPGR. The CRI – Department of Vegetables and Special Crops in Olomouc has responsibility for the international collection of vegetatively reproduced *Allium* species; the Gene Bank Prague has the responsibility for the European Wheat Database (EWDB), which is accessible on-line on the url: http://genbank.vurv.cz/ewdb/. The European ECPGR databases for two grasses (*Arrhenatherum elatius* and *Trisetum flavescens*) are available on the url: http://genbank.vurv.cz/arrh_tri/.

Two other on-line applications, the Catalogue of Wheat Pedigree and Identified Alleles of Genes (http://genbank.vurv.cz/wheat/pedigree/) and the Barley Pedigree Catalogue (http://genbank.vurv.cz/barley/pedigree/), were developed in collaboration with Dr. S. Martynov, VIR St. Petersburg (Martynov *et al.* 1996a, 1996b, 1997).

In the last few years several Czech specialists joined the EU research project GENRES. Also, bilateral agreements and cooperation between Czech and foreign institutes often focus on plant genetic resources. Effective international contacts, based on the international exchange of materials and information, exist among foreign gene banks and the Czech Gene Bank (ECPGR, 2008), as well as other Czech institutions involved in the National Programme. Traditionally, close contacts exist between CRI Prague and RIPP Piešťany in the Slovak Republic; as well as with N.I. Vavilov Institute in St. Petersburg, IPK Gatersleben, and IHAR Radzikow.

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Corresponding author:

Ing. Ladislav Dotlačil, CSc., Výzkumný ústav rostlinné výroby, v.v.i., Drnovská 507, 161 06 Prague 6-Ruzyně, Česká republika
tel.: + 420 233 022 374, e-mail: dotlacil@vurv.cz