Integration of Conservation Strategies of Plant Genetic Resources in Europe

Proceedings of an International Symposium on Plant Genetic Resources in
Europe held in Gatersleben, Germany, December 6-8, 1993.

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Preface

When in autumn 1992 the Science and Exchange Officer of The British Council in Germany, visited the Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben, she was particulary interested in the Institute's plant genetic resources programme reaching from collection and conservation to evaluation and germplasm enhancement. Still under the fresh impression of the UN Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992, which adopted Agenda 21, a global environment and development programme recognizing the crucial importance of plant genetic resources (PGR) conservation - both in situ and ex situ - and presented the Convention on Biological Diversity, which is now signed by over 150 countries, the idea arose to organize a joint symposium at Gatersleben covering some of these actual topics.

A preparatory meeting took place at the Information Centre for Genetic Resources (IGR) in Bonn on the first of June 1993 with national delegates and representatives of EC, IPGRI, UNESCO, IUCN, GRAIN and representatives of IPK and The British Council. Th edelegates in preparation of the "International Symposium on Plant Genetic Resources Activities in Europe and Perspectives", which was then held at IPK Gatersleben from December 6-8, 1993 indicated the following objectives:

- Identification of conceptual perspectives for PGR-activities in Europe, the potential of an integrated PGR-approach including nature conservation, genetic resources activities, plant breeding and crop production;
- identification and organisational perspectives and/or institutional cooperation in Europe with specific interest in developing a European information system and
- preparation of collaborative project proposals.

Country reports were prepared by the respective representatives on ex situ conservation and management of PGR including NGO activities with a special focus on potential cooperation between genebanks , botanic gardens and plant breeders. Invited papers were presented on in situ and on farm conservation of PGR with emphasis on potential cooperation between genebanks, botanic gardens and nature conservation as well from the GO as from the NGO sectors.

Progress within the objectives was obtained. As had to be expected, the elaboration of collaborative projects only reached a nucleus stage. Three working groups discussed possibilities of collaboration among genebanks and (1) nature conservation/biosphere reserves, (2) botanic gardens and other ex situ conservation institutions and (3) on farm conservation. The participants finally elaborated a resolution.

With the help of IGR in Bonn it was possible to publish the proceedings of the symposium which can now reach a broader auditory beyond the some more than 60 participants and hopefully will carry on the necessary discussion within Europe and worldwide.
The scientific organizers of the symposium are especially grateful to The British Council in Germany for effectively supporting this important and stimulating event.

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Opening of the INTERNATIONAL SYMPOSIUM ON PLANT GENETIC RESOURCES IN EUROPE, Gatersleben, December 6-8, 1993

U. WOBUS[1]

Ladies and Gentlemen,

I am pleased to welcome you for our European Symposium on plant genetic resources here in Gatersleben. When Dr. Helen Kearns the then British Council Science and Exchange Officer for Germany visited us more than a year ago we talked about the research activities and the re-organisation of the Institute of Plant Genetics and Crop Plant Research. It was her idea to chose genebank issues, i.e. plant genetic resources, as a possible theme for a British Council-sponsored activity, We are very glad that this idea materialised so successfully and that after a preparatory meeting in June this Symposium on Plant Genetic Resources in Europe can now be opened. It is my special pleasure to welcome participants of fourteen European countries. The British Council is represented by Mr. David Constable whom I especially welcome.

The scientific part in organising the present meeting was mainly played by the staff of our genebank, especially by Dr. Hammer and Dr. Begemann. The latter one is now at the Information Centre for Genetic Resources (IGR) in Bonn.

The Gatersleben genebank as part of the Gatersleben Institute has a long and outstanding tradition. We celebrated in June 1993 the 50th anniversary of our institute which included as a prominent part from the beginning in 1943 a steadily growing collection of plant genetic resources. The unification of Germany and the complete re-organisation of the East-German scientific landscape, i.e. the integration into the West-German system of scientific institutions, caused various uncertainties also for this institute. These uncertainties have mainly been solved and the institute made already a remarkable jump forward. Just during the last week the present worl of the institute was presented to the Scientific Advisory Board in nearly forty talks and more than 60 posters quite a number relevant to our topic.

The institute presently employs more than 470 people, about 150 of them scientists. The department structure and the main research topics are depicted in the following diagram. One point demonstrated by the scheme is the integral part played by the genebank for numerous research activities within the institute beside its important national and international functions. The increasing use of molecular methods already begun to further intensify both the genebank work with its material and the use of the collections by the other departments.

As everybody will agree plant genetic resources are an important national issue but it is equally accepted that the problem needs intense international cooperation. Questions of how the duties can be shared without endangering the material preserved *ex situ* in genebanks, of how the information can be shared properly and of how the genetic resources can be saved especially in the Eastern European countries where the political and financial problems threaten the existing collections - all this important issues will

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certainly be discussed intensively during the next three days. It is my hope and my firm believe that the results of this meeting will have an important impact on the future dealing of Europe with its plant genetic resources. In addition, your discussions will certainly be regarded as an important European step in preparation of the FAO meeting in 1996 probably held in Saxonia-Anhalt rather close to this place.

I would like to wish you an interesting and stimulating meeting and will finally give my warmest thanks to The British Council who made this meeting possible.

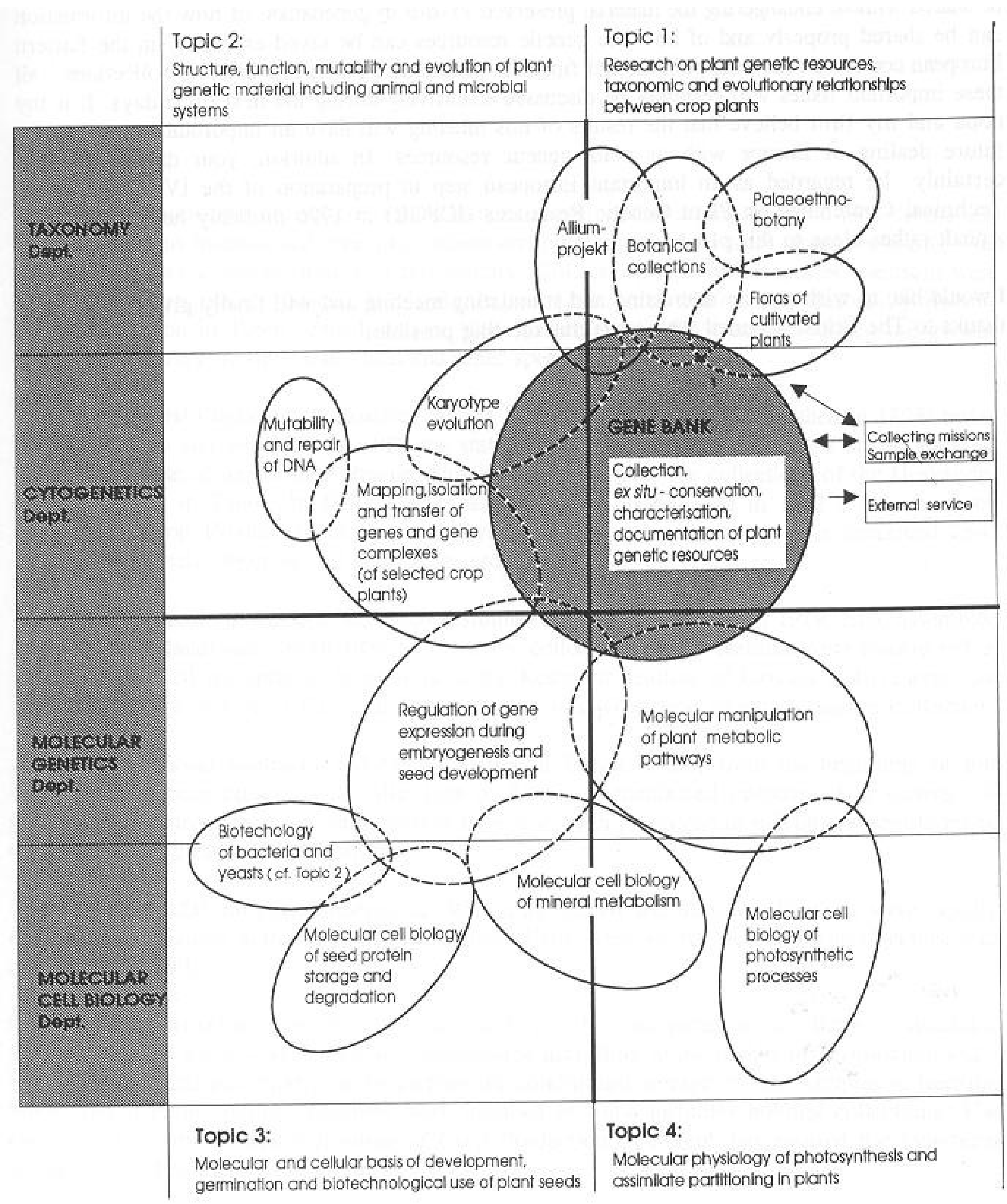

Fig. 1: The scientific department of the Institute of Plant Genetics and Crop Plant Research, their major research topics and the relationsships between them

National activities on plant genetic resources in the Czech Republic

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1. Introduction

Study, conservation and utilization of plant genetic resources has a long tradition in Bohemia and Moravia. Various research and breeding stations and botanical gardens were already working with genetic resources at the beginning of this century. Collections of a wider species spectrum were gathered in three places (BARES, 1984; BARES and DOTLACIL, 1987). The Husbandry Botanic Research Station in Tabor (established in 1880 and closed in 1919) started testing the genetic resources of barley in 1899 and wheat and other species in 1903.

The Chemical and Physiological Research Station in Jenec near Prague (established in 1898) tested various species and varieties. In 192O the station was transferred to Uhrineves at the National Research Institute of Agriculture, Prague. This institute took over the collections of the Husbandry Botanic Station in Tabor. In 1948 it was transferred to Doksany and in 1952 to the Research Institute of Crop Production in Prague-Ruzyne. At that time, the collections contained 2847 varieties of cereals, legumes, oil and fodder crops.

The Moravian Land Agricultural Research Institutes in Brno, established in 1919, have assembled a collection of land races. From 1951 to 1954, the collections of this institute were transferred to newly established institutions. Most went to the Research Institute of Cereals in Kromeriz, the Research Institute of Fodder Crops in Troubsko and to its Grassland Research Station in Roznov.

A number of local landraces and bred varieties of Czech origin, from the beginning of this century, have been preserved in collections of the above mentioned institutes. Old varieties of vine and fruit woods from the same period have also been preserved in plantations registered or documented by these research institutes.

The original 6000 varieties gathered in 1951 in the Czech and Slovak collections were rapidly extending, particularly in the fifties and the sixties. There were 42.5 thousand of accessions in Czechoslovak collections in 1991.

Considerable working capacity was directed to the maintenance of these collections. Seed-propagated species were regularly regenerated according to the results of germination tests. In the seventies and particularly in the eighties air-conditioned storage of seed samples in freezing boxes and later in cooling chambers were installed in some institutes holding collections. The Gene Bank of the Research Institute of Crop Production in Prague has assured the long-term storage of seed samples for all institutes since 1988.

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The National Information System of Plant Genetic Resources (EVIGEZ) was developed during seventies and eighties (BARES et al., 1985). Presently it is used by all institutes holding collections.

The genetic resources studies in the former Czechoslovakia have been decentralized in the collections of individual institutes. Since 1954, the overall methodological coordination has been provided by the Research Institute of Crop Production in Prague-Ruzyne. Since 1991 two National programmes have been prepared and implemented in the Czech and Slovak republics. However, the Czech and Slovak Board of Plant Genetic Resources (former Czechoslovak board) still exists as a common consultative body and professional forum of all institutes dealing with plant genetic resources in both countries. The Czech Gene Bank in RICP Prague provides long-term storage of seed samples and information system (EVIGEZ) services for Slovak institutes until suitable facilities are created in the Slovak republic.

Since the middle of the sixties, the Czech and Slovak institutes have begun to develop international collaboration. From 1964 to 1990 the cooperation went on mostly within the COMECON organization. In the seventies and eighties cooperation with the EUCARPIA Gene Bank Committee and the International Board of Plant Genetic Resources (IBPGR) was developing successfully. The IBPGR was significantly helping Czech institutions not only by professional information and materials unaccessible at that time, but also by significant backing of specialists' participation at international meetings and courses. In 1983 our country joined the European Cooperative Programme ... (ECP/GR) and since then Czech institutions have been participating at the work of all crop working groups of ECP/GR.

2. Contemporary state of "ex situ" conservation of plant genetic resources

There are now 19 institutions working on plant genetic resources of cultivated plants. All seed-propagated collections are stored in active collection (selected materials also in base collection) in the gene bank in RICP Prague. All collections of vegetatively propagated species are maintained by institutes holding these collections.

A survey of plant genetic resources in Czech collections is given in the following table.

As it is obvious from this survey, the largest collections are in cereals (16 O56 samples) and vegetables (7668 samples).

Methodological coordination of study and conservation of plant genetic resources in the Czech Republic is provided (commonly with Slovak republic) by the Czech and Slovak Board of Plant Genetic Resources. The board is composed of all collection curators ,workers of the gene bank, breeders, representatives of universities and variety testing institutes. General principles are presented in the Methodology of Study and Conservation of Plant Genetic Resources for the Years 1992-1995 (DOTLACIL, RYCHTARIK, STEHNO; 1992).

Table 1. Survey of plant genetic resources in Czech collections (by 1.1.1993)

Crop/group of crops	*Number of accessions*
Wheat	8 5O7
Barley	3 779
Ray	626
Oats	1 75O
Triticale *)	242
Wild Triticeae	1 152
Grasses	1 298
Fodder crops	639
Legumes	1 687
Oil seed crops	917
Potatoes	1 781
Beet	43O
Industrial crops	2 100
Vegetables	7 668
Aromatic plants	894
Fruit plants	1 898
Ornamental plants	2 358
Total	37 854

*)Czech and Slovak collection

The institutes holding collections are responsible for supplying and extension of the collections (eventually in cooperation with the gene bank), documentation, evaluation and regeneration of genetic resources. In vegetatively propagated species the institutes also assure conservation, (usually in field collections, but in potatoes this method is combined with "in vitro" maintenance). Some institutes dealing with seed propagated species have facilities for medium term seed storage and they can store working collections or safe duplications of collections, too. Attention is devoted to the gathering of resources of Czech origin (including local collecting missions), their evaluation, documentation and conservation.

During the last three years all these activities had to be limited and reduced due to strong cuts in the budgets of all institutes. Due to significant decrease of staff it is difficult in some collections to assure even their maintenance. All activities concerning evaluation and utilization of plant genetic resources were strongly reduced. Gathering of local materials (including wild relatives), documentation and conservation of collections are considered as priorities.

Collecting of local wild relatives and landraces

At present, domestic land races represent only 1.5 % and domestic wild relatives only O.5 % of the whole number of germplasm in Czech collections. In fact, wild material especially is not fully documented and the percentage should be higher.

Kühn and Tempir studied and have been collecting old traditional crops in Czechoslovakia since the

6O's. KÜHN (1974) guided three German expeditions to the Carpathians. They collected 1 15O local genetic resources of cereals, legumes, vegetables, oil seed and fodder crops. These collections are maintained in Gene Banks Gatersleben and Praha-Ruzyne and in the Agricultural University Brno. Many of these accessions were lost.

Wild relatives of domestic origin have been widely used for breeding of fodder plants in the Research station for Grasses Roznov since 3O's. Many cultivars originated in ecotypes collected in the mountains near the Station. Similarly several cultivars of fodder leguminous plants originated in ecotypes collected in Moravia near the Research Institute for Fodder Plants Troubsko (Coronila, Lotus). In the 7O'several expeditions were organized by this Institute in South Moravia for collecting fodder legumes. Collecting missions were started again by Repka. He collected 161 samples during 10 short trips in 1991.

HOLUBEC and KÜHN (1993) investigated localities of **Aegilops** in Slovakia. They gathered **Aegilops cylindrica** in an old wine plantation and on alluvial deposits of the Danube River in South Slovakia in 1989. This locality can be considered as the most northern original distribution of this species.

In fruits, land races and old cultivars are very seldom planted and disappear when old gardens, alleys and solitary trees in landscape are cut down. During the last 5 years, some of these land races were collected by Paprstein, in the Research Institute for Fruits,Holovousy.

A new project for collecting and conservation of the widest genetic diversity of wild fodder plants, wild relatives of cultivated crops and threatened land races of fruits and other crops on the territory of the Czech Republic was prepared in the Gene Bank Prague with cooperation of Research Institute for Fodder Plants Troubsko and Zubri and Research Institute for Fruits, Holovousy. The time schedule includes a one week, joint expedition every year and several short excursions by particular institutions.

Genetic resources evaluation and utilization

Holding of collections in the Czech Republic is distributed among 19 institutions among which belong research institutes, breeding and research stations, universities and institutions of botanical research (Table 2). Systematic collection extending, evaluation of new accessions, recording of received data into a database and multiplication of stored seed samples belong under the main activities of cooperating institutions.

Consecutive completing of the descriptive part of the database with evaluation results increases utilization of stored genetic resources. Collections described in this way are more valuable.

To reach this goal, coincidental for all crops, some literature data can be used. But such utilization is limited to characters having low interaction with environment. Evaluation under conditions of their future application is important for a rank of characters with considerable response to growing environment.

In spite of different methods of evaluation of particular crops, three steps are recommended at least for main agricultural and garden plants.

Preliminary evaluation has in addition to first, simple characterization also quarantine function. The extent of quarantine observations is specific for each crop according to phytosanitary regulations.

From the point of view of collection formation, the elimination of unsuitable GR is an important goal of this step. When only small samples are available, this step also serves for seed multiplication.

Basic evaluation of genetic resources is the main source of data for descriptive part of EVIGEZ - information system. Comparison of GR with check cultivar/cultivars in plot experiments is the usual method. Evaluation takes place mostly for 2 - 3 years, or longer.

During base evaluation, productivity and its structure, quality of the product, morphological, physiological and economical characters are estimated. Disease, pest and abiotic stress resistance used to be estimated as well.

Received data are coded in accordance with national lists of descriptors in a nine-point scale. National lists of descriptors for 21 crops are available.

Special evaluation of genetic resources is aimed mainly at choice of donors for breeding; it can be applied only in a part of collection. Usually GR, selected on the base of basic evaluation results or literature data are included into this step of evaluation.

Methodology of evaluation is, as a rule, aimed at selection of donors of particular characters, estimation of yield potential and it°s stability, suitability for prospective growing etc. To reach such goals two/three-years experiments, in replications, if possible in some localities are arranged.

Documentation system EVIGEZ

All available data on genetic resources maintained in collections of former Czechoslovakia were systematically recorded into the EVIGEZ information system (ROGALEWICZ et al., 1986, 1989). The system will continue in both new countries.

The EVIGEZ system consists of three basic and other complementary databases. All of them are mutually communicating on the base of national accession number (ECN), which is used for unique identification of accession. ECN is constructed to enable quick user orientation according to the crop or institution of collection holder.

Passport database contains the basic data on genetic resource in a form of 33 descriptors : common information in the first part, data on breeding process in the second part and information concerning collecting of wild species in the last part. Other supplementary data is maintained in form of a remark. Passport data represents the basic and most important part of the information on GR and serves for primary orientation in the collection. At present 34 000 plant genetic resources are described in passport database.

Descriptive database consists of 110 descriptors elaborated in detail for morphological, biological and economical characters. Descriptive characteristics are results of evaluation according to national descriptor lists using 1 - 9 point scale. Data included in descriptive database serve first of all as an information for breeders. Descriptive database consists at present of 4 900 records.

Long-term store monitoring forms the third part of the information system. Assigned ECN is considered as a precondition for seed sample storing under regulated conditions. Another key data, the store code, identifies seed sample location in the storage facility. Data on seed sample state and seed amount is gathered in the database as well. In long-term storage documentation 11 000 accessions stored in 14 500 covers have been gathered. Seed sample collection of introduction (new seed samples not having ECN yet) is documented separately.

The EVIGEZ documentation system is continually upgraded.Presently it works in FoxPro environment.

Seed storage in the Gene Bank

The Czech Gene Bank in the Research Institute of Crop Production Praha-Ruzyne is in charge of long-term storage of all seed-propagated plant genetic resources in the Czech Republic and until Slovak Gene Bank operates in the Slovak Republic as well. The Gene bank building was completed in 1988 and its operation started in 1989. Total storing capacity of the long-term store is 100 000 seed samples. It consists of 5 cooled chambers, two of them (with capacity of 55 thousand of samples) are cooled to +2°C, three others operating at -15°C to -20°C have capacity of 45 thousand accessions. They can be used for storage of the base collection. This capacity is fully sufficient for the needs of Czech Republic in the next few decades. Presently, part of the capacity is used commercially.

Seed samples entering the gene bank are controlled for their purity, germination and health. If the seeds conform to the requested parameters, they are dried to 4% - 8% of moisture content (according to the species) and placed into sealed glass jars (370 ml or 210 ml respectively, according to the seed size). The jars are stored in moving shelves in cooled chambers.

The active collections of most species are stored at +2°C. All base collections and the active collections of species with rapid loss of viability (some vegetables, flowers, medicinal and aromatic plants) are stored at -15°C. The storing technology allows the great majority of species to maintain the viability of seeds for 15 - 20 years without regeneration.

The seed viability as well as the seeds stocks are monitored cyclically (in 5-years period). All data have been included in the EVIGEZ information system.

When the seed viability and/or seed stock decrease under acceptable limit, the gene bank organizes regeneration of such samples in cooperation with the institute responsible for the corresponding collection.

Seed samples from active collection are distributed free of charge to users. Only utilization for breeding and research purposes is allowed, not for commercial use. Access to some samples in the active collection can be limited and conditioned by the approval of the collection curator or by the owner of the sample.

All plant genetic resources of local origin and some other valuable materials are maintained in duplication in base collection as well. At present, the collections of seed propagated species in the Czech Republic contain 32,8 thousand items. The active collection of the gene bank now contains 12 thousand samples, that is about 37 %. Most accessions of wheat, winter barley, maize and grasses have been transferred into gene bank. Further fast increase of gene bank collections is the priority of the National Programme of Plant Genetic Resources. Progress will depend on the mutual effective collaboration of institutes and gene bank as well as on the financial means available.

Table 2: List of institutions involved in "ex situ" conservation in the Czech Republic

Institution	Crop collections
Research Institute of Crop Production, Praha-Ruzyne	**Triticum, Hordeum (winter), Triticale,Aegilops and other wild Triticeae, Helianthus annuus, Fagopyrum, Panicum, Amaranthus**
Cereal Research Institute, Kromeriz	**Triticum, Hordeum (spring), Avena, Secale**
Research Institute of Technical Crops and Legumes, Sumperk-Temenice	**Linum usitatissimum, Pisum sativum, Vicia faba, Vicia, Lupinus**
Research Institute for Potato Growing Ltd., Havlickuv Brod	**Solanum**
Hop Institute Ltd., Zatec	**Humulus lupulus**
Research and Plant Breeding Institute of Vegetables, Olomouc	**vegetables, aromatic and medical plants**
Research Institute for Fruit Growing and Breeding, Holovousy	**Malus,Pyrus,Cerasus avium, C.vulgaris,Prunus domestica, Corylus, Sorbus, Juglans regia**
Ornamental Gardening and Plant Breeding Research Institute, Pruhonice	**flowers, ornamental woody plants**

Institution	Crop collections
Research Institute for Fodder Plants, Troubsko u Brna	**Medicago, Trifolium, other fodder legumes and plants**
Grassland Research Station, Zubri	**Poaceae, Lolium, Festuca, Poa, Agrostis, other wild grasses**
Research Institute of Oilseed Crops, Opava	**Brassica napus, Papaver somniferum, other oil seed crops**
Research Station of Vitis, Karlstejn	**Vitis vinifera**
Breeding Station, Uhersky Ostroh	**Phaseolus vulgaris, Glycine max**
Agricultural University, Department of Horticulture, Praha-Suchdol	**Malus, Pyrus, Cerasus, Persica**
Institute of Tropical and Subtropical Agriculture, Praha-Suchdol	**Citrus, Psophocarpus, Gossypium, Allium**
Institute of Botany, Czech Academy of Sciences, Pruhonice	**wild plants**
University of Agriculture, Agronomical Faculty, Brno	**Prunus, Rosa**
University of Agriculture, Faculty of Horticulture, Lednice na Morave	**Carthamus tinctorius**

3. "In situ" conservation of plant genetic resources

Conservation "in situ" is presently not used in genetic resources of agricultural plants, it is used exclusively in wild plants and in forest trees' resources. Main institutions which provide "in situ" conservation of wild plants' resources are botanic gardens and protected areas. Legal status of these institutions has been declared by Ministry of Environment of the Czech Republic in 1992 (Sbirka zakonu _. 395/1992).

There are 70 **botanic gardens** in the Czech Republic (Table 3), belonging to different institutions, schools, cities etc. Methodological coordination is provided by Advisory Committee for Botanic Gardens, members of which are skilled specialists. Size and scientific level of particular botanic gardens are of course rather different, depending on the main mandate and financial sources.

Table 3: Botanic Gardens in the Czech Republic

Czech Academy	- Institute of Botany CAS, Pruhonice of Science(botanic garden, park)
Universities	- Masaryk Univ., Brno - Univ. of Agriculture, Brno - Agric. Univ., Fac. of Forestry, Brno - Charles' University, Fac. of Pharmacy, Hradec Kralove - Univ. of Agriculture, Praha; Fac. of Forestry, Kostelec nad Cernymi - Lesy - Agric. Univ. Brno, Experimental Farm, Lednice - University of Palacky, Fac. of Natural Sciences, Olomouc - University of Ostrava, Fac. of Natural Sciences, Ostrava - Charles' University, Fac. of Natural Sciences, Praha - Univ. of Agriculture, Praha; Institute of Tropical and subtropical - Agriculture, Praha.
Research Institutes	- RI of Forestry, Arboretum Sofronka, Plzen - RI of Ornamental Gardening, Pruhonice
City Bot. Gardens	- Liberec, Plzen, Praha (2), Prostejov, - Teplice, Olomouc (Flora Olomouc)
Bot.Gardens belonging to museums	- Museum Olomouc - Silesian Museum, Arboretum Novy Dvur
Bot.Gardens in Forestry	- Arboretum Hruba skala Karlovice u Turnova - "American Garden", Chudenice
Bot.Gardens in Natural Preserves	- Horní hrad, Ostrov - Zamek, Vrchlabi
Bot.Gardens in high schools for Agriculture (Forestry, Gardening)	- 43 botanic gardens belonging to schools, mostly only for educational purposes

As important ones, the botanic gardens belonging to the Institute of Botany of the Czech Academy of Science, to universities (10) and to research institutes (2) can be considered. On the contrary, only few botanic gardens in high schools have more than local importance.

Cooperation between institutions dealing with genetic resources of agricultural plants and botanic gardens is not developed. Mostly it depends on the personal contacts of specialists. One of the fields of mutual cooperation can be based on the situation that Gene Bank in RICP Praha has capacity for long-term storage, which could be used by some botanic gardens for maintenance of seed-propagated species. Up to now this service of gene bank is used only by Institut of Botany, Pr_honice. Establishing of more productive contacts is one of the tasks in plant genetic resources conservation in the Czech Republic.

Important role in "in situ" conservation have **protected areas**, where plants are protected by law and industrial and/or agricultural activities are limited. Three types of preserves are distinguished, according to the level of protection: National Natural Preserve (highest level of protection), National Natural Monument and Natural Preserve (Table 4). Altogether, there are 666 protected areas in the Czech Republic. In many cases, protected areas have been established to maintain endangered plant species or ecosystems. Taking in account the risks of loss, three levels of danger are characterized (Table 5). In the Czech Republic are presently protected 480 plant species, 245 of them as critically endangered.

Recently the research project "Active help to endangered species of selected animals and plants" has been prepared by The Czech Institute for Nature Protection. The aim of the project is protection of biodiversity for global strategy of sustainable development. Research of populations of protected species and their protection will be carried out in the framework of this project. Another research projects has been prepared by the Czech Academy of Science and its Institute of Botany. Cooperation has been discussed between research projects on wild plants and those on genetic resources of agricultural crops. Mutual cooperation in collecting has been agreed; samples of some species will be provided to the agricultural institutes dealing with relevant crops.

Table 4: Protected Areas in the Czech Republic

Status	*Number of Localities*
National Natural Preserves	*114*
National Natural Monuments	*99*
Natural Preserves	*453*

Table 5 Protected Plant Species in the Czech Republic

Status	*Number of species*
Critically endangered species	*245*
Strongly endangered species	*143*
Endangered species	*92*

4. Conservation of Plant Genetic Resources in Forestry

Present status of forest ecosystems in the Czech Republic can be considered as an ecological disaster. Many for forestry important species of wood trees are seriously endangered or damaged, some of them were lost. Significant forest areas have shown decreased fertility on damaged trees; there are also longer interval between bringing seed production and a quality of the seeds produced is lower.
This unsatisfactory situation has to be changed by the use of all accessible means. Threrefore, the project has been prepared, aimed at regeneration of genetic resources in forestry in the Czech Republic. This project includes :

- list of means for maintenance and regeneration of forest genetic resources and ways of their conservation;
- proposals for changes in the legal status in forestry;
- proposals for more effective use of research capacities and recommendations for particular research projects;
- proposals for financial and material support;
- system of education of the specialists, who will be involved in the project;
- proposals for the international cooperation.

Maintenance of genetic resources of forest trees will be assured mainly in:

- forest gene basis (113 747 ha)
- forest areas which were evaluated and recognized as acceptable for seed production (148 093 ha)
- special seed woods (3 755 ha)
- selected trees (6 008 particular trees)
- seed orchards (350 ha)
- experimental plantations of forest trees (208 ha)

The national parks can contribute also to the maintenance of forest trees' resources (their area is 110 000 ha), as well as large-scale protected areas, arboretums and botanic gardens. The establishment of the gene bank for forest trees' resources is considered as an important task to be solved.

Above mentioned facilities for maintenance and regeneration of genetic resources in forestry have to be preserved as a national welfare. In this way sustainable source of materials for regeneration and restoration of forests should be assured, undependently on the ownership of these facilities. An amendment of the legal status is being prepared at this time; the proposed regulations will solve some adverse circumstances existing presently. Furthermore, particular research projects has been chosen which will be continuously supported by grants and will be carried out by research institutes which have both working capacity and experts in this field. Also international cooperation should be devoloped.

Owing to a complex stress effects the present threats for some species and forest trees' ecotypes is so serious that special procedures preventing their extinction had to be worked out.

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Ex-situ and in-situ conservation of plant genetic resources in Germany

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1. Historical Development of Plant Genetic Resources Activities in Germany

Plant genetic resources activities in Germany have developed since the end of the 19th century when the importance of traditional landraces for agricultural production in general, and plant breeding in particular, has been acknowledged [LEHMANN, 1990]. The concern about losses of old landraces, today termed genetic erosion, led to a movement devoted to the conservation of valuable germplasm in agriculture and forestry. But right from the beginning, conservation was meant to safeguard genetic material as a genepool for further sustainable use in production and breeding.
With increasing importance of plant genetic resources, a number of individuals paved the way to safeguard landraces and wild relatives of cultivated plants. Conservation activities developed in a twofold way. Some individuals tried to maintain traditional seed or vegetative plant material on their own farms to be independant and have a good choice of seed adapted to their specific environment. Other individuals were in a position to create official institutions with the support of public funding. Today, we regard the latter as formal sector while the former constitutes the informal sector. It is only logic that many individuals, especially of the informal sector, have been working unknown to the public. But to introduce two lead figures who became well-known in the field of agricultural plant genetic resources, Erwin Baur and Hans Stubbe should be mentioned here.
Erwin Baur (1875-1933) became the first director of the new Kaiser-Wilhelm-Institute of Research on Plant Breeding which was founded in 1927. Although this institute collected germplasm samples in Turkey and some Latin American countries its main concern had not been the conservation of plant genetic resources but topics such as crop plant evolution and genetics.
As a consequence, in 1943, a new Kaiser-Wilhelm-Institute of Crop Plant Research was founded near Vienna by Hans Stubbe (1902-1989), a student of Erwin Baur. He became the first director and moved the institute from Vienna to Gatersleben due to World War II where it became the most important plant genetic resources centre of the former German Democratic Republic. By that time, it was the GDR-counterpart of the largest plant genetic resources centre of the Federal Republic of Germany which was founded in 1970 at the Institute of Agronomy and Plant Breeding of the FAL in Braunschweig. Today, the genebank in Gatersleben is the largest plant genetic resources centre of the united Germany [BEGEMANN AND HAMMER, 1993].

2. Ex-situ Conservation and Management of Plant Genetic Resources

Traditionally, plant genetic resources activities were split according to (1) agricultural and horticultural crops, (2) forestry species and (3) wild species. This holds true for the formal and informal sector as far as it is known.

2.1 Formal Sector

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2.1.1 Agricultural and Horticultural Crops

In the various institutions of the formal sector in Germany, there is a large variety of agricultural and horticultural crop collections (see Figure 1). The most important collections total some 170.000 accessions representing more than 1800 species and 70 families (see Table 1). Besides, there is a range of other important germplasm collections (mainly working collections) at State research institutions, Max-Planck-Institutes and universities. The conservation methods used at the different locations include seed storge, in vitro collections, cryo-preservation, field collections and DNA-libraries [BEGEMANN AND HAMMER, 1993].

Obviously, some of these ex situ conservation methods separate the germplasm from the environment, hence, deliberately interrupt its exposure and possible adaptation to environmental conditions. By doing so, the genetic resources are safeguarded with their original properties not ignoring the fact that genetic erosion might even take place in these centres under scientific guidance.

2.1.2 Forestry Species

In Germany, it is mainly the States being responsible for the conservation of forest genetic resources. Therefore, a working group consisting of representatives of the Federal and State Forestry Administrations had been founded to coordinate all forest genetic resources activities [MELCHIOR ET AL., 1989]. The active members of the working group are listed in Table 2.
Ex-situ conservation methods in German forestry encompasses seed, pollen, in vitro and field conservation. More than 80.000 clones of seed plantations of 39 tree species are being maintained on some 1.000 hectares [MUHS, 1993].

Table 1: Agricultural and horticultural crop collections in selected institutions

Institution	*Accessions*	*Crops*
Ahrensburg ***BAZ, Inst. for Breeding of Ornamental Plants***	543	Fruit Crops and Ornamental Plants
Braunschweig-Völkenrode ***FAL, Inst. of Agronomy***	57.120	Agricultural and Horticultural - Crops
Braunschweig-Völkenrode* ***FAL, Inst. of Research on Pasture and Forages***		Forages
Dresden-Pillnitz ***IPK, Genebank of Fruit Crops***	1.915	Fruit Crops
Gatersleben ***IPK, Genebank***	73.784	Agricultural and Horticultural Crops
Groß Lüsewitz ***IPK, Potato Genebank***	5.095	Potatoes
Grünbach ***BAZ, Inst. of Resistance Genetics***	2.450	Barley, Wheat, Potatoes
Güstrow-Gülzow ***IPK, Rye and Triticale Collection***	2.648	Rye, Triticale
Hannover* ***BSA, Federal Office of Plant Varieties***	3.800	Agricultural and Horticultural Crops
Malchow/Poel ***IPK, Collection of Oil Crops and Forages***	12.494	Oil Crops and Forages
Quedlinburg* ***BAZ, Institute for Breeding of Vegetables, Medicinal plants and Spices***	5.000	Horticultural Crops
Siebeldingen ***BAZ, Inst. for Breeding of Grapes***	2.927	Grapes, Dye and Tanning Plants
TOTAL of selected Institutions	167.776	

* = exact number of accessions are not available

Table 2: Active members of the Federal/State Working Group for Forest Genetic Resources (State research institutes of the following States as indicated)

Baden-Würtemberg
Bayern
Brandenburg
Hessen
Niedersachsen and Schleswig-Holstein
Nordrhein-Westfalen
Rheinland-Pfalz
Sachsen

Federal Forestry Research Institute

2.1.3 Wild Species

Wild species are mentioned in this paper too, but separately, as they can be considered as future genetic resources although a utilization in the near future might not be the case. Similarily to the forest genetic resources, conservation of wild species is mainly in the responsibility of the States. Ex-situ conservation is being executed by some 70 Botanic Gardens in Germany. They are represented by an Association of Botanic Gardens which has recently undertaken steps to more closely collaborate with the movement of plant genetic resources and indicated to link its documentation system to the central documentation of plant genetic resources that is being developed at the Information Centre for Genetic Resources (IGR) in Bonn [STÜTZEL AND BOOS, 1993].
Nevertheless, there is no complete picture over the various collections held in the gardens. This will be achieved once the documentation systems of the botanic gardens have been improved and completed.

2.2 Informal sector

In Germany, the informal sector (non-governmental organisations (NGO) or individuals) are yet to be well coordinated. Hence, there is no complete picture of informal activities. Only some groups or individuals that are known to the German Information Centre for Genetic Resources (IGR) can be listed here. Most of these initiatives deal with the conservation of agricultural and horticultural crops (Table 3).

Table 3: A selection of non-governmental organisations and individuals dealing with ex-situ conservation of plant genetic resources in Germany

Arbeitsgemeinschaft bäuerliche Landwirtschaft (AbL), Rheda-Wiedenbrück
Arbeitsgemeinschaft Ökologischer Landbau (AGÖL)
Verein zur Erhaltung der Nutzpflanzenvielfalt (VEN), Arenborn
Pflanzenzuchtverein Wernstein, Mainleus
Institut für landwirtschaftliche Forschung und Untersuchung (IlFU), Halle
A. Bauer, Breitbrunn
J. Reckin, Finowfurt
Stählin, Wettenberg-Wismar

The different methods applied are not fully evident; most activities are ´on-farm´ conservation which has a leg in the ex-situ and another leg in the in-situ approach depending on the genepool that is being maintained. If it is exotic material it should be counted as ex-situ conservation whereas indigenous or introduced samples could be regarded under in-situ conservation.

3. In-situ Conservation

3.1 Formal Sector

The formal sector is involved in in-situ conservation too, particularly of forestry and wild species and to some extent of agricultural crops.

3.1.1 Agricultural and Horticultural Crops

Initiated by the Information Centre for Genetic Resources in Bonn, a concept has been developed to safeguard indigenous genetic resources of agricultural crops in-situ; it should be understood as one way of in-situ conservation which is not an exclusive approach. Based on the concept, in-situ conservation will be in the responsability of the biosphere reserves that constitute a significant component of the ´Man and Biosphere Programme (MAB)´ of the UNESCO. Under the guidance of a particular biosphere reserve administration, farmers voluntarily grow samples of landraces or old cultivars that ideally originated from the respective region.
In response to this approach, a first pilot project has been started at the Biosphere Reserve Schorfheide-Chorin situated northeast of Berlin. The project will conserve some five accessions of rye and potatoes. The germplasm samples will be provided by the Genebank Gatersleben where, at present, samples are being multiplied for the 1994 season. Other projects with fruit crops are already being discussed with institutions in Baden-Würtemberg and Sachsen.

3.1.2 Forestry Species

Naturally, in-situ conservation is dominant in the forestry sector; conservation of natural stands has a long tradition with the majority of the indigenous species. Most activities are executed at the State level and being supervised by the Federal/State Working Group for Forest Genetic Resources (Table 2)

1 Ahrensburg BAZ, Institute for breeding of ornamental plants
2 Aschersleben BAZ, Institute for pathogene Diagnostics
BAZ, Institute for epidemiology
3 Bonn ZADI, Information Centre for Genetic Resources
4 BraunschweigFAL, Institute of Agronomy
FAL, Inst. of research on pasture and forages
5 Dresden-Pilln. IPK, Genebank of fruit crops
BAZ, Institute for fruit breeding
6 Gatersleben IPK, Genebank of agricultural and horticultural crops
7 Gr. Lüsewitz PK, Potato genebank
BAZ, Institute for breeding of crop plants
BAZ, Institute for stress physiology and qualityof raw materials
8 Grünbach BAZ, Institute of resistance genetics
9 Gülzow-Güstrow IPK, Collection of rye and triticale
10 Hannover Federal Office of Plant Varieties
11 Malchow/Poel IPK, Collection of oil crops and forages
12 Quedlinburg BAZ, Institute for breeding of vegetables,medicinal plants and spices
BAZ, Institute for quality analysis
BAZ, Institute for breeding methods in vegetable
13 Siebeldingen BAZ, Institute for breeding of grapes

fig. 1: Ex-situ conservation, management and documentation of genetic resources of agricultural and horticultural crops in Germany (selected institutions)

[MELCHIOR ET AL., 1989].

Besides the forest research institutes, numerous arboreta safeguard forest resources. A complete documentation of the existing activities is, however, yet to be provided as numerous documentation systems will have to be compiled for an easy retrieval.

3.1.3 Wild Species

In-situ conservation of wild species in Germany is mainly in the responsability of the States but, at the Federal level, coordinated by the Federal Office for Nature Conservation (BfN) in Bonn. BfN is charged with the monitoring of biological diversity and the compilation of the red data books listing the most endangered species. BfN compiles reports of the wild flora and maintains an updated database of the German flora.
With respect to the genetic resources requirements it is noteworthy to state that BfN has begun to develop a concept to work not only at the species level but also at the level of populations of species. The information arising from these efforts will be compiled in a central database as soon as the concept will be implemented [BFANL, 1992].

3.2 Informal Sector

Apart from scattered fruit tree plantations or fruit tree allees alongside roads, part of the in-situ conservation activities are being implemented by individuals or private groups. Some groups focus on living collections at their own farms (see under ex-situ conservation, 2.2) while other groups aim at the protection of entire ecosystems. There are a number of NGO´s of particular importance, just to mention the following three:

- World Wide Fund for Nature (WWF, Germany), Frankfurt
- Bund für Umwelt und Naturschutz Deutschland (BUND), Bonn
- Landschaftsförderverein Nuthe-Nieplitz-Niederung, Zauchwitz

There is, however, no complete picture of the plant genetic resources that are being taken care of by the different groups.

4. Cooperation between the different Parties

4.1 Legal Framework

The legal framework that is relevant to conservation of plant genetic resources is very comprehensive and sophisticated. It is even more complex than in some other countries because of the Federal system of Germany where the responsability for the conservation itself stays with the States and the Federal government is in charge of the coordination and foreign relations. Table 4 shows an excerpt of laws that are most relevant to the work in Germany.

Table 4: Legal framework relevant to plant genetic resources conservation (selected laws)

Varieties Protection Act (Sortenschutzgesetz) of 11 December 1985, Bundesgesetzblatt I, p. 2170 (last amendment of 27 March 1992, Bundesgesetzblatt I, p. 727)

= Legal regulations concerning breeders´ rights

Seed Trade Act (Saatgutverkehrsgesetz) of 20 August 1985, Bundesgesetzblatt I, p. 1633 (last amendment on 23 July 1992, Bundesgesetzblatt I, p. 1367)

= Legal regulations concerning the trade in seed and planting stock (small amount of seed samples are, as a rule, not subject to these provisions

Federal Nature Conservation Act (Bundesnaturschutzgesetz) of 12 March 1987, Bundesgesetzblatt I, p.889 (amended on 12 February 1990, Bundesgesetzblatt I, p.205 and the laws enacted by the States (Länder))

= Basic regulations concerning the historically grown diversity of species and biotopes (nature conservation areas, protected landscapes, national parks, natural monuments and parts of protected landscape)

Federal Forest Act (Bundeswaldgesetz) of 1975 and respective **State Forest Acts**

Forest Seed Trade Act (Gesetz über forstliches Saat- und Pflanzgut) of 1957, amended 1979.

Patent Act (Patentgesetz) of 16 December 1980, Bundesgesetzblatt I , p.1 (last amendment on 20 December 1991, Bundesgesetzblatt II, p. 1354)

= Regulations on plants under patent law and breeding of plants (plant varieties are excluded. Patentability only for procedures of a ´technical nature´ to create new plants)

Ratification Act of the Convention on Biodiversity (Konvention über biologische Vielfalt) 1993.

some **EC regulations such as 2078/92** and **UPOV-regulations**.

4.2 Use of Plant Genetic Resources and Collaboration between the relevant Partners

Concern has been raised that plant genetic resources are only insufficiently used as is probably also the case in other countries. There may be various reasons for the under-utilization and sub-optimal conservation of plant genetic resources; one of the main reasons, however, seems to be insufficient interaction between the relevant partners (see Table 5):

Table 5: Collaborating parties (main actors) in the field of plant genetic resources conservation

Sectors	Formal	Informal
Ex-situ conservation		
Agriculture and Horticulture	IPK, FAL, BAZ, BSA	AbL, AGÖL, VEN, PZ Wernstein
Forestry	Fed./State WG for Forest GR and coop. institutes	
Wild Species	Association of Botanic Gardens	
In-situ conservation		
Agriculture and Horticulture	MAB, Biosphere Reserves	AbL, AGÖL, VEN, PZ Wernstein
Forestry	Fed./State WG for Forest GR and coop. institutes	WWF, BUND
Wild Species	BfN	WWF, BUND

One step to improve this sub-optimal situation has been the establishment of the Information Centre for Genetic Resources (IGR) in Bonn. IGR aims at the improvement of conservation and utilization of genetic resources; hence, it has been charged with information exchange and consultation of all interested cooperants in this field. To achieve these objectives IGR´s key activities are as follows (Table 6):

Table 6: Objectives and key activities of the Information Centre for Genetic Resources

IGR´s present objectives are

- to assist individuals and institutions, particularly in Germany, to assess and meet their needs for genetic resources conservation,
- to contribute to improved links between conservation and utilization activities,
- to support collaboration between the formal and informal sector in the field of genetic resources,
- to strengthen and contribute to the German cooperation at national and international level,
- to support the development and promotion of improved strategies and techniques for genetic resources conservation and use and
- to provide a focal point for national and international information exchange on genetic resources issues.

IGR´s key activities to achieve these objectives are

(1) to establish the German database on genetic resources. Emphasis will be placed on the genetic resources of agricultural and horticultural crop plants and their wild relatives; however, if need be, it will be open to integrate information on other plants (ornamentals, forestry and wild species) as well as on animals and micro-organisms,
(2) to develop and maintain a database of German experts in the field of genetic resources conservation, documentation and utilization,
(3) to support institutions in analyzing their information on the germplasm,
(4) to assist in the preparation and implementation of collaborative projects concerned with the conservation and use of genetic resources and
(5) to provide a comprehensive information service to the scientific community and the interested public.

5. Strategic Plans

The conservation activities outlined here constitute a significant component of the strategic plans being published by the Federal Ministry of Food, Agriculture and Forestry (BML). The concept became known to the public under the names of the authors ´Bommer/Beese-concept´ [BOMMER AND BEESE, 1990]; it was published in 1990 by BML in its series ´Angewandte Wissenschaft´ volume 388. Some updated information [BEGEMANN AND HAMMER, 1993] has recently been provided in the same series, volume 422; this became necessary after German re-unification in order to inform about the former GDR activities and the impact of recent international developments such as UNCED and the convention on biodiversity on German activities toward the conservation and utilization of plant genetic resources (Figure 2).
Nevertheless, a review of the most important plant genetic resources activities in Germany is underway to find some recommendations how to further optimize conservation, management and utilization of plant genetic resources. The review is due to be finalized by the end of June 1994.

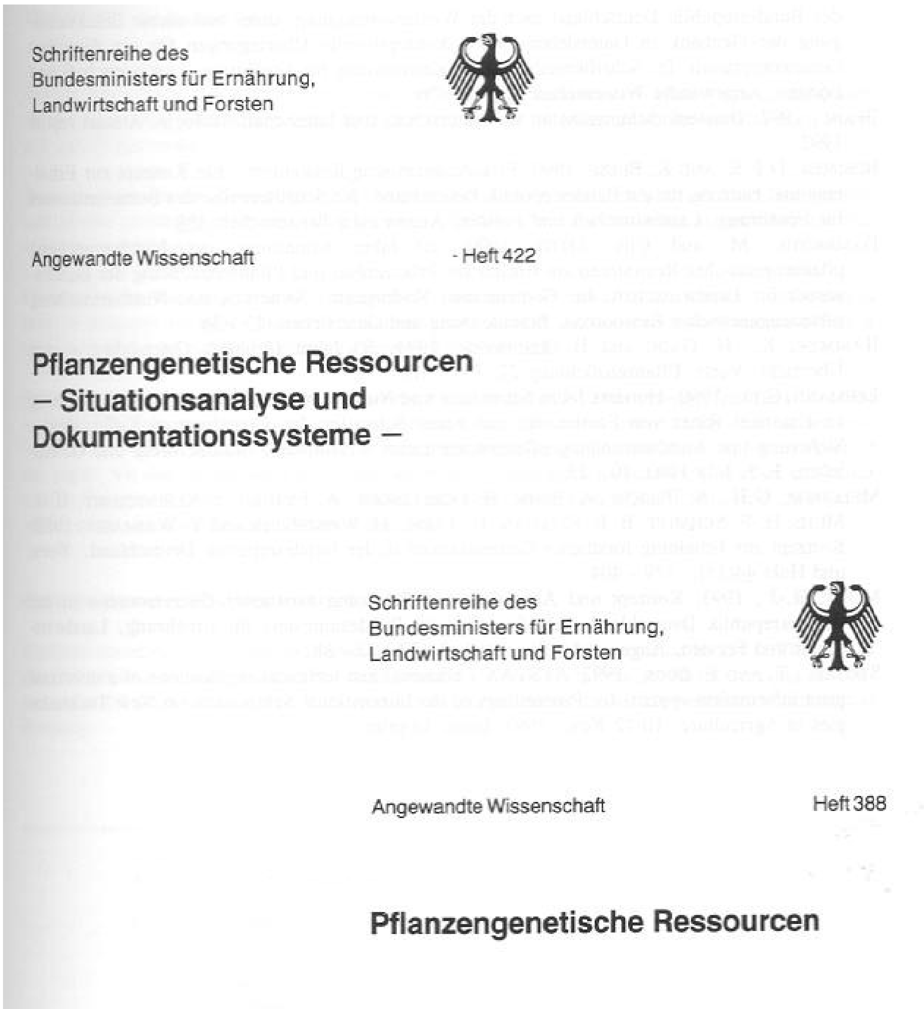

Figure 2: Strategic plans for plant genetic resources activities in Germany

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Conservation and management of plant genetic resources in France

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France has a long tradition in the conservation and management of Plant Genetic Resources (PGR). Its actions, which have often be backed up by several Ministries[3], are devoted both to *ex situ* and *in situ* conservation.

Numerous actions are developed for *ex situ* conservation by different partners from both public and private institutions, all concerned by plant breeding. Non governmental associations are also efficient in this sector.

Concerning *in situ* conservation, a significant effort has been made in the forest sector and is now in progress for grass plants. The conservation of wild species related to domestic plants is also carried out by national botanic gardens and natural parks.

In the first part of this paper, we briefly review the contributions of the principal partners involved in PGR. Then we present an original way for genetic resources management in terms of network organization, which should be the way to favour for most species in the future. In the last part of the paper, we discuss the need for a real policy about long term conservation of PGR in France and in Europe. We present the new "Bureau des Ressources Génétiques" the mission of which is also to contribute to define this policy.

1. Contribution of institutions involved in PGR

National coordination in PGR was assumed by the "Bureau des Ressources Génétiques" (BRG) which was created in 1983. The aim of this board was to make aware the whole French Community of the problems refering to conservation of plant, animal and microorganism genetic resources as a protection of biological diversity.

The BRG has ensured different actions :

- supporting and encouraging research works refering to the management of PGR ;
- coordinating several actions of PGR conservation (establishment of networks;

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organization of actions developed separately by different institutes ; ...) ;
- promotion and dissemination of knowledge in terms of PGR (meetings, publications).

Though the BRG has worked still now with few persons and a low budget, its contribution has been very significant in the sudden awareness of a national responsibility for the conservation of PGR.

1.1. Contribution of INRA: National Institute for Agronomical Reseach

INRA maintains important collections of PGR, recovering about 80 cultivated species (100 000 accessions) and 60 forest species (30 000 trees). These collections include populations (local ecotypes as well as artificial populations), old and modern varieties (clones, inbred lines, hybrids and populations), specific genetic material (alloplasmic, isogenic, aneuploïd and haploïd lines, translocated material,...) and wild species related to cultivated plants. These collections are properly maintained as long as INRA keeps a breeding program on associated species. However, their conservation becomes very uncertain when INRA stops their selection.

INRA has also been an active partner in the devlopment of a network for *in situ* conservation of forest species in collaboration with CEMAGREF and ONF. This network concerns 5 species today : *Abies alba, Fagus sylvatica, Picea abies, Quercus petraea* and *Quercus robur* ; it should be extented to 6 other species from now to 2000 . *In situ* conservation is also thought for meadow species : *Dactylis glomerata, Festuca arundinacea, Lolium perenne* and *Trifolium pratense.*

Several research works about the methodologies for management of genetic diversity are developped on several species.

The first ones refer to the characterization and the organization of diversity based on numerous criteria which were submitted to different selection pressures. The comparison of the results obtained with different criteria will help to better understand how the diversity is structured for characters submitted or not to artificial selection. It will also help to rationalize significant criteria for long term genetic resources management.

The second type of works refers to the creation of core-collection on one hand and of genetic pools on the other hand in order to reduce the number of resources which must be kept while maintaining most of the original diversity, and to enhance their utilization.

The last studies refer to the dynamic management of genetic variability, which needs a better understanding of genetic entities to be kept, as well as studies for optimization of *in situ* management.

1.2. Contributions of CIRAD and ORSTOM

These two institutes are concerned with tropical species. They have made numerous prospections of local cultivars and their wild relatives in Africa for the most important food plants : cereals, vegetables and fruit plants, root and tuberous plants. International Centres for Agronomical Research were supplied with this material. More, duplicates of collections are secured in France and stored either in cold rooms (rice, maize, *Sorghum*, millet, *Panicum*, Gombo) or *in vitro* (pineapple, banana, yam and manioc). French gene banks from CIRAD and ORSTOM include each about 15 000 resources.

Both institutions are also concerned with industrial crops : cotton plant, palm tree, coconut palm, coffee-tree, cacao-tree and several forest species for which large prospections were also carried out. The conservation of these woody species is made in fields including several thousands of trees, and is distributed over the agronomical stations from African and American partner countries. Also, researchs for *in vitro* conservation and cryoconservation are made in collaboration with the CNRS for these recalcitrant species which do not accept dessication and storage in cold rooms.

All these collections are now well known from a morphological viewpoint. Also, their proteic and nucleic characterization is now in progress for most species. As it was previously mentionned for INRA, research works are developed on the structuration of genetic diversity following different characters. They will be very informative for the choice of relevant criteria in the establishment of core collections.

1.3. Contributions of CNRS, Universities and National Museum for Natural History (MNHN) and national repositories

The CNRS and Universities are not directly involved in the conservation of genetic resources. However, they develop numerous research actions which can help in the management of diversity:

- molecular biology of plant genomes ;
- reproductive systems and ecology, directly connected to spatio-temporal structuration of genetic diversity ;
- cryoconservation of embryos and meristems ;
- physiology of seed.

The MNHN is concerned with the study of wild plants and the evolution of ecosystems. It keeps up large botanical collections and is in charge of the inventory and the follow-up of the natural patrimony in France. It makes interesting works concerning lyophilization of pollen grains and seeds, as well as evolution of natural and modified systems.

The national repositories are very efficient in the collection, conservation and test of old fruit and vegetable varieties : there are large collections of *Prunus* species at the repository of Porquerolles, and of *Malus* and *Pyrus* as well as rose trees in the repository of Gap-Charance.

Also, the development of *in situ* conservation in National Parks and Repositories is highly encouraged by the Ministry of Environment (ex : *Beta, Brassica, Agropyrum, Daucus, Prunus,...*).

1.4 Contributions of GEVES and from private breeders

The GIP-GEVES is concerned by *ex situ* conservation. It maintains seeds of old and new varieties which are or were registered in the French official Catalogue. These varieties are characterized by internationl UPOV criteria and are regularly multiplied. Generally, these resources are protected and their distribution is not free. The GIP-GEVES is also involved in the establishment and the coordination of several networks for genetic resources conservation.

Private breeders maintain specific collections which are not free. Some of them are also involved in networks for genetic resources conservation, in which they accept to introduce a part of their material and to participate in their evaluation.

1.5; Contribution of NGO for collection and conservation of genetic resources

Many local organizations (NGO) are also active for protecting their own biological patrimony. Some of their actions were federated by the AFCEV society, which has been particularly efficient in the conservation of fruit trees : definition of standards for the description of varieties, and specifications for the approval of orchards-conservatories ; writting of didactic handbooks for description of varieties.

These NGO actions should be extended to other species, if all partners directly concerned by a specific species accept to cooperate in a common program for the preservation of the genetic diversity of this species.

2. An original way for conservation and management of genetic resources : the constitution of networks.

2.1 General principles

The first steps is to make an inventory of genetic resources available in the country, for a group of species.

The second step is the characterization of all resources for different criteria : passport data first, and then several data the characteristics of which have to be simple and not susceptible to environmental variation. This step also allows the removal of duplicate material from the whole collection.

The next step is to ensure the multiplication of all resources introduced in the network. The originality of this system is that the labours devoted to characterization and multiplication of all resources are distributed over the partners who have joined the network. The cost of conservation is shared between all partners. Moreover, a double of the collection is always secured in a definite place. This organization needs a coordinator to manage the whole system.

2.2. Active and developing networks

2.2.1. Forest trees

Preliminary work and thoughts of INRA, CEMAGREF and ONF since 5 years, has led the Ministry of Agriculture to initiate a national policy for *in situ* conservation of main forest trees in 1991. This policy is consistent with the European program for conservation of forest trees, in which France had a leading role.

The following pattern was designed for each species included in the network : 10 geographic sites are choosen to represent the whole natural diversity of the species ; each site covers about 100 ha, with a central zone of 10 ha, protected from contamination. Three species are considered first (*Abies alba, Fagus sylvatica, Picea abies*) and ten species will be concerned in the next five years.

2.2.2. Cereals

This networks was initiated in 1991 by INRA, GEVES and private breeders (SPSS).It includes about 15 000 accessions of *Triticum aestivum* (about 50%), *Triticum durum, Hordeum bulbosum, Avena sativa, Secale* and Triticale.

It is managed by a piloting committee, which includes the coordinator, several representatives from INRA, GEVES and private breeders and one representative of the Ministry of Agriculture and of the

Bureau des Ressources Génétiques (BRG). It is coordinated by a person from GEVES, who is working next to INRA plant breeders in Clermont-Ferrand, and who is responsible for the double of the whole collection stored in cold room at Clermont-Ferrand.
Today, the network includes resources which are maintained over 5 INRA plant breeding stations and over 6 private breeders stations.

2.2.3. Tomatoes
This network was initiated in 1988 by INRA and three private firms : CLAUSE, VILMORIN and TEZIER. It is coordinated by the INRA plant breeding station in Montfavet. It includes about 2000 genetic resources, involving varieties and selfed lines, mutants and isogenic lines, wild species from the genius *Lycopersicon*. The first step of this program, which was financially supported by the Ministry of Research, was the characterization of the whole material. Actually, the lack of a permanent financial support does not allow the multiplication of the whole collection of resources.

2.2.4. Forage, meadow plants and grasses
This network was initiated in 1990 by INRA, GEVES and private breeders from AFCEV ; it is really efficient since 1992. It is ensuring the conservation of more than 2000 resources which are Graminaceae (*Lolium perenne* and *multiflorum*, *Festuca* and *Dactylis*) and lucernes (annual and perenial). Each partner is responsible for the multiplication of his material, and has to supply the coordinating centre (GEVES-Le Magneraud) for the seed distribution.
There are 3 types of gene banks in the network : an active one for the distribution of seeds and a long-term one where seeds are maintained at -20●C, which are both located in Le Magneraud ; a security bank distributed over all sites of the network where seeds are stored at +4●C.

2.2.5. Maize
A cooperative program concerning the conservation of populations' genetic diversity was initiated in 1984 by INRA and maize private breeders (PROMAÏS). It was financially supported by the Ministry of Agriculture since the beginning of the program. 1200 populations, which are maintened in cold rooms at 4●C in Montpellier, were characterized for *per se* value and test-cross values, and then grouped in 32 genetic pools. The agronomical performance of 24 of these pools was improved, by crossing them with improving hybrids. These pools represent an interesting basis for the development of recurrent selection shemes ; they are now managed by the partners of the program. Also, the multiplication of individual populations (every 10 years) is distributed over years and partners, in order to reduce the annual cost of conservation for each member of the network.

2.2.6 Other species
Because of the diversity of actors involved in the conservation of fruit species (fruit trees and little fruit shrubs), there is a need for coordination of all activities. The constitution of a network for fruit species is actually thought ; it should involve partners from public research, from National Conservatories and natural Parks, from nursery men and from organizations (AFCEV).

A network for the conservation of *Pelargonium* resources (about 500 sets) has been initiated in 1991. It includes 8 partners from the company Union-France-Pelargonium and 2 private partners from the GIE Clause-Limagrain. The company on one hand and the GIE Clause-Limagrain on the other are responsible for the conservation of half of the collection.

Besides all these network systems, France has very large collections of national impact for several species :

- The vine collection including more than 3 300 varieties (Montpellier) ;
- The potato collection including more than 2 500 clones, half of which is of *Solanum tuberosum*. A large part of the collection is maintained *in vitro* to prevent any sanitary risk (Landerneau) ;
- The crucifers collection (forage and vegetable species), which includes more than 1100 old local populations (Rennes).

3. International implications

France, as 123 other countries, is a member of the international Commision for Plant Genetic Resources, which was created in 1983 by the FAO in order to secure the conservation of PGR all over the world. So it has approved the international agreement for PGR and ensured a financial support for this action.

France is also involved in actions developed by the International Board for Plant Genetic Resources (IBPGR), particularly devoted to developing countries : prospections for main cultivated species ; organization of their conservation *ex situ* ; definition of passport data for characterization of resources setting of local coordinators to work in a consistent way with national programs. Also, IBPRG assumes a logistic support in the European Cooperative Program for the establishment of networks. France is responsible for several databases at an European (Lucerne, *Prunus*) or International (Banana, Coconut,...) level.

4. Towards a national strategy for the Conservation of Genetic Resources

As it was previously said, a lot of work has been done in France for the conservation of PGR. However, works remain to optimize and to better coordinate actions and implications of actors for the conservation of plant, animal and microorganism resources.

These reasons have justified the creation of a Groupement of Scientific Interest (GIS) in 1993, the partners of which are directly involved in the conservation of genetic resources : three ministries, five public institutions and the GEVES. This GIS which is named "Bureau des Ressources Génétiques" (BRG), has to ensure different missions :

- to organize concertations and works in the field of genetic resources concerning animals, plants and microorganisms ;
- to encourage the scientific research on genetic resources ;
- to favour the transfer of knowledge and of results by information and training ;
- to record and bring into lines national actions in the field of genetic resources ;
- to develop the thoughts and the concertation about the maintenance and the use of collections of genetic resources ;
- to put its scientific representativeness at the disposal of national establishments, in order to have a significant French representation in international authorities.

The new BRG is now forming a Scientific and Strategic Commission, which will help it to define an efficient policy in order to ensure its previous missions.

The definition of this policy, its strategic orientations and scientific axis, will be the first task of the Bureau in 1994.

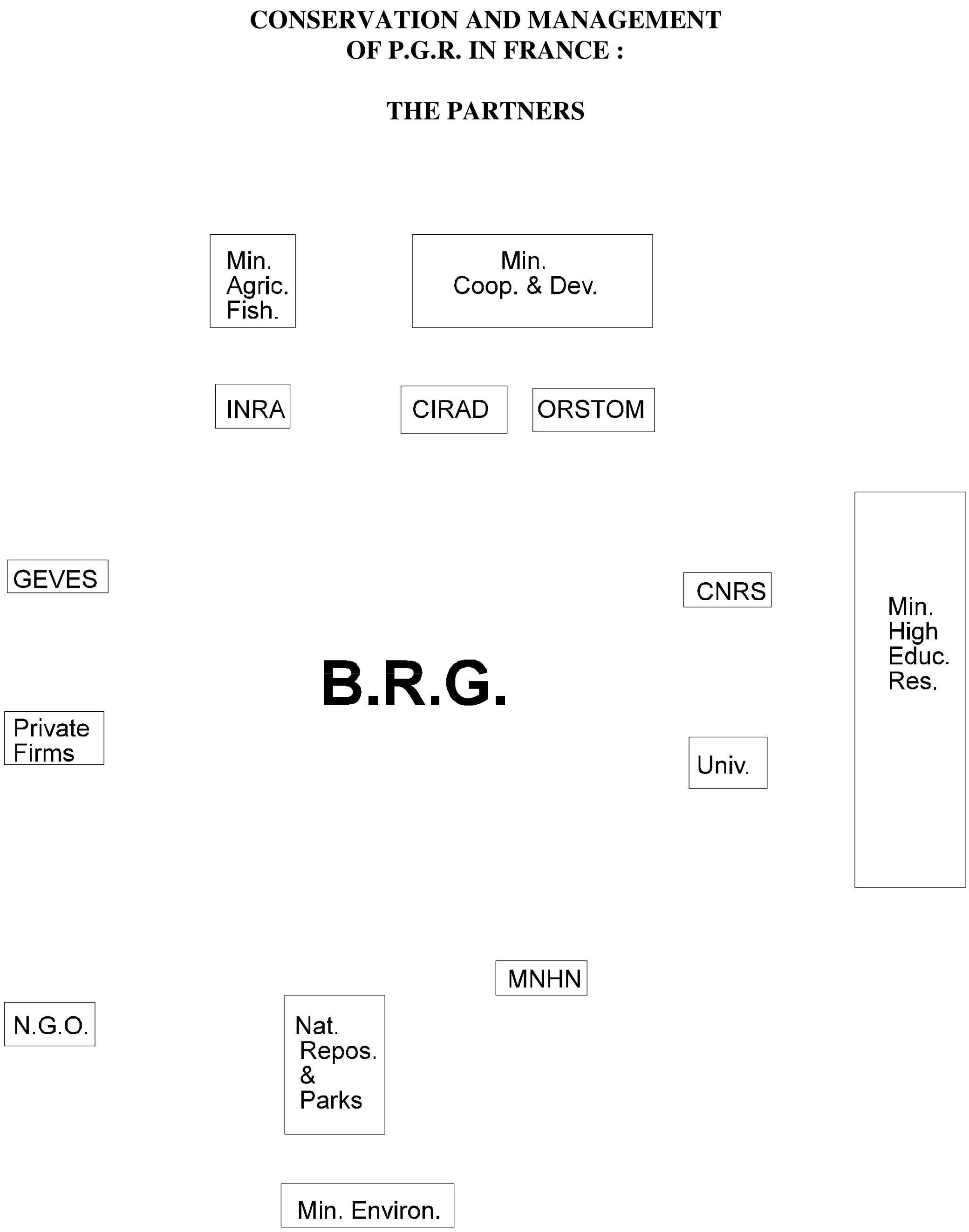

Fig. 1: Conservation and management of PGR in France: The Partners

Plant genetic resources activities in Italy

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1. Introduction

The Mediterranean region is an important centre of origin of several cultivated species. It is an area where in the past a lot of varieties and different genic combinations arose, thanks to natural phenomena such as mutations, spontaneous hybridizations and polyploidy (Scarascia Mugnozza, 1972). Unfortunately, most of this genetic diversity, accumulated through centuries, has been lost through the well known phenomenon of genetic erosion, which is due to several reasons but mostly to rapid spreading of few, new and modern varieties. Some examples may help in understanding the magnitude of the problem and the several actions undertaken by scientists, governments, national and international organizations in order to stop or to reduce genetic erosion.

1.1 Cereals

In the case of cereals and in particular of wheats, in Sicily, at the beginning of the century, some researchers (De Cillis, 1927) listed as many as 289 wheat varieties; later on (De Cillis, 1942) only 45 varieties were classified; more recently (Perrino and Martignano, 1973; Perrino and Hammer, 1983) only 32 varieties, out of the previous 45, were recognized. If all the peninsula of Italy is considered more than 400 wheat varieties were cultivated before and soon after the second World War (De Cillis, 1927; Ciferri and Bonvicini, 1959-1960). In the last twenty years, research carried out for collecting and preserving these old varieties have shown that only very few (1 - 2 %) could be found (Perrino, 1988, 1992a). On the other hand the number of new, or relatively new, varieties is not only lower, about 200, but it is hard to believe that their genetic base and genetic distances are as large as those of the old ones. However, based on these results and other considerations, the loss of genetic diversity in wheat cultivation has been estimated to be of at least 90 % (Perrino, 1992b). Some questions are still on foot. How much of this 90% is really lost? How much of it has been transferred into modern varieties? How much of it was collected by previous explorers and actually preserved in gene banks or elsewhere? How much of that genetic diversity is present in the actual world collections stored in Leningrad, Fort Collins, Kyoto and Bari? No one can tell us if all of those old varieties collected, maintained for decades and studied by De Cillis, Ciferri, Bonvicini and others, were duplicated and included in the above mentioned world collections or lost for ever. For sure, some of those varieties were used by Italian and foreign breeders, so that some genes were saved and are still working in some new varieties in Italy and throughout the world. But, are they the most important genes? Are they enough for the agriculture of today and tomorrow? Whatever are or will be the answers, it is almost sure that scientists were right in starting preservation activities.

1.2 Vegetable crops

In the case of vegetable crops the phenomenon of genetic erosion seems to have been less severe and especially for those not much modified from their wild forms. This may be the case of Taraxacum officinale, Foeniculum officinale, etc. It seems that low genetic erosion may have occurred for primitive cultivars, though genetic introgression from improved varieties may have taken place for some crops. This may be the case of some Brassica species (broccoli, cauliflower, etc.). There must have been more genetic erosion and is more likely to occur in the future for vegetable crops for which the wild progenitor is unknown or is extinct, like onion, artichoke, etc., or for those introduced from other centres of origin, like tomato, spinach, etc.. The danger of genetic erosion seems to be lower for those vegetable crops that have been cultivated in Italy for centuries: carrot, onion, pea, lactuca, etc. However even in this case the introduction and spreading of F1 hybrids may have to be considered very carefully before concluding that these crops are less threatened (Crisp and Astley, 1983; Astley et al, 1984; Maggioni and Soressi, 1992). In conclusion for most of the vegetable crops the possibility of preserving genetic diversity seems to be easier than for cereals. This may explain why, at least in the past, scientists paid less attention to the preservation of this group of crops.

1.3 Fruit trees

In the case of fruit trees the very high number of varieties developed, through centuries, all over the peninsula, has been very much eroded, though quite a few specimens survive, here and there, in several regions of the peninsula. As for cereals, several researchers took care of their preservation and started serious studies on their variability and geographical distribution (Scaramuzzi, 1988).

These examples of cereals, vegetable crops and fruit trees show that preservation of old varieties in Italy was one of the first actions to be taken. As already mentioned, that of wheat was the earliest because breeding activity was also started earlier or was more intensive than for other crops. Although, in Italy, preservation of plant genetic resources started very early this century, only later on, that is around 1960, the problem of loss of genetic diversity became very acute also at the international level. At least for herbaceous plants, it was reported (Ciferri and Bonvicini, 1959 - 1960) that old varieties for some undesirable traits were substituted by new improved ones. However since the former were carrying traits that could have been useful in the future and they were going to disappear, the interest for their collection, investigation and conservation increased.

Since, at the same time, breeders were engaged more and more in breeding activity and plant genetic conservation was becoming, more and more, a full time job, scientists, national and international organizations suggested the foundation of genebanks.

At present, plant genetic resources activities in Italy concern "ex situ" and "in situ" conservation, besides collection, multiplication, characterization, evaluation, documentation, distribution and utilization.

2. "Ex situ" Conversation

"Ex situ" conservation, generally known as genebanks, includes seed genebanks, field genebanks, botanic gardens, alpine gardens, arboreta and tissue culture (including cryoconservation), according to the method used to store samples of genetic stocks.

2.1 Seed genebanks

In 1970, in Italy, the National Research Council (CNR) founded, in Bari, the Germplasm Institute with the main aims of collecting and preserving plant genetic resources of interest for Italian and

Mediterranean agriculture.

Thanks to numerous exploration missions, carried out in different regions of Italy, Mediterranean countries, Ethiopia and South Africa (Perrino and Porceddu, 1990; Perrino et al, 1990; Perrino, 1991; Hammer et al, 1992), still relatively rich in genetic variability, the Germplasm Institute has collected and stores 11,802 accessions of seed samples (Tab. 1). They represent several cereal and grain legume crops and wild relatives typical of the visited regions. If besides these samples, directly collected by the staff of the Institute in collaboration with other institutions and international organizations, one considers also those obtained through exchange activities with other genebanks and similar institutes of the world, the number of accessions stored at the Germplasm Institute grows up to 55,806 (Tab. 2) . These genetic stocks represent more than 40 genera and more than 584 species. The high number of accessions, more than 30,000, of Triticum species, stored in Bari, may already indicate that the Germplasm Institute, together with the National Seed Storage Laboratory of ARS-USDA in Fort Collins (Colorado, USA), the Pansoviet Institute for Plant Industry N.I. Vavilov of the Academy of Science of CSI (St. Petersburg), and the Department of Genetics of the University of Kyoto (Japan), is responsible for the safeguard of the world collection of wheats.

The information collected during exploration and characterization, as well as the one deriving from evaluation, is filed in special data bases of the Institute. The documentation service is a source of information on the stored material. It allows to check the amount of genetic erosion occurring in different areas, to decide about the opportunity of organizing further missions for collecting germplasm, to know the amount of material available for distribution, its germinability, and the need for rejuvenation. It is a source of information necessary for taking further decisions.

In Italy, including the Germplasm Institute, there are at least 16 institutions that maintain seed germplasm collections (Tab. 3). It is possible to count 55 genera, 137 species of crops and wild relatives, and 60,118 accessions. If one excludes the world collection of Triticum, stored at the Germplasm Institute, the rest of the collections, in most cases, are small or relatively small. In particular 14,243 accessions, stored by 15 institutions others than the Germplasm Institute, are maintained for breeding purposes and not always available for distribution. The effective total number of accessions stored as seed collections in Italy can be worked out by adding 14,243, shared by 15 institutions (Tab. 3), to 55,806, stored at the Germplasm Institute (Tab. 2). The result would be 69,049 accessions. Naturally here is not considered the number of samples of germplasm used and mantained by the several seed companies.

2.2 Field genebanks

As far as perennial and vegetatively propagated crops, wood and fruit trees conservation are concerned, an important role has been played by institutes of several Universities, Ministry of Agriculture and Forestry (MAF), CNR and various other formal and informal organizations.

In fact, since 1960, several institutions started identification, collection and conservation of old varieties of fruit trees.

In 1980 a European Cooperative Programme for Conservation and Exchange of Crop Genetic Resources (ECP/GR) of IBPGR was started; it included European countries and Palestine. Taking into account the priorities established by IBPGR in 1981, the scientific Committee of ECP/GR considered most of the fruit species cultivated in Europe at the highest priority for conservation.
In 1981 a national Working Group "Protection of Genetic Resources of Fruit Arboreal Species" was

founded by the CNR and coordinated by the Faculty of Agriculture of Florence. The Group, while interacting with the ECP/GR European Working Groups, brought together the major national fruit tree research institutions. Each of them takes care of the conservation of different species depending on the Region in which it is located. As a result of this activity, carried out for several years, today there are at least 18 Institutions which take care of the preservation of 14 genera of fruit crops and other perennials , including 46 species and 13,560 accessions (Tab. 4). In particular as far as fruit trees are concerned all over the Italian peninsula, there are, already, 43 stations, 6 of which for olive, pear, and apple trees, 5 for vines, 4 for peach trees, 3 for almond, cherry and citrus fruit, 2 for apricot, plum trees and other species. The more important and spread out the species, the higher the number of the stations; in some areas the same Institution takes care of the safeguard of different species located in different stations (Perrino, 1990a). It seems that this activity of creating other stations for field collections is still going on (Tab. 6).

Thus, a series of programmes organized in working groups has been carried out, in order to face the problem of genetic erosion and conservation in a global way.

Within these initiatives, in Italy a range as wide as possible of genetic variability of fruit trees and their wild relatives has been identified for collection and conservation purposes. This material is conserved as field collections, because other methods of conservation do not guarantee their genetic stability and "in situ" conservation is not always possible.
A methodology for the evaluation and documentation of accessions has been set up; information is stored in computers and is available for all potential users.

Notwithstanding these efforts and the ones of IBPGR in coordinating the centres of collection and storage of fruit germplasm, the number of stations and field collections is thought to be insufficient to represent the variability still present in fruit tree species. In the future, it is desirable that the number of specialized stations be increased and studies on "in vitro" culture and cryoconservation promoted.

2.3 Botanic gardens

The first botanic garden in Europe was founded in Italy in 1545. The model was soon imitated by the main Universities and Courts of Europe. They became the meeting centres of explorers and scientists with the aim of improving our knowledges about nature and man.

Today, in the world, there are about 600 botanic gardens conserving, as field and greenhouses collections, only a small portion of the existing plant species. In Europe about 300 botanic gardens are conserving thousands of plant species. It is difficult to figure out the exact number of species due to the existence of several duplicates among botanic gardens.

In Italy there are 36 botanic gardens (Tab. 5; Fig.1), of which 27 belong to Universities of different Regions (Raimondo, 1992). Numerous field and greenhouses collections representing several thousands of species of different geographical origin are maintained on a limited surface. In fact the surface of each botanic garden ranges from ca. 1,000 to ca. 200,000 sq m, while the total surface all over the peninsula is 1,258,239 sq m (= ca. 1,3 sq Km). In the absence of detailed lists of species, maintained at each botanic garden, it is impossible to know the total number of species conserved over the total Italian surface dedicated to this kind of protection. One can only report that the number of species present in each botanic garden ranges from very few , say 10 to ca. 6,000 species. Usually, each botanic garden conserves native and exotic species.

2.4 Alpine botanic gardens

The first alpine gardens were founded in Austria, Switzerland and Bavaria in 1800. Numerous alpine gardens were created at the end of last century in several European countries with the aim of protecting alpine flora. Today in Italy there are 18 alpine gardens (Tab. 5; Fig.1) founded on the Alps, Appennines and Etna mountains. The total surface is very limited, 422,000 sq m (= sq Km 0,42), but the number of protected species may be quite relevant.

2.5 Arboreta

One of the functions of the arboreta founded in 1700 was education. More recently they have been engaged for the conservation of natural patrimony. In Italy there are only 4 arboreta (Tab. 5; Fig.1) with a total surface of 1,806,210 sq m (= sq Km 1,8). On a limited area a great number of native species is conserved.

2.4 Tissue culture

If "in situ" conservation is excluded "in vitro" culture represents the only way of storing plants propagating through bulbs or rhizomes. The problems that can be met when this method is used are due to the difficulties in finding the right combination of nutritional elements and growth conditions. Besides, it is necessary to better study and understand the techniques of reproduction of plants starting from tissue cultures and the biological phenomena which occur during conservation, particularly referring to genetic integrity of collections. If tissue cultures resulted particularly unstable, then the prospects of this method of conservation would be limited. At present, satisfying techniques for "in vitro" conservation of potato, sweet potato and some fruit trees of temperate regions have been set up. This method, if improved, could be extended to the conservation of plants that do not produce fruits easily, in order to conserve material collected at the vegetative stadium, and for species with recalcitrant seeds. In Italy, as in the world, there are few laboratories, where scientists are working out techniques of "in vitro" culture and cryo-conservation for long term preservation.

3. "In situ" Conservation

In the last decade, with the influence of IUCN and the support of WWF, a lot of natural areas have been established. The aim is to preserve populations representative of different ecosystems, often also including agricultural systems and cultivated plants.

For this kind of conservation, the main problem is to determine the minimal size of populations, without endangering their genetic structure and stability. For this purpose, it is very useful to know the genetic structure of the population, but unfortunately, the studies in this field are still limited.

3.1 Fruit and perennial crops

"In situ" conservation is a method suggested for fruit trees, pasture species and wild relatives. The first step for setting up protected areas (reserves, national parks and biospheres) is to prepare a list of the species threatened of extinction and determine the areas in which the highest level of their genetic diversity is concentrated.

The Working Group, founded in 1981 by the CNR in collaboration with Universities and other institutions, for conservation of fruit trees, in addition to the "ex situ" activity has played an important role also for "in situ" conservation. In fact the Group has suggested to protect areas particularly rich in genetic variability, already identified and from which experts are still collecting materials for making field collections (Scaramuzzi, 1988 ; Agabbio, 1992). As a result of this activity the national Group, in collaboration with technical agricultural schools, amateurs, botanic gardens, farmers, etc. has defined, for 10 fruit crops, at least 84 stations, throughout the peninsula, where 8,861 traditional cultivars have been identified and are actually protected by 24 different institutions (Tab. 6; Fig. 2). The importance of the role played by amateurs and farmers for "in situ" and or "on farm" conservation of old varieties of fruit crops has been mentioned by several authors (Perna and Della Ragione, 1992).

3.2 Forest and perennial species

In 1988, all over the world, more than 3,500 protected areas were counted, distributed in 125 countries, for a total of 4,300,000 sq km. Several species have been preserved. For example, in the Caucasian mountains, the wild relatives of wheat and fruit trees have been protected; on the east coast of the Caspian Sea, the wild pistachio, apricot and almond trees and several wild forages; in Ethiopia the wild species of coffee. At present, in the Ivory Coast, over 28 parks and reserves preserve about 5,000 sq Km of tropical forest; in Tanzania there are parks for 12% of the total surface, in Botswana for 18%.

In Italy the total surface covered by forest trees is of ca. 87,000 sq Km, which represents the 29 % of the total surface of the peninsula . Unfortunately until 1985 only 7% of the total forestry surface under bonds, that is ca. 6,000 sq Km, was submitted to naturalistic bond, like parks, reserves, oasis, etc. (Tab. 7).

3.3 National parks

Today, as far as the national parks are concerned, the situation is slightly improved. In fact, at present, there are 18 national parks for a total surface of 9,430 sq Km (Tab. 8; Fig. 3). In these areas, several species find an adequate preservation. However experts suggest that, if the objective is protection and conservation of existing species, in these areas human activities should be continued, exerting the same influence as in the past.

The limits of this kind of conservation are represented by the high costs, unavailability of large surfaces, and the impossibility to carry it out in all the parts of the world.

3.4 Biosphere reserves

This type of protected area is especially suitable for conserving wild relatives. The aims of a biosphere reserve are to conserve genetic resources and representative samples of the world's ecosystems; whatever is the aim, education and training are priorities.

Unesco's Man and the Biosphere Program (MAB) started the idea of biosphere reserves in 1974 and, since then, some 269 protected areas in 70 countries around the world have entered into the Unesco list and are part of the MAB network.

In Italy, in 1977 three biosphere reserves (Tab. 8; Fig. 3) have been designeted: **Miramare** (Trieste

) with 60 hectares (= 0.60 sq Km), **Circeo** (Latina) with 3,260 hectares (= 32.60 sq Km) and **Collemuccio-Montedimezzo** (Isernia) with 478 hectares (= 4.78 sq Km). The protected biome belong respectively to evergreen schlerophyllous forests (including costal/marine component), evergreen sclerophyllous woodlands and mixed mountain systems with complex zonation. The first two biospheres belong to the biogeographical province of Mediterranean Sclerophyll, while the third one belongs to that of Central European Highlands. Up to now only that of Miramare has started monitoring and research on the following themes: sea water chemistry, plankton, experimental fish breeding.

3.5 "On farm" conservation

In some Regions, amateurs and some private associations, in collaboration with local administrations, have just started initiatives to promote conservation of landraces and ancient crops with the help of traditional farmers. The Germplasm Institute has been consulted to promote the cultivation of few ancient or, more in general, neglected and underutilized food crops. In some cases the initiative has been so successful that the model is going to be imitated by other traditional growers of marginal agricultural areas.

4. Medicinal, aromatic and officinal plant

Italy represents the centre of origin or diversification of many species belonging to this group of plants (Perrino, 1984).

The Institute of Pharmaceutical Botany of the University of Sassari, in collaboration with other national (Society of Botany) and international organizations has started a study for the safeguard of numerous species of medicinal plants originating in the Mediterranean region. The study is also aiming to improve the knowledge on the geographic distribution of different species, above all of the ones threatened of extinction. The most suitable method for the conservation of this group of plants is the "in situ" one, but it could also be possible to establish regional centres for seed and field collections.

5. Other activities

5.1 Distribution and exchange of genetic resources

Preserving germplasm useful for agriculture does not mean to set up a museum. It also means taking care of distribution and utilization of germplasm for a direct use, the constitution of new varieties and several other purposes. For these reasons, genebanks and other kinds of "ex situ" conservation take care also of the rejuvenation and multiplication of collections when the availability of the material is reduced. In order to give an idea of the amount of work deriving from the activity of distribution, the Germplasm Institute of Bari, since 1970, has distributed, throughout the world, more than 70,000 samples, of which more than 45,000 are represented by wheat species. Several institutions by using these thousands of samples of wheat may have contributed to incorporate genes in their recently constituted varieties , which may have been distributed and cultivated in different parts of the world. This is not only useful for the wheat-growing, but also for conservation and multiplication of genes and gene complexes (Perrino, 1990b).

In those cases in which the requested genetic resources are not available at the genebank, this may help by requesting them to other similar institutions acting in different parts of the world.

5.2 Data base for rare species

The Germplasm Institute of Bari, in addition to the data bank created for the stored collections, has started a data base for plant species that grow in Italy but are rare or very rare, endemic, etc.. This kind of information is provided to Regional Administrations that are willing to start conservation activity.

5.3 Data base for neglected crops

The Germplasm Institute of Bari in collaboration with IBPGR and ENEA (National Institute for Alternative Energy) has made a list of plant species not adequately exploited and that may have a potential for the future development of agriculture in Italy, Mediterranean and European countries.

Since 1970 collection and surveys for obsolete crops, including the above mentioned group of species, is carried out in Italy and other Mediterranean countries, by the Germplasm Institute in collaboration with international organizations, like IBPGR, ECP/GR, EC, national institutions, like Universities, MAF and since 1980 also in collaboration with the German IPK (Hammer et al, 1992).

5.4 Environmental Union

The Environmental Union, WWf and other well known organizations, like Crocevia, GAB, etc., are very active in calling the attention of the Ministry of the Environment, MAF, Regional Administrations and politicians on the importance of "in situ" and "on farm" conservation.

5.5 Finalized Projects in Agriculture

Within the framework of these projects and especially of RAISA P.F. 1.29, which deals with developmental models in mountainous areas of the peninsula, one theme of research concerns the multi-functionality of agroforestal farms and the social and environmental function that farmers may hold, integrating the function of productivity with a set of socio-environmental services that include protection and maintenance of landscape, production through eco-compatible techniques (in particular biological agriculture) and maintenance of vital cycles (in particular water). Among these new functions and considered the importance that the theme on biodiversity has been given, in these last years, at international level also, there may well be that of mountainous areas as a reservoir of indigenous germplasm for which genetic erosion is already evident.

In this respect it has been suggested to make an evaluation of the economic aspect of the biodiversity, concerning the costs of its loss and the benefits of its conservation. This kind of analysis is not simple at all but the results of such approach would be very useful for undestanding the environmental and agricultural politics that are in favour or against the safeguard of biodiversity. The Germplasm Institute will contribute to the above mentioned project by providing data concerning the biodiversity, its loss and its conservation.

5.6 National coordination

The Germplasm Institute has been recently contacted and consulted by several Italian scientists, institutions and private associations for playing an active role in starting a sort of national coordination with the aim to increase and improve both conservation and utilization of plant genetic resources in Italy. After several meetings it has been realized that there are some difficulties in coordinating formal and informal sectors. However since there are no doubts that a kind of coordinating is necessary national workshops on this matter have been suggested and foreseen.

Meanwhile some Regions are interacting with the Germplasm Institute for submitting to the EC regional projects concerning conservation and utilization of threatened indigenous germplasm. This initiative is in agreement with the new proposal for a Council Regulation (EEC) on the conservation, characterization and utilization of genetic resources in agriculture and other recent proposals for a sustainable agriculture.

5.7 Germnet project

People who deal with plant breeding of cultivated species often meet with the difficulty to have promptly available the information on the genetic variability existing in nature. The on-line data bases represent an example of how this obstacle can be overcome. The Germnet project is intended to realize a computer system for the whole country which connects the institutions interested in exchanging information on the available germplasm.
The idea is to set up a communication network formed of nodes placed in different geographic areas inside the research centres interested in taking part to the initiative, integrating the already existing resources and creating new ones where necessary. The network will also include heterogeneous nodes (different hardware), linked through dedicated lines of data transmission (such as the EARN net). Through the use of Germnet it will be possible to connect the different Italian Institutes interested in the exchange of data, images and any other information on germplasm. This network will consist of a central node and other nodes scattered all over the country. Moreover, it should also be possible to have access to other national networks, such as CARR (connecting CNR, CILEA, CINECA, etc.) and IATINET (connecting CSATA, CRES, CRAI, CRIAI, CORISA). Each node will be linked to the public network ITAPAC both to have alternative and reserved routes and to connect the different nodes directly to the users.

To summarize, Germnet will be based on computerized image data bases whose aims will be to:
- organize data and images on germplasm collections;
- give users access to the existing data bases;
- distribute information;
- have access to data located elsewhere.

In general, the services of this network will consist in: interactive exchange of messages, electronic mail, file transfer, inquiry and retrieval of information, images, and plant material. Moreover, Germnet not only will be a service, but will also include programmes relative to:
- the development of technologies concerning the organization of information (i.e. the realization of a new software) for a better data management;
- the development of softwares for the acquisition, elaboration and management of images;
- the acquisition of new information on the existing genetic material.

Usually the number of traits studied is limited because of the high number of samples analysed. The analysis of traits such as resistance to particular biotic and abiotic stresses requires a study much more specific than the study on morphological traits, but would allow to bring out the genetic patrimony available at present, in order to introduce it in breeding programmes.

6. Conclusions

The safeguard of genetic resources is for sure a planetary problem, whose solution depends first of all on the capacity of different countries to cooperate.
In Italy, the Germplasm Institute, promoting missions for germplasm exploration and collection has contributed a lot to the preservation of the genetic patrimony left by the previous generations. Moreover, the studies on evolution, description of genetic variability, techniques of population sampling and multiplication, seed physiology, without any doubt have improved the management of genetic resources as well as their utilization in breeding programmes. The activity of the Institute is directed to:
- increase the existing collections and the collection of germplasm of cultivated (tomato, etc.) and wild (Agropyron, Aegilops, etc.) species, threatened of genetic erosion;
- extend the collaborations with national and international researchers in order to operate in a larger context. This exigency derives from the knowledge that the study of biological diversity requires the collaboration of researchers of different vocation, with a specialization in different fields of biology.

As far as the two methodologies of conservation are concerned, "in situ" and "ex situ", both of them are worth of consideration because each of them compensates the weakness of the other and only an integration of both of them allows to preserve as much as possible the richness of threatened plant forms that represent an inestimable patrimony on which the survival of humanity depends.

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National Activities on Plant Genetic Resources in the Netherlands

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1. Introduction

Ex-situ conservation of plant genetic resources requires very high operational standards and procedures. Genebanks must balance long-term conservation with more short-term user orientation. Accessions entered into a genebank collection must represent meaningful genetic variation, the seed has to be pure, maintain its genetic integrity and be of high physical quality. Accessions need to be well documented and accessible to users and storage conditions have to be optimal. To achieve all these objectives in a cost-effective manner high standards of management are required.

1.1 History of the CGN

The Centre for Genetic Resources, The Netherlands (CGN) was established as an independent institute in 1985. This followed ten years of deliberation, where even the Dutch parliament was involved, about what The Netherlands should do to make its contribution to the conservation of genetic resources. The CGN was created by combining the existing programmes in the field of genetic resources of the two plant breeding research institutes in Wageningen at that time: the Foundation for Agricultural Plant Breeding (SVP) and the Institute for Horticultural Plant Breeding (IVT).

When, in 1990 these two institutes fused to form together the Centre for Plant Breeding Research (CPO), the young CGN was included in the fusion product. One year later, in 1991, this CPO was again fused with some other institutes in the field of plant reproduction research and variety registration, resulting in the current Centre for Plant Breeding and Reproduction Research (CPRO-DLO) of the Netherlands Department of Agricultural Research (DLO).

Though the CGN is part of the CPRO, within the CPRO it has a separate budget, staff and programme status to safeguard long term objectives of conservation independent of the more short term perspectives of plant breeding research.

1.2 The international context

The CGN accepts in full the FAO Undertaking on Plant Genetic Resources. All material in the collections is documented and available for serious professional users without restrictions.

International cooperation in the conservation of Plant Genetic Resources is considered essential. At the global level this is actively promoted through cooperation with IBPGR and FAO, amongst

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others by acceptance of base collection responsibility for a number of crops (see 2.2). Central in the approach is the establishment of crop-networks of genebanks holding collections of the particular crops and coordinated with the help of common international crop data bases.

At the regional level, the CGN participates in the European Cooperative Programme on Plant Genetic Resources Networks (ECP/GR), linking programmes in both Eastern and Western Europe. In addition the CGN has a bilateral agreement of cooperation with the FAL, Germany, on joint programmes in wild species of potato and in beets. A similar arrangement is in discussion with HRI in Wellesbourne (U.K.) on a number of horticultural crops.

1.3 Internal organization

The CGN has a technical staff of 10 persons supported by 4 field staff. One staff member is stationed at the FAL, Germany, as head of the potato genebank in the German-Dutch cooperative programme.

Activities are coordinated by a director with a part-time secretary. Within the genebank three departments can be distinguished:

- Crop department
  Responsible for the compilation and description of strategic crop collections, and promotion of their use by the scientific and breeding community. The staff consists of 3 academic staff (one stationed in Germany) and 2 technical assistants.
- Seed management department
  Responsible for the safe storage of germplasm and supervision of both quantitative and qualitative factors affecting the availability of germplasm and staffed by a part-time coordinator and a part-time assistant.
- Documentation/methodology department
  Responsible for the development and management of systems for the storage of information on genetic resources and the stimulation and support of the use of these systems. Furthermore it provides methodological scientific support on all decisions within the genebank concerning the composition of collections and seed handling procedures. Staff consists of a coordinator with a part-time data typist and an analyst.

Field and greenhouse facilities, including personnel, are provided by the CPRO. Some regenerations are carried out by the crop departments of the CPRO and by private breeding organisations, the latter as an in-kind form of support.

Its compact nature facilitates direct communication between the various departments and provides a flexible and efficient organizational framework for genebank activities.

Evaluation and some regeneration is carried out in close collaboration with public and private breeding organizations. These organizations also participate in crop advisory committees, which provide the genebank with the indispensable feedback from the user community. Crop advisory committees exist for cereals, pulses, fodder crops, crucifers and lettuce.

Besides private and public breeding organizations, extensive contacts have been developed with organizations engaged in relevant scientific disciplines such as the department of Taxonomy of Wageningen Agricultural University.

Since 1974 there is an agreement between the Ministries responsible for agriculture in Germany and the Netherlands for cooperative programmes in plant genetic resources. The programme started with a joint programme for wild tuber bearing species of potato, located at the FAL, Germany, and headed by a Dutch scientist. In 1985 the programme was expanded with a joint activity in Beta. Recently this programme was also expanded with Brasssica.

2. Collection strategy

2.1 Acquisition of germplasm

Since its establishment the CGN has been provided with a substantial number of germplasm collections by breeding institutes of the Department of Agricultural Research (DLO) and Wageningen Agricultural University Wageningen (WAU) both in the Netherlands. These collections represent the larger part of the present collections totalling approximately 14,511 accessions divided over 18 different crops. Selective broadening of the collections was realized with material from commercial seed firms, notably cultivated material. Wild material was usually obtained from other genebanks, botanical gardens and informal collecting activities. Recently (1990-1993), the CGN has participated in missions in the USSR and Turkey to collect *Beta*, *Allium* and *Lactuca* species. Additional collecting has taken place in Spain, Portugal and further north, along the Atlantic coast of western Europe. Starting in 1993, wild species of potato will be collected in the Andes in cooperation with CIP and Sturgeon Bay (USA). In the future more collection missions will probably be undertaken to collect wild (related) species and primitive landraces of various crops.

Newly introduced material is first issued a provisional receipt number. A new sample is included in the collections when it enhances the existing collection in terms of genetic variation and enough viable seeds are obtained to assure proper conservation and distribution to users. In general, hybrid varieties are not included. For certain crops this means that only old varieties qualify for inclusion. When a sample is admitted, it receives a CGN number and its provisional receipt number is discarded. Rejected samples are discarded, but the information on these samples is summarized and remains available within the genebank information system. By keeping a record of every receipt number that is issued, whether it is included in the collection or not, the history of every sample can be reconstructed. This leaves no doubts on what has happened to the material.

2.2 CGN collections

Three main types of collections are distinguished: base, active and duplicate collections (see table 1).

- Base collection
  The main objective of a base collection is to represent the overall genetic diversity of a certain group of plants and to assure its availability for an unlimited period of time. It concerns crops for which CGN has accepted international responsibilities in the context of the worldwide network of base collections. This network is coordinated by the International Board for Plant Genetic Resources (IBPGR) in Rome, Italy.
- Active collection
  Active collections contain accessions representing a specific part of known genetic diversity for a certain group of plants. The primary objective of the collection is to cater to specific breeding objectives.

Table 1. CGN collections

Crop	*Size*[1]	*Type*	*Remarks*
Onion and leek	73	base & active	Allium cepa, A. ampeloprasum and related species. Shared base responsibility with HRI, Wellesbourne (UK) and NGPS (USA). Duplicate collection is stored at HRI, Wellesbourne (UK).
Lettuce	1767	base & active	Lactuca sativa and related wild species. Duplicate collection stored at HRI, Wellesbourne (UK).
Beet	205	base & duplicate	Beta vulgaris and related species. Shared responsibility with FAL, Braunschweig (Germany).
Cole crops	474	base, active & duplicate	Brassica oleracea. Shared responsibility with HRI, Wellesbourne, and CAAS, Beijing, China. Duplicate collections exchanged with HRI, Wellesbourne (UK).
Miscellaneous crucifers	774	active & duplicate	Brassica napus, B. rapa, B. juncea, B. carinata, B. chinensis, B. pekinensis, Raphanus sativus, Sinapis alba. Duplicate collections exchanged with HRI, Wellesbourne (UK).
Wheat	4866	active	Mainly Triticum aestivum, but also some primitive and wild species.
Lupin	41	active	Lupinus alba and L. luteus.
Cocksfoot	28	active	Dactylus glomerata.
Timothy	34	active	Mainly Phleum pratense, some P. bertolonii.
Oats	540	active	Mainly Avena sativa, few wild species.
Barley	3082	active	Mainly Hordeum vulgare, but also H. spontaneum and some wild species.
Maize	482	active	Mainly cultivated Zea mays (fodder types).
Faba beans	492	active	Mainly Vicia faba.
Peas	757	active	Mainly Pisum sativa.
Spinach	353	active	Mainly Spinacia oleracea, some S. turkestania and S. tetandra.
Tomato	279	active	Lycopersicon esculentum and related wild species
Pepper		active	Capsicum annuum and related species
Clover	137	active	Mainly Trifolium pratense.
Rye-grass	127	active	Mainly Lolium perenne.
Eggplant		active & duplicate	Solanum melongena and related species. Partial duplication of IBPGR collecting activities, together with the University of Birmingham (UK).
Potato		duplicate	Solanum sp. Duplicate collection from FAL, Braunschweig (Germany).

1) number of accessions (March 1993)

- Duplicate collection
  A duplicate collection is a replicate base collection, stored at an alternative location, to prevent loss of valuable germplasm in case the base collection or part of it is destroyed.

The current number of accessions is 14,511 (see table 1). It is expected that in the next ten years the number of accessions will increase up to ±20,000. This increase will be mainly due to some large vegetable collections which are being included in the CGN collection: tomato (1300 accessions), pepper (900 acc.), eggplant (400 acc.) and cucumber (1000 acc.). Some other important existing collections will be expanded: onion/leek (+300 acc.), crucifers (+400 acc.), lettuce (+300 acc.), cereals (+1500 acc.) and peas (+500 acc.).

2.3 Rationalization of collections

Rationalization of collections has become an important issue, since this leads to collections being organized so that utility and maintenance are optimized. Reduction of duplication within collections, to minimize the collection size while maintaining its genetic diversity, is very effective.

In the case of cross pollinating crops, samples with a corresponding genetic origin are bulked. For *Brassica oleracea*, *Allium cepa* and *Allium ampeloprasum* group Leek, farmers and breeders have made numerous selections, based on a limited number of heterogeneous cultivars. Hence, many selections share a common genetic background. Closely related material are grouped on the bases of historical evidence and morphological characteristics. Crop experts from private breeding firms, the Dutch cultivar registration service and the inspection service for vegetable and flower seeds assist in grouping the samples. The samples of a specific group are bulked in a joint regeneration. To maintain the total genetic variation of the compound sample, all samples of a group contribute an equal number of plants (at least 20) to the joint regeneration of at least 100 plants. The bulking of samples has resulted in a 50% reduction in collection size for cabbages, Brussels sprouts, onions and leek, all originating from the Netherlands.

Another aspect of rationalization is the splitting of heterogeneous samples in distinct homogeneous fractions. For self-pollinating crops, this approach can be used to simplify the description of accessions. Additional concepts for rationalization, such as core collections, are being studied but have not yet been implemented in our genebank procedures.

3. Regeneration

Regeneration is the renewal of a seed sample by taking a random sample of seeds, sowing and growing the resulting plants under conditions so that the seeds harvested will possess the same characteristics as the original population. Regeneration of seeds is required when the germination percentage has fallen below acceptable levels or shortage of seed occurs. As a rule, the germination percentage should be above 75-80%. Samples are marked for regeneration when seed is no longer available for distribution. The seed manager monitors all accessions for these criteria.

Most regenerations are carried out by CGN itself, although some are conducted in cooperation with private breeding firms who have similar regeneration procedures to CGN. Cooperation with these firms, enables CGN to increase its capacity for seed regeneration.

When regenerating germplasm a number of points must be taken into consideration:

- Selection within the original population as a result of regeneration procedures should be minimized.
- No contamination with other samples, both during regeneration and seed handling should be allowed.
- The breeding system of the crop in question is important. Cross pollinating crops need additional measures to insure proper isolation.
- The population size of the original sample should be sufficiently large to avoid genetic drift. Compared to self pollinating species, cross pollinating species usually require a higher number of plants for regenerations to maintain the genetic variation that exists within the population.

To minimize the impact that regenerations can have on the genetic identity of a seed sample, the frequency of regeneration should be kept as low as possible.

Plants that during regeneration clearly seem contaminants and not belonging to the total population are discarded.

The reproduction rate should also be considered in order to produce sufficient seeds. So far only in the case of faba beans the reproduction rate is a limiting factor and a relatively high number of plants is used.

Table 2. Regeneration of crops

Crop	*Breeding system*	*Pollination mechanism*	*Isolation*	*Number of plants*
Onion and leek	Mostly CP	Insects	Gauze cages	80 - 150
Barley	SP	-	1)	± 200
Beets	Mostly CP	Wind	Hemp/ Green-houses	50 - 60
Cole crops	Mostly CP	Insects	Gauze cages	80 - 150
Tomato	SP	-	-	5
Pepper	SP	-	-	5
Eggplant	SP	-	-	5
Clover	CP	Insects	Rye fields	± 50
Cocksfoot	CP	Wind	Rye fields	± 50
Lettuce	SP	-	-	8 - 16
Miscellaneous crucifers	Mostly CP	Insects	Rye fields	50 - 100
Faba beans	Often CP	Insects	Rye fields	≥ 100
Rye-grass	CP	Wind	Rye fields	± 50
Lupin	CP	Insect	Rye fields	≥ 100
Maize	Mostly CP	Wind	Bagging	100
Oats	SP	-	-	± 200
Peas	SP	-	-	≥ 50
Spinach	Mostly CP	Wind	Greenhouse compartments	80
Timothy	CP	Wind	Rye fields	± 50
Wheat	SP	-	1)	± 200

CP= Cross pollinating, SP= (Predominantly) self pollinating.
1) Only wild species in greenhouse.

A very important aspect of regeneration is the production of healthy, viable seeds. In general, regenerations under glass yield better quality seeds compared to accessions regenerated in the field.

Germplasm that is distributed by genebanks, must be carefully checked for the presence of seed-borne pathogens and pests, so that it does not contribute to the spreading of diseases and pests. It should provide an uncontaminated basic stock for breeding programmes. CGN maintains a high standard of disease and pest control, including pathogens with no official quarantine status, such as Lactuca Mosaic Virus.

4. Characterization and evaluation

Characterization and primary evaluation allow identification of a sample and a description of its genetic variation. If proper assessment of a descriptor requires expert knowledge, crop specialists are consulted. Where possible characterization and primary evaluation are carried out during regeneration. To insure proper seed production, plants sometimes receive special treatments, resulting in atypical growth, which makes them unsuitable for proper description. For example lettuce is regenerated under glass to promote rapid bolting for seed production. Therefore important characteristics exhibited during the mature vegetative stage, notably head characteristics, can not be described properly. For such crops special evaluation trials are carried out. Approximately 40 plants per accession are used in non-replicated plots under conditions that are normal for cultivation in The Netherlands. During these trials users are given the opportunity to view the collections.

Active participation of users in the evaluation of germplasm is encouraged, since CGN is not equipped to screen all the collections for properties such as disease resistance, chemical properties and physiological parameters. Although the field crops are screened for field resistance of some diseases during regeneration to provide to preliminary indications, additional information on collection material is valuable. Therefore the users of collections who perform this type of screening are always requested to feedback their evaluation data. Characterization data obtained during trials performed by users are also returned, and recorded in the CGN information system GENIS-VAX.

Many decisions in genebank management are based on expectations about the genetic diversity in and between accessions and (parts of) collections. E.g. if accessions are to be merged it should be known if they actually are or only seem to be identical. But also for research in strategies for maximizing genetic diversity in germplasm collections knowledge about genetic diversity is necessary. The most appropriate tool to determine genetic diversity is provided by biochemical analysis. The CGN has recently set up a facility for the analysis of electrophoresis of iso-enzymes.

5. Seed storage management and distribution

All accessions that have become part of the collections need to be stored. Seed should also be available for distribution.

5.1 Seed-processing/storage facility

The seed-storage and -processing facility is located in a separate building. The seed-storage facilities of the CGN consist of the following compartments, all 3 m high:

- 2 deep freezer compartments (-20°C) each of 30 m^2
- 1 cooler compartment (+2°C to +4°C) of 30 m^2
- 1 dryer compartment (+16°C, 12% RH) of 10 m^2
- 1 working compartment of 20 m^2

5.2 Seed storage

The CGN has both long- and medium-term storage facilities. The total seed bulk after regeneration of an accession is split into two parts. The user bags are stored for short/medium-term storage in a numbered box at 4°C. The bags of the other types (regeneration bags, germination bags and rest bags) are placed in a numbered box for long-term storage at -20°C.

The numbered boxes are placed on numbered shelves in the storage rooms grouped by crop. The location of storage (box and shelve) is recorded in the CGN information system. A computer terminal is present in the seed storage facility to enable direct updating of storage information in the central collection database.

5.3 Distribution of germplasm

Requests for material by users should preferably be made in writing, on official stationary of the organisation making the application. The request should state a description of the material needed, a short explanation of the proposed use and the name of the person making the request.

Requests for material are handled by the responsible crop scientist and the seed manager. Specified requests for material are checked against information on the availability of user samples. If available, the samples are booked for distribution (number of user samples is updated and the sample is registered as distributed). Using the storage information in the CGN information system, the storage location is retrieved. The samples are packed in shock proof material. Additional passport and evaluation information are supplied on demand. Phytosanitary certificates are issued on request of the user.

6. Information management

Nearly all activities at a genebank generate some kind of information which has to be stored and made available. The genebank information systems deal with all aspects of the genebank activities: registration, characterization, regeneration, storage, monitoring and distribution. Information technology is a key element of the conservation and exploitation of plant genetic resources. For this reason CGN has devoted considerable effort into the development of what we consider good and user-friendly applications based on the DataBase Management System (DBMS) Oracle version 6.

A major concern of any genetic resources DBMS is that it will facilitate not only easy access for users, but also the exchange of information with DBMS's of other collection holders. The principle for data excahnge is not standardization, but flexibility and integrity. If the flexibility of the sender of data is such that data of any format can be loaded, data exchange is possible. To make exchange usefull, full interpretability of the datafiles should be guarantied.

6.1 Information management applications

Concerning the information management activities, several areas can be distinguished:

- Documentation of CGN collections (ORACLE)
- Documentation of CPRO working collections (ORACLE)
- Documentation of European collections of cultivated *Brassica* species with the European Database for Brassica (ORACLE)
- Documentation of bibliographical information (CARDBOX)
- Documentation of miscellaneous information (CARDBOX)
- Documentation of information originating from other genebanks (ORACLE)

Between brackets is the name of the software programme that is used for these specific activities.

For simple applications the CARDBOX programme is appropriate. When dealing with complex or very large data sets, the powerful ORACLE data base management system is used.

6.2 Documentation of CGN collections

After consultation with the International Board for Plant Genetic Resources (IBPGR) and an analysis of existing systems at the time, 1985, it was decided that a project team should develop a new information system for the documentation of CGN collections. A review of information on genetic resources yielded a logical structure that enabled the user to store all relevant data. The current information system, referred to as GENIS-VAX (GENetic resources Information System on VAX computer), makes use of the ORACLE version 6, on a Digital VAX minicomputer. The system contains all passport, evaluation, utilization and seed management data of the CGN collections in a single centrally managed information system. This information can be accessed by genebank personnel from the various working sites in the administrative building and the seed storage facility. The ORACLE data base management system, on which GENIS-VAX is based, allows definition of multiple users each with its own privileges for accessing the information. This makes it possible to restrict data entry, updating or deleting privileges to personnel of the Documentation department, while other personnel are only allowed to view collection information or do some limited updating.

The system has been extensively documented in a data dictionary, describing all aspects of the information system. This data dictionary is available on request.

Conservation of Plant Genetic Resources in Poland

H.J. CZEMBOR, S. GORAL, W. PODYMA[1]

Poland has long tradition of preservation of environment, conservation of protected place and endangered species. The network of national parks and botanical gardens have in situ and ex situ conservation programmes. The conservation of biological resources has received considerable attention in the past decade and new, mainly utilitary priorities have been consider. The understanding of importance of genetic resources for the increase of agricultural and forestry production has gained great appreciation in Poland, and the national plant genetic resources programmes were established. All these conservations programmes construct very vast but not consise system of biodiversity preservation.

Organization and Financing

The conservation of genetic resources is financed by different governmental and non-govermental bodies. Four ministries are engaged in the process: Ministry of Environmental Protection, Natural Resources and Forestry; Ministry of National Education; Ministry of Agriculture and Food Economy; Committee of Scientific Research. Real input is given also from other organization and international bodies (as the International Bank for Reconstruction and Development).

Nine hundred twenty two mln $ was provided on genetic resources conservation in 1991. National Parks realizing in situ programme used 98% of the sum. Only 2% of budget was utilized to ex situ conservation by botanical gardens, zoological parks, museums and gene banks (Andrzejewski, Weigle 1993).

In the area of agriculture and forestry there are two programmes of plant genetic resources conservation (tab.1). The Forest Biodiversity Protection Programme has been recently undertaken and initiates conservation of key endangered forest in Poland (GEF 1992). The project will investigate both in-situ and ex-situ options to conserve biodiversity. The Programme of Crop Plant Genetic Resources Conservation represents long experience of ex situ conservations of crop plants, possesses gene bank facilities, and has developed standards of storage, documentation and evaluation (Buli_ska-Radomska, Góral 1991).

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Tab.1: Organization and financing of economic plants conservation

Crop Plant Genetic Resources

Formal basis:	Agreement between Ministry of Agriculture, Ministry of Education, Ministry of Light Industry and Polish Academy of Sciences- August 1979
Financed by:	Ministry of Agriculture, Department of Plant Production; Committee of Scientific Research
Objectives:	Preservation genetic material of major economic plants and their wild and weed relatives for breeding and research. Establishment of crop gene bank
Funds:	Ministry of Agriculture - 0.35 mln $ in 1993 Committee - 0.08 mln $ in 1993
Period of financing:	annual

Forest Biodiversity Protection

Formal basis:	Forest law- Aug. 1991
Financed by :	Ministry of Environmental Protection,State Forests International Bank for Reconstruction and Development,Global Environmental Facility
Objectives:	Conservation the biodiversity of key endangered forests Establishment of forestry gene bank
Funds:	Ministry of Environmental Protection - 3mln $ GEF Grant- 4.5 mln $
Period of financing:	1991- 2010

National Programme of Crop Plant Genetic Resources Conservation

Collecting and conservation of plant genetic resources were established in Poland by Prof. Kaznowski in the Research Institute of Agronomy (PINGW) at Pu_awy in 1922 and Agricultural Academy at Dublany. Since calling the Plant Breeding and Acclimatization Institute into being (1951), collections of crops at particular consideration of the Polish local cultivars and ecotypes were collected. The national programme of conservation of crop plant genetic resources established in 1979 constitute continuation of earlier investigations concerning this matter. The main goal of this undertaking is to preserve genetic material of major crop plants and their wild and weed relatives for breeding and research.The objectives of the programme are realized by:

- collection of genotypes endangered with extinction,
- evaluation of collected materials,
- preservation of collected materials in viable form and provision for breeders,
- documentation of collected materials.

The programme was enriched with new elements with the passage of time, in particular:
- greater number of species was comprised with the investigations,
- research groups of universities, branch institutes and plant breeding stations were involved in the programme,
-increased the share of basic investigations, such as phytogeography, mapping of genes, specific substances in Fabaceae and others.

The National Crop Genetic Resources Conservation Programme in Poland is based on multi-institutional input (Buli_ska-Radomska et al. 1991) Three universities, 6 branch instituties, 7 breeding station, the Botanical Garden of the Polish Academy of Sciences and the Botanical Garden of PBAI carry the responsibility for evaluation, regeneration and multiplication of crop collections (tab.2). The programme is financed by the Ministry of Agriculture, and the Committee of Scientific Research. Figure 1 shows the organizational framework of the programme.

The role of national coordinator of the plant genetic resources conservation programme has been entrusted to the Plant Breeding and Acclimatization Institute. Introduction, documentation and storage services are handled centrally by Gene Bank Laboratory of PBAI. It also organizes collecting missions, trainings and meetings.

Collection state

The number of all objects in the collections worked out within the programme amounted to 62 ths, which represents a broad range of plant categories such as: cereals, forages, root and tuber crops, horticular plants, vegetables, spices, medicinal, fibre and industral plants (tab.3). Among 11 groups of plant most frequent are cereals (about 23,000 accessions) and grasses (20,000 accessions).

The structure of collections is breeders orientated who prefer to work with advanced materials and breeding lines. However expedition missions provide important amount of unique materials. The exploration of territory of Poland as well as other countries is organized mainly by Gene Bank Laboratory and Botanical Garden of PBAI. Since 1976 several such trips have been held to northeast, east and southeast parts of Poland to collect cultivated, wild and weed germplasm. These regions have been traditionaly regarded as the agriculturaly least advanced and therefore most likely to provide old varieties and landraces of crop plants. During the missions about 2000 samples were collected. The previous collecting missions were orientated on collecting of cereals. Now collectors of germplasm are focused on collection of vegatables which primitive forms are still available. The programme of preservation of landraces of vegetables is done by Gene Bank Laboratory and the Institute of Vegetables.

Tab.2: Localization of collections

Institution	*Group of plants*
- Plant Breeding and Aclimatization Institute (PBAI) Radzikow Gene Bank Laboratory PBAI	Avena, Secale, Vicia faba, other introduction, documentation, storage facilities
Branch Division PBAI for Cereals and Forage Crops - Krakow	Trifolium, Medicago
Botanical Garden PBAI - Bydgoszcz	grasses
Experimental Station PBAI - Bakow	Hordeum
Experimental Station PBAI - Borowo	Brassica, Papaver, Helianthus annum
Experimental Station PBAI - Konczewice	Beta
Experimental Station PBAI - Smolice	Zea
Experimental Station PBAI - Strzelce	Triticum
Research Institute of Vegatable Crops -Skierniewice	vegetables
Research Institute of Pomology and Floriculture - Skierniewice	horticultural plants
Institute of Medicinal Plants - Poznan	medicinal plants and spices
Institute of Natural Fibres - Poznan	Linum
Potato Research Institute - Bonin	Solanum
Institute of Soil Science Plant Cultivation - Pulawy	Humulus lupulus, Nicotiana
University of Agriculture (SGGW) - Warszawa	Solanum, Cucurbitaceae
Agricultural Academy - Lublin	x(Tritico-Secale), Triticum durum
Agricultural University - Poznan	Phaseolus, Salix, Vitis
Botanical Garden of Polish Acad. of. Sci. - Warszawa-Powsin	Secale
Plant Breeding Station - Wiatrowo	Lupinus, Pisum, Ornithopus

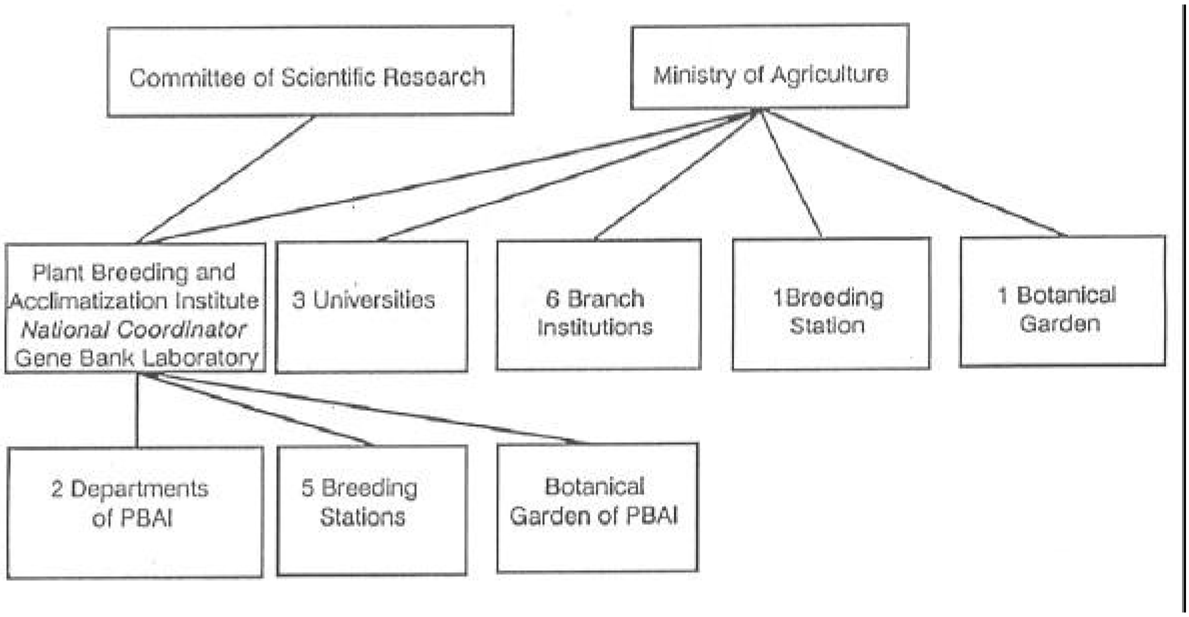

Fig. 1: Organizational framework of the Polish National Programme of Crop Plant Genetic Resources

Tab.3 Collection size and state of the stored plant genetic resources

Crops	*collection size*	*preserved in cold storage*
cereals	22850	2047
grasses	20272	12304
large-seed legumes	7299	3564
small-seed legumes	879	400
oil and fibre plants	1744	761
hop and tabacco	1588	1138
potato	2928	
beet root	204	171
horticulture plants	2190	
vegetables	2104	1451
medicinal and spices	245	160
Total	62303	43971

Characterization, evaluation and documentation

All collections are subject to characterization and evaluation. Accessions are screened for 3 successive years in fields or greenhouses and laboratories. As a rule, standard variety or set of varieties are included both to monitor within trial, and for trial to trial variation. Emphasis has been placed on yield compenents and yield related characters, disease resistance and tolerance to stress and adverse conditions. Most of the accessions have been evaluated. Computerized passport data have all accessions and evaluation data 68% of accessions. Best documented are cereals and grasses, hop and tobacco. In grasses over 83% of the accessions have both passport and evaluation data, in hop and tobacco around 61%, in cereals around 73% and in large seed legumes around 62%. For the remaining collections less than 60% of the accessions have both kinds of information (fig.2).

Storage of seeds and clones

Different storage forms were applied to all accessions, thereof to accessions 43,971 in the long-term store. The germplasm has been maintained as seed in controlled temperature conditions in two chambers with -15°C and four with +4°C 168 m^3 each located at the Plant Breeding and Acclimatization Institute at Radzików. Prior to storage, samples undergo routine cleaning, drying to 5-7% water content and are checked for viability (which should not be lower than 85%), then packed in glass jars (active collection) and in small metal cans (base collection) and labeled. The viability control is accomplished currently at a special laboratory. Seed samples of less than 80% germination capacity are reproduced at a full preservation of genetic purity principles. Methods applied are dictated by the reproductive biology of the plant in question.

Collection of horticultural and hop plants have been preserved as tubers under controlled conditions but some particularly valuble accessions of potato have been stored using in vitro meristem tip culture. The remaining objects are kept in store rooms of coperating units or exist in the form of orchards, hop plantation and berry shrubs. The status of germplasm preservation is illustrated by fig.3.

Future prospects

During several years of activities Polish Gene Bank has developed, in cooperation with other gene banks, serious technology of ex situ conservation of plant genetic resources. Ex situ conservation of plant genetic resources requires very high operational standards and procedures, which are not aviable by other organization (eg. botanical gardens) maintaining plant genetic resources. From other hand important task to be resolved is a preservation of wild relatives of crops which can be done by in situ conservation using existing organization of nature protection. New philosophy of nature conservation cross traditional understanding of nature conservation. Especially an idea of preservation of biodiversity needs new solutions. The strategy is the attempt to treat in an integrated fashion, four major levels of biodiversity- at the molecular level with ex-situ genome conservation (gene bank), at the species level, at the habitat or community level, and at the landscape level. In case of new possibilites activity of gene bank will join new environmental programmes, this means that gene bank potential ex situ conservation will support complex environmental protection.

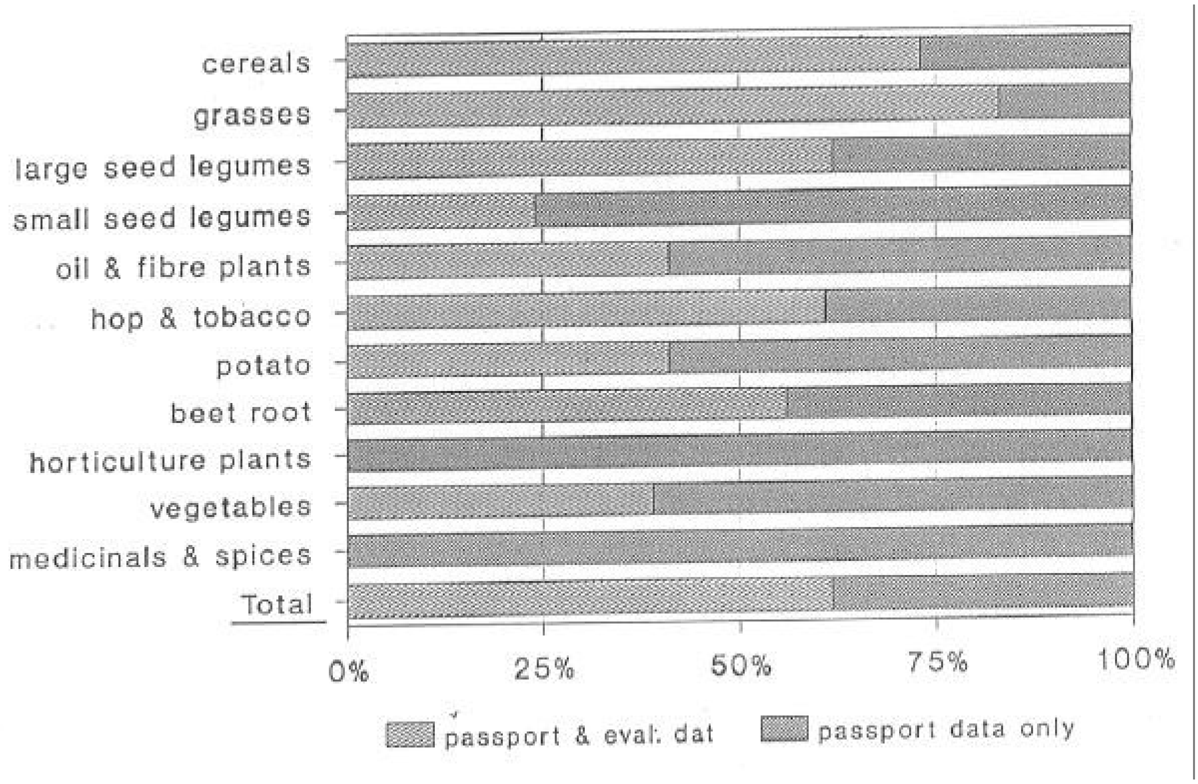

Fig. 2: Computerized documentation of plant genetic resources in Poland

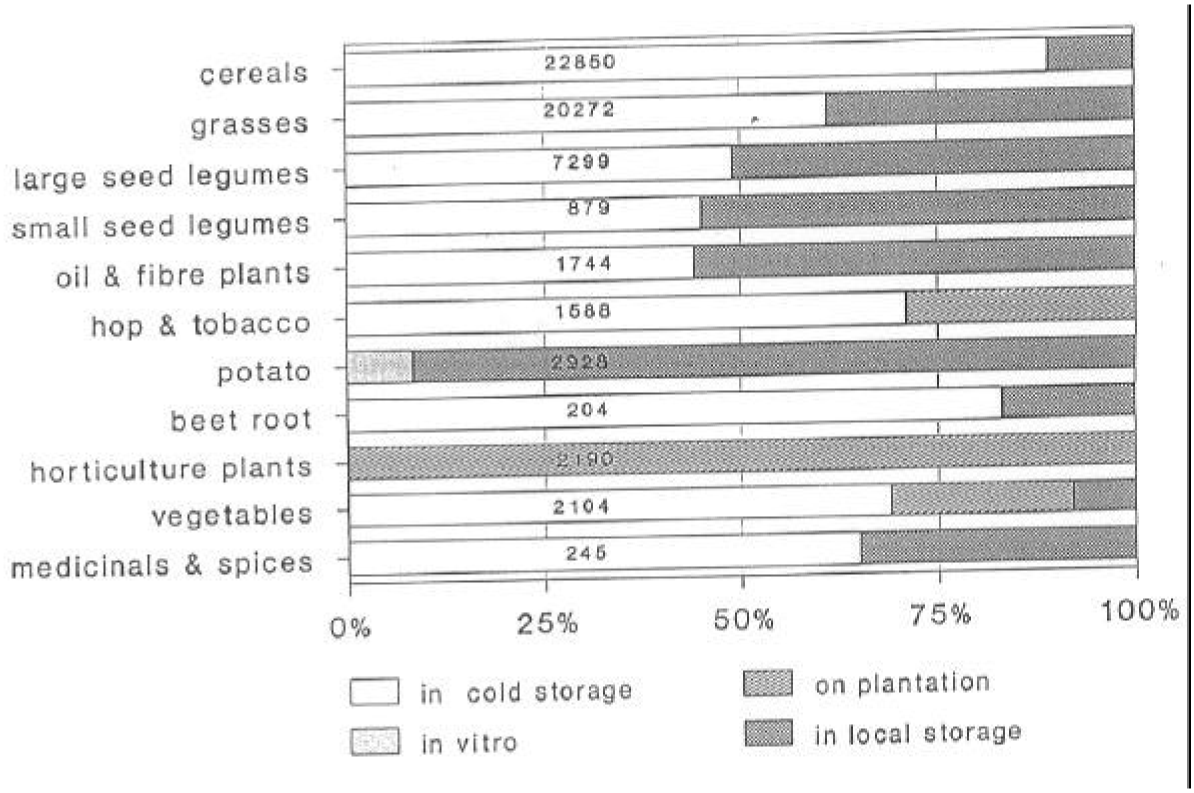

Fig. 3: Status and preservation of plant genetic resources in Poland

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CONSERVATION AND UTILIZATION OF PLANT GENETIC RESOURCES IN PORTUGAL PRESENT STATUS AND PROSPECTS

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Intoduction

As a result of its particular geographic localization, a wealth of diversity of plant germplasm was developed in the Portuguese continental territory and island. Furthermore, the early enterprise of the overseas' discoveries, at the end of the XIV century, and the long-lasting permanence in overseas territories promoted a wide introduction of exotic germplasm, subsequently subjected to periodic gene introgressions.

This enormous potential was recognized by the scientific community, throughout the world, and several collecting missions were undertaken in Portugal during the present century (*e.g.* as by Vavilov or, more recently, by Gladstones).

With the progression of modern industrial agriculture (in particular with the development and generalization of the idea of pure line for autogamous species) a large number of landraces of most of all the cultivated species became endangered by urban pressures which, in some particular areas, represent a menace to ecotypes of some wild relatives of the cultivated species.

A noticeable National effort was, already, undertaken in this area, in particular since 1977, when FAO/IBPGR gave support to a few collecting missions and, afterward, to the implementation of the Portuguese Germplasm Bank. However, as the responsibility for plant germplasm conservation and utilization is spread over four Ministries (and by Institutions within the same Ministry and groups within the same Institute), it lacks an appropriate coordination that would make the most of current endeavours and those for the future.

Ex situ conservation

In most cases, the germplasm collections of plant material directly involved in plant breeding projects, in Portugal, until 1977, were field collections, either of forest and fruit trees or annual crops. In particular, for annual crops, this method, besides being expensive (too much time and labor consuming) did not allow for the safeguarding of genotype integrity, due to the introgression to which the material is permanently exposed.

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From 1977, a growing effort was devoted to *ex situ* conservation, of seeds gathered in collecting missions performed in the Azores Islands (Bettencourt & Gusm o, 1981) and the continental territory (Mota *et. al.*, 1981, 1982). Since this period, a large number of Institutions implemented seed conservation facilities, in particular for germplasm directly involved in their breeding or genetic studies (active collections).

The relevance of the *ex situ* seed conservation, within the international efforts in this matter, was officially recognized and, in 1985, the Portuguese Germplasm Bank was created, in Braga (Ministry of Agriculture), with financial support from FAO/IBPGR. These facilities, however, are far from being fully (or rationally) utilized, due to the lack of a national programme which takes into account a policy of safe duplications or even a National data base for plant genetic resources.

At present, we can identify in Portugal 20 Institutions (comprising 45 different working groups) with seed conservation programmes for domesticated and wild relatives of cereal, forage and horticultural crops and also aromatic and medicinal species.

In vitro conservation of virus free germplasm material is carried out in a few institutions, particularly for *Vitis*.

The *ex situ* field conservation, particularly suited to perennial species, is mainly performed in field collections of fruit and forest trees (namely, genus *Pyrus, Malus*, *Prunus*, *Juglans*, *Castanea*, *Corylus* and *Citrus*, and species *Olea europaea*, *Amygdalus communis*, *Poncirus trifoliatus*, *Ficus carica*, *Quercus suber* and *Pinus pinaster*) and shrub plants (as *Vitis vinifera* and *Coffea* spp.).

Ex situ field conservation is also performed in Botanical Gardens, within the Universities' domain and in the "Tropical Agricultural Museum-Garden" (where endangered perennial plant species from ex-Portuguese overseas territories/former colonies are due to be preserved).

As reported by Palhinha (1947), the first Portuguese Botanical Garden, was founded in 1772, for exotic plants. However, Paiva (1981) refers to the establishment of a botanical garden for medicinal plants in Goa, by Garcia de Orta, in the middle of the XVI century. According to Paiva (op. cit.), the Botanical Garden of the Coimbra University was also established in 1772, mainly for medicinal plants. The modern Botanical Gardens are progressively paid a growing concern to endemic or otherwise endangered Portuguese species, as a repository of existing germplasm collections.

Another way for *ex situ* field conservation, which was put in practice in several Portuguese counties, was proposed by Vasconcellos (1943), and is the maintenance of the autoctonous species in public gardens.

Some of the work in *ex situ* conservation is carried out in collaboration with International Organizations, such as FAO and IBPGR.

In situ conservation

An important part of plant genetic resources conservation is traditionally made in several Natural Parks or, simply, in some protected areas where many endemic species are naturally grown, under protection.

Some endemic species are benefiting from national recovering programmes, as is the case for: *Pilularia minuta* Durieu ex A. Braun, *Herniaria algarvica* Chaudri, *Omphalodes kuzinskyanae* Willk., *Asphodelus bento-rainha* P. Silva, *Narcissus scaberulus* Henriq., *Avenula hackelli* (Henriq.) J. Holub. and *Tuberaria major* (Wilk.) P. Silva & Rozeira.

Some of the work in *in situ* plant preservation, under the aegis of the Ministry of the Environment, is accompanied by studies of crop production, that may reduce the anthropogenic pressure over the wild species in nature.

The *in situ* conservation of endemic, or otherwise endangered autoctonous species, whenever it is recommended, is complemented by *ex situ* conservation.

Some of the germplasm utilization work in course is being conducted in collaboration with International Organizations, such as the European Council and the Royal Botanical Gardens (Kew).

Prospects for plant genetic resources in Portugal

The valuable plant germplasm collections, existing in Portugal are a powerful means to support an increase of biodiversity in agriculture. However, this material is spread over numerous Institutions, within four Ministries, requiring an urgent coordination effort to make them more easily available.

In order to achieve this coordination, an Inter ministerial National Centre for PGR is to be implemented, in Portugal. Its proposed main scopes are:

- To establishe and up date an inventory of the material and human resources involved in collection, evaluation and utilization of plant genetic resources;
- to compile and publish national data on collection, evaluation and utilization of plant genetic resources;
- to define a duplication policy on national base collections;
- to established minimum standards for plant genetic resources conservation and the surveillance of its correct implementation;
- to formulate the criteria for accession and exchange of germplasm with the proposition for adequate legislation;
- to delineate and up date of a National Program for plant genetic resources collection, evaluation and utilization;
- to coordinate the national effort with the International Organizations on plant genetic resources endeavors.

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Prospects of development of ex situ conservation of plant genetic resources collections in Russia

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In the former USSR there were two officially adopted types of plant genetic resources collections: (a) VIR's collection housing genetic diversity of agricultural crops and their wild relatives; and (b) botanical gardens (about 70), each preserving wild plant species of the area where it was located and, to some extent, those introduced from other regions. BBotanical gardens were supervised by the USSR Academy of Sciences and local universities. It is important to emphasize that botanical gardens comprised mainly non-consumable plants. At present, there are 58 botanical gardens in Russia. Each garden stores about 4000 plant species.

In addition, there are small collections at the breeding centres (like private collections) maintained for routine work. Such collections have often been eliminated after being used.

It is also worth mentioning that comparatively small plant germplasm collections exist at some specialized research institutes. For example, the All-Russian Research Institute for Forages (Moscow Region) stores a collection of leguminous fodder grasses amounting to about 9700 samples. The All-Russian Institute of Medical and Aromatic Plants maintains a collection of 1000 medical plant samples.

The most comprehensive collection of plant genetic resources belongs to the N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry (VIR). This Institute originated as the Bureau of Applied Botany in 1894. The Bureau was reorganized in 1924 into the All-Union Research Institute of Applied Botany and New Crops. In 1930 it was renamed again and became the Research Institute of Plant Industry.

The basic objectives of scientific research and practical work at VIR include:

- collecting the global plant genetic diversity: varieties, forms and hybrids of cultivated plants and their wild relatives;
- preserving the collected germplasm in viable conditions;
- studying the collected plant germplasm;
- supplying breeding centres with initial materials for practical breeding; and
- performing theoretical and methodological research.

To challenge these objectives, a number of specialized departments and experiment stations were established within the Institute. An important division is the Department of Plant Introduction. Its principal task is to organize the exploration and collecting of plant germplasm, exchange of accessions and quarantine testing of the acqired materials.

All the germplasm accumulated by the Institute (including seeds, scions, tubers and bulbs) undergo registration with the Department of Plant Introduction. Each accession acquires its permanent introduction number, which would be attributed to this sample further on.

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Plant germplasm coming from abroad undergo quarantine tests at one of the 7 introduction quarantine nurseries. After that, accessions are forwarded to the Plant Resources Department. These departments are organized according to the principle of closely related crops. For example, wheat and triticale are studied at the Department of Wheat; maize, rice, buckwheat, sorghum, etc. - at the Department of Maize and Small Grains; clover, alfalfa, timothy and other grasses - at the Department of Fodder Crops, and so forth.

The experts of each department perform primary evaluation of the received accessions and hand them over to the methodological laboratories engaged in studying plant immunity, physiology, cytology, molecular biology, biochemistry and genetics. By the results of these studies, most promising samples are selected.

To study accessions from different countries in the most appropriate climate and soil conditions, the Institute operates a network of experiment stations. They are spread from Kola Peninsula (Polar Region) to the Caucasus (subtropics), and from the European part of Russia to the Far East. At these statons the collections undergo two conventional stages of assessment: (1) field evaluation, and (2) laboratory evaluation.

During the field assessment of germplasm VIR's experts examine peculiarities of plant biology and morphology or, in other words, phenological phases of vegetation, duration of the vegetation period, yield, disease and pest resistance, heat and frost tolerance, resistance to draught, excessive moisture and other environmental stress factors. Afterwards the morphological description of plants is made. All this work is performed by appropriate techniques and against the background of commercial (standard) varieties. Finally every accession acquires a passport, where all importnat biological and morphological characters are registered, and the deviations from the standard (i.e. positive and negative features) are included.

The experts of each experiment station, department or laboratory examine definite aspects of the life of plants, which correspond to their field of research. This makes it possible to obtain maximum information about the value of accessions preserved in the collection, and so to extend the passport data accumulated by the researchers from the Plant Resources Departments.

The studied germplasm is further made available for breeding centres and is used in national breeding programmes.

The most crucial goal of the Vavilov Institute is to conserve the entire collection, which may be classified into four groups:

- genetic diversity from the centres of origin;
- landrace populations of folk breeding;
- cultivars of modern breeding, and
- genetic lines, introduced mutants and other new forms obtained experimentally.

The Institute has a special Laboratory of Seed Testing, which controls seed germination and viability, and a long-term storage facility at the Kuban Experiment Station near Krasnodar, where 200,000 seed accessions are now conserved in sealed containers at the temperatures between +1°C and +4°C. The long-term storage experts pursue the task of raising the level of investigations for further improvements of storage techniques and, ultimately, increasing the safety of the plant germplasm under storage.

The staff of VIR consists of 400 employees. Among them there are 220 researchers and 180 technical staff workers including loboratory assistants with higher agricultural education. The staff of VIR's experiment stations consist of 1,400 people, 540 of which are researchers.

The collection of the world's plant genetic diversity, founded by Vavilov himself, his associated and disciples, currently numbers about 350 thousand accessions and still remains the richest and unique collection in the world. It comprises 2,539 plant species representing 304 genera belonging to 155 botanical families. The Institute also preserves more than 250 thousand herbarium specimens of cultivated plants and their wild relatives (Appendix 1).

98% of the Institute's total funding come from the State Budget via the Russian Academy of Agricultural Sciences. Budget allocations for 1993 amounted to 406 million roubles. Staff salaries consumed about 121 million roubles in 9 months.

The monthly salary of a leading researcher at the Institute currently makes 50 thousand roubles (approximately U.S.$ 41), while that of a technical assistant is 26 thousand roubles (U.S.$ 20). It is worth mentioning here that the subsistence basket in St. Petersburg is estimated by economists as 35 thousand roubles. Heavy inflation keeps on devaluing the salaries.

The situation with the Institute's finances and procurement is serious enough. Problems are exclusively numerous, and many demand urgent solution. The Institute needs modern equipment, chemical reagents, climate chambers and freezing units, whereas the Institute's library requires new scientific publications and periodicals.

What are the prospects in the development of the plant genetic resources system in Russia?

It should be mentioned that the state authorities pay much attention to the problems of VIR and its network. However, the government is now at the difficult primary stage of reconstructing the social, political and economic system of this country. For example, the government has allotted land for a new experiment station to be built instead of the Sukhumi Station in similar ecological conditions. Moreover, 62 million roubles have been earmarked for reconstruction of the Kuban National Seed Store. There are plans to provide certain funding of scientific events dedicated to the 100th anniversary of VIR scheduled for early August 1994.

Great contribution to the Institute's re-equipment was made by USDA. Ten computers were supplied to VIR in accordance with the agreement signed with ARS/USDA in 1991. Very active is the cooperation with IBPGR. VIR currently stores 4 base collections of the Board. Joint activities made it possible to conduct 5 collecting missions in Russia and the regions of the former USSR. Training courses were organized for the representatives of plant genetic resources programmes of South America and Asia.

Step by step the data base on the world's collections is being accumulated (Appendix 2). We are establishing contacts not only with national genetic pogrammes (Japan, South Korea, Germany, United States, Netherlands, etc.), but also with commercial companies. Considerable mutual benefits are expected from the joint project on vegetable crops with "ROYAL SLUIS". Also promising may appear the cooperative programme with "PIONEER" who are now discussing an agreement with VIR concerning the study of maize genetic resources. Together with the Finnish Institute for Horticulture a joint collecting mission to the North-Western Area of Russia is planned ´for 1994. Another joint exploration with the scientists of Nordic Genebank will be arranged in Kaliningrad Region. Efforts are made to send a Russian-Japanese jount mission to the Far East.

The exchange of plant germplasm from VIR's collections is still intensive. In 9 months of 1993 about 3000 samples have been shipped abroad following the requests of foreign colleagues, while VIR has acquired more than 5000 new accessions.

Promising joint research programmes are now developed on such topics as "Effects of Pathogens on Seed Viability in Long-Term Storage" (Russia-Germany-IBPGR) and "Preservation of the Fruit Crop Diversity" (Russia-Belgium-France) under the auspices of the E.E.C.

We are also considering a joint project to be established on collecting, preservation and study of plant genetic resources with C.I.S. countries, since former experiment stations of the Institute has become National Institutes on plant genetic resources.

Development of the programmes dedicated to conservation and research of plant diversity remains the highest priority. In the modern world this problem can be solved only on the basis of large-scale international cooperation.

Appendix 2

VOLUME OF VIR'S DATA BASES

(for September 20, 1993)

No	**Crop**	**Number of accessions**			
		in the collection	in the computer data base		
		Nc	passport data Np	Np 100% / Nc	Evaluation data Ne
1	2	3	4	5	6
1. Department of Wheat (IBM-386, 486)					
1.1	Wheat	58057	30695	52.9	7559
1.2	Aegilops	3324	2649	79.7	--
1.3	Triticale	4387	2046	46.6	--
	TOTAL	65768	35391	53.8	
2. Department of Rye, Barley and Oats (IBM-486)					
2.1	Rye	3037	2685	88.4	553
2.2	Barley	25364	18326	72.3	1937
2.3	Oat	13015	9207	70.7	--
	TOTAL	41416	30218	73.0	
3. Department of Maize and Small Grains (IBM-286)					
3.1	Rice	6658	3946	59.3	374
3.2	Sorghum	11504	4227	36.7	--
	TOTAL	18162	8173	45.0	
4. Department of Fodder Crops (IBM-286, 486)					
4.1	Alfalfa	3019	2932	97.1	

1	2	3	4	5	6
5. Department of Leguminous Crops (IBM-486)					
5.1	Pea	7527	6024	80.0	--
5.2	Soybean	7098	937	13.2	--
5.3	Phaseolus	10124	7021	69.4	487
5.4	Vetch	3050	1731	56.8	1594
5.5	Lupin	2543	1901	74.8	--
5.6	Chickpea	2432	1355	55.7	--
5.7	Faba bean	1594	1026	64.4	--
5.8	Peavine	1100	723	65.7	--
5.9	Lentil	3182	2282	71.7	--
	TOTAL	38650	23000	60.0	
6. Department of Industrial Crops (IBM-286)					
6.1	Sunflower	2750	1129	41.1	--
6.2	Flax	5278	4524	85.8	--
6.3	Rapeseed	691	315	46.0	--
	TOTAL	8719	5968	68.4	
7. Department of Tuber Crops (IBM-286)					
7.1	Potato	10091	9748	96.6	--
8. Department of Vegetable Crops (IBM 486)					
8.1	Cabbage	3703	1221	33.0	--
8.2	Tomato	6516	951	14.6	--
8.3	Carrot	1500	1001	66.7	--
8.4	Beet	3003	935	31.3	254
8.5	Watermelon	3548	1383	39.0	--
8.6	Pumpkin	2917	500	17.1	--
	TOTAL	21178	5991	28.3	
9. Department of Fruit Plants (IBM-286)					
9.1	Pear, quince	2300	419	18.2	419
9.2	Cherry	621	621	100.0	--
9.3	Sweet cherry	980	980	100.0	--
9.4	Strawberry	720	427	53.9	--
	TOTAL	4621	2447	53.0	

Plant Genetic Resources Activities in Spain

C. DE LA CUADRA[1]

1. Ex-Situ Conservation

The National Programme of Conservation and Management of Crop Genetic Resources in Spain were brought up to date in a Ministerial Rule, 1993 April 23, where also the Plant Genetic Resource Center (CRF) was created as a modification of the previous Center of Conservation of Crop Genetic Resources.

The basic objectives of this programme are:
1. To avoid the loss of the genetic biodiversity of crop species and wild species related that could be used in food-crops, industrial-crops, energy-crops and ornamental-crops.
2. To obtain a good management of the PGR through ist evaluation and documentation.

The Plant Genetic Resource Center has the Central Base Seedbank, is the documentation Center of the plant genetic resources network and is a Center for technological advice in seed conservation subjects.

The National Networks of ex-situ collections is constituted by:
1.1 The above mentioned CRF
1.2 Active collections network
    1.2.1 Seed active collections
    1.2.2 Asexual reproduction species collections
1.3 Botanic gardens

1.1 Plant Genetic Resource Center/Centro de Recursos Fitogeneticos (CRF)

COLLECTIONS:	- Seed Base Bank - Seed Active Collections
INSTALLATIONS:	- Building (1000 m^2) - Laboratories - Bureaux - Two climatized rooms for conservation (540 m^2) - Three climatized rooms for dryness (108m^2) - Garden (4000m^2) - Two plasic greenhouses - Agricultural Farm (38 Ha)

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CRF BASE BANK COLLECTIONS

CROPS	Nº ACCESSIONS	PERCENTAGE
Cereals	8608	40
Leguminouses	7195	33
Horticulturals	3927	18
Pratals	1413	7
Industrials	392	2

CRF DOCUMENTATION: Species multiplicated and characterizated included in CRF data base.

Cereals	Legumes	Horticultural	Fruits
OatLupin	Chard	Apricot tree	
Barley	Chickpea	Eggplant	Almond tree
Ry	Pea	Borage	Hazel tree
Wheat	Broad bean	Calabash	Cherry tree
Triticale	Bean	Onion	Plum tree
	Lentil	Cabbage	Cherimoya
	Lathyrus spp. Spinach	Mango	
		Melon	Apple tree
		Pepper	Peach tree
		Radish	Walnut tree
		Water melon	Olive tree
		Tomato	Pear tree
		Carrot	Bananatree
			Grapevine

CRF ACTIVE COLLECTION: See active collections network

1.2. Active Collections network

CHARACTERISTICS

- Actice banks normally specialized in a kind of crop.
- With breeders working and/or implications in the regeneration and evaluation of the accession from the other banks.
- With the accessions duplicated in base bank of CRF and/or the data computerized in data base of CRF (in this moment we are working in this point).
- Part of the collection is available for exchange.

Tab. 2: Seed active collections

CROP	PLACE	SPECIES
Horticultural	Zaragoza	Allium cepa
	Valencia	A. porrum
		A sativum
		Asparrafus officinalis
		Beta vulgaris
		Brassica napus
		B. oleracea
		Capsicum annuum
		Citrullus lanatus
		Cucurbita maxima
		C. pepo
		C. ssp
		Cucumis melo
		C. sativus
		Lactuca sativa
		Lycopersicum sculentum
		Raphanus sativus
		Solanum melongena
Pratal and Forrage	Badajoz	Trifolium subterraneum
		T. glomeratum
		Medicago app.
		Ornithopus compressum
		Lolium perenne
		L. multiflorum
		L. rigidum
		L. canariense
		L. temulentum
		Dactylis glomerata
		Avena spp.
Legumes	Albacete	Cicer arietinum
	Badajoz	Lathyrus cicerea
	Cordoba	L. sativus
	Cuenca	Lens culinaris
	Madrid (CRF)	Lupinus albus
	PontevedraL. angustifolius	
		L. consentinii
		L. hispanicus
		L. luteus
		L. micranthus
		L. mutabilis
		Phaseolus vulgaris
		P. coccineus
		Pisum sativum
		Vicia ervilia
		V. faba
		V. monanthos
		V. sativa
		V. villosa

Winter Cereals	Madrid (CRF)	Aegilops spp. Avena sativa A. strigosa Elymus spp. Hordeum vulgare Hordeum spp. Secale cereale Taeniatherum caput-medusae Triticum turgidum T. aestivum T. monococcum T. timophaevi Triticosecale
Springtime Cereals	Madrid (CRF) Galicia	Sorgum bicolor Zea mays
Industrial crops Andalucia	Amaranthus spp. Canarias Madrid (CRF)	 Gossipyum hirsutum Hibiscus cannabis H. sabdariffa Hibiscus spp. Papavers spp.

Tab. 3: Asexual reproduction species collections

CROPS	**PLACE**	**SPECIES**
Fruit Crops	Zaragoza Murcia	Anona cherimola Corillus avellana Ficus carica Juglans regia Malus domestica Olea europea Pirus domestica Olea europea Pirus domestica Prunus persica P. domestica P. caerasus P. armeniaca
Ornamentals	Madrid (CRF)	
Grapevine	Cadiz Canarias Madrid	Vitis vinifera

1.3 Botanic gardens

The botanic gardens in Spain have traditionally played an important role in the conservation of the plant biodiversity and together with the Botanic Department of the Universities, are the most important centers of basic botanic researchs.

But, in the last ten years, Botanic Gardens as well as the Botanic Department of some Universities have been improving its capacity forming a new generation of seed banks that depend on them.

They are small banks that only work in wild species using the more sofisticated method of conservations. They care on the conservations of endemisms and species soon to become extint.

These new seeds are:
- Seed bank of Botanic Garden of Sóller (Mallorca)
- Seed bank of Botanic Garden of Marimurtra (Gerona)
- Seed bank of Botanic Garden of Córdoba
- Seed bank of Botanic Garden "Viera y Clavijo" (Canarias)
- Seed bank of Real Jardín Botánico (Madrid)
- Seed bank of Vegetal Biology Dep. Escuela Técnica Superior de Ingenieros Agrónomos de Madrid

The relation between the Botanic Gardens and its seed banks and the above indicated agronomic seed banks network is improving close through the exchanges of conservation methods and technologies. But the most important potential relationship between seedbanks, botanic gardens and breeders is in the search for genes of resistances in wild species useful in agricultural research through biotechnology methods.

NGO Activities

In Spain there are some NGO working in Plant Genetic Resources and the coordination between them and the public Program could be very useful.

The relations between these NGO and Public Centers are not yet well established.
To promote a good coordination it is necessary to organize meetings to develop the future cooperation.

2. In-Situ Conservation

The in-situ conservation in Spain is carried out most of all through the National Parks but also by other national protected spaces.

The law 4/89 (1989-March-27) has control on the protection of natural resources in our country. This rule created the National Parks network, where each park is a representative pattern of the biodiversity of the different Spanish environment. There are nine National Parks in Spain.

Here the conservation is nearly natural with few human inferences, except the necessary regulation to avoid dangerous or undesirable consequences of human activity.

At the moment the studies performed in these locations are principally theoretical and basic researches without relationship with agronomical or practical subjects.

The potential cooperation between genebanks, botanic gardens and natural conservation are:
1. To search wild species that could be used in new crops with new finalities.
2. To study botanic associations that could be used to cover setaside lands from PAC.
3. To look for resistances and environmental adaptations of species with potential utility in agricultural research or breeding.

3. List of Strategic Plans

In our country the PGR priorities in this moment are:

1. To obtain the best method and technology to undertake a safe and prolongated conservation.

2. To collect all the ancient crops and wild species related.

3 To evaluate the PGR collected searching non food use possibilities and crops with added value.

4. To improve the use of different species of legumes as green fertilizer to avoid erosion in set aside lands from PAC.

5. To improve the use of aromatic and ornamental species to get crop diversification.

The Nordic Gene Bank

S. BLIXT[1]

Background and Administration

The Nordic Gene Bank (NGB) is an institution which reports to the Nordic Council of Ministers, the executive assembly for cooperation between the Nordic countries. NGB's aim is to preserve and document the genetic variation in agricultural and horticultural plants and their wild relatives in this area. Samples and information are freely available to plant breeders, plant scientists and other *bona fide* users.

Two members, one from administration and one from plant breeding, from each of the countries (Denmark, Finland, Iceland, Norway, and Sweden) sit on the board of NGB. The Board has two regular meetings annually. The board has a Technical Advisory Committee consisting of national sections, which represent the view of their respective countries. NGB has internordic Crop Working Groups as expert bodies. There are seven working groups at the moment.

The institute is based in Alnarp in the south of Sweden, 10 kilometres north of the city of Malmö. The eleven members of staff are engaged on four-year contracts. The engagement is maximised to two periods.

Cooperation with plant breeders is very well build out and functioning smoothly through the activities of the working groups. Cooperation with botanic gardens is probably not of interest to any of the parties except in exceptional cases, since botanic gardens normally work on the species diversity level and NGB works on the infra-specific level.

1. Ex situ conservation

1.1 Conservation

Most material is preserved ex situ. Seeds are kept dry at - 20 C. Fruit trees, berries and landscape plants are preserved in clonal archives (field genebanks) and potatoes are preserved in vitro.

NGB's seeds are stored in three different collections:

- The active collection, used for the distribution and characterization/evaluation of material;
- the base collection, for the long-term storage and to maintain genetic integrity and identy;
- The safety base collection, a duplication of the base collection, for safety storage in a container placed in a coal mine under the permafrost on the Svalbard Islands.

Information related to the materials is stored in computerized databases. The computer system at NGB consists of personal computers (IBM and compatibles) connected in a local area network. The database

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management system dBASE IV is used to handle the information. Catalogues for various crops are published to make the information available. Potential genebank users can also receive databases and request print-outs of selected information.

After checks for quantity and viability the material is prepared for storage in the active, base and safety base collections. If an accession meets the agreed criteria for preservation it is given the status "accepted". Otherwise it is given the status "temporarily accepted" until the appropriate working group changes the status to "accepted" or "rejected". In the latter case the acquired information is nevertheless stored for future reference.

NGB deals with special collections made for specific purposes, which often are accompanied with databases containing very specific information. NGB may take the responsibility for a special collection even if the amount of material is not enough to form an active, base and safety base collection.

1.2 Working programme

Cereals

NGB keeps one Nordic database for each of the four main cereal species grown in the Nordic countries: barley, oats, wheat and rye. In these databases, passport information is registered as well as characterization and evaluation data for Nordic varieties, landraces and breeder's lines. The data was originally supplied from the donors of the material, such as Nordic breeding companies, universities and research institutes. Since 1991, the Working Group for Cereals has been running projects to characterize and evaluate the collection in order to make the information in the Nordic databases more comprehensive.

The series of Nordic Cereal catalogues includes the Nordic Barley Catalogue, published in 1989, the Nordic Oat Catalogue, published in 1990 and the Nordic Wheat and Rye catalogue, published in 1992.

The mandate of NGB is to preserve the genetic variation in Nordic material of agricultural and horticultural crops. Cereal material that is to be accepted for long-term preservation must fulfil the requirements put forward in a document complied by the Working Group. Many lines are still stored temporarily, while awaiting a decision about NGB's responsibility. In 1991, the Working Group initiated a detailed examination of the cereal collection to determine what material should be accepted for long-term preservation.

The International Board for Plant Genetic Resources (IBPGR) has started an International Network for Barley Genetic Resources. At a meeting in Helsingborg in 1991 the objectives of this network were defined. One of the basic projects should be to compile a gene list for barley and a database for the genetic stocks found in various collections worldwide. In 1992, NGB started a pilot study to implement this project. The pilot study was funded by the Nordic Council of Ministers. The study was presented in 1993 and NGB is presently looking at various ways of raising funds for the main project so that this database can be developed.

Fruits and berries

The main task of the Working Group for Fruit and Berries is the collection, description and maintenance of both valuable local varieties of Nordic origin and indigenous wild material in clonal archives.

The clonal archives are located at various institutes. NGB provides some financial support once the institute has agreed to maintain genebank material and to notify NGB when a clone is endangered. However the main expenses are paid by the institutes themselves.

Potato

NGB has the long-term responsibility for the preservation of Nordic local potato varieties of unknown origin, commercial varieties produced at Nordic plant breeding institutes and breeding clones with particularly valuable traits. Old foreign varieties which were cultivated over large ares in the Nordic countries are also included if they are not preserved elsewhere.

In 1991, because of the high cost of preserving potato clones, the Working Group decided to restrict NGB's responsibility for commercial varieties to those varieties which have been widely used in the Nordic countries or which have been important as parental material in Nordic breeding programs.

By the end of 1992, 54 clones had been accepted for long-term preservation and 22 had been granted temporary status. The accepted clones are either already stored *in vitro* at IVK Potatis AB or still kept at various institutes in the Nordic countries. In addition to these, a few old commercial varieties and valuable local varieties meet the agreed criteria for maintenance, but have not yet been acquired.

The available material, 14 clones, was described in a booklet published in Swedish in 1993.

Accepted clones are made pathogen free and kept *in vitro* for long-term storage at IVK Potatis AB in Umeå. For security reasons and in order to provide material for study and distribution, these clones are grown in the field at the Norra Sunderbyn Experimental Station near Luleå. At the Swedish Seed Testing and Certification Institute near Lund these clones are also grown in the field together with clones that are awaiting identification.

Forage crops

Between 1979 and 1983, NGB collected forage crops in all the Nordic countries including Greenland. Since then, forage species have been collected more sporadically. NGB also has material collected in the 1970´s before NGB was established.

The material collected was multiplied in the country of origin. Seeds from more than 2000 accessions are now available at NGB. The rest of the material is either still vegetatively stored in the country of origin or has been discarded.

The Working Group for Forage Crops at present mainly works on the multiplication of collected populations which have yet to be transferred to NGB and on the rejuvenation of material from NGB:s seed store which has low germinability. Rejuvenation is usually carried out in the country and district of origin. In most cases the material was characterized and evaluated during rejuvenation/multiplication. New legume material was collected in Iceland in 1992.

The collection data for NGB:s forage collections is now available upon request in the Nordic Forage Database (NFDB). A catalogue for these collections is also available from NGB upon request (the Nordic Forage Catalogue).

In order to study genetic diversity in a forage crop and at the same time have a collection of maximum genetic variation available for scientists and plant breeders, the ECP/GR Working Group for Forage Crops initiated a pilot project in 1991 with respect to a European "Core Collection" of *Lolium perenne*. NGB is responsible for the Nordic contributions. Five accessions have been chosen to represent the genetic diversity of *Lolium perenne* in the Nordic countries, and multiplication of seed has begun.

Vegetables

Most of the vegetable material preserved by the NGB is landraces originating in a Nordic country together with Nordic bred cultivars. Non-Nordic cultivars which have been grown in a Nordic country to a significant extent are preserved if they are not preserved in any other genebank. Furthermore, material from parental lines of F_1-hybrids and genetic stocks of Nordic origin are preserved in the NGB.

The vegetable material is mostly stored *ex situ* as seeds in the NGB's seed store. The vegetative material from onions and rhubarb is stored as clones in national clonal archives.

Roots, oil-crops and pulses

The main task for the Working Group has been to compliment the information on material already stored in the NGB. The group is planning to compile the information about the stored material in a catalogue ready in 1994. Norway is the only country that still might have some local varieties of root crops that should be acquired for storage.

Medicals and Herbs

Since Working Group 9 was established in 1987, the group members have studied and compiled information from available Nordic literature on the use of medicinal plants in the Nordic countries. The group has prepared a preliminary list of medicinal plants by including species discussed in some of Linnés papers and in the book *Materia medica regno vegetabili*, by Professor Peter Jonas Bergius, which was published in 1778.

The preliminary list of species, updated in 1991, was revised by the Swedish group member in 1992 and is now referred to as the main list. For each of the species in the main list, the Swedish group member registered its origin, occurrence in the Nordic countries, biotope, and active chemical substances. The historical use of each of the species is described together with the effects it was supposed to have on various diseases. References to pharmacopoeia and literature have also been registered. Finally, for each species the need for preservation was evaluated and specific preservation methods recommended.

To illustrate the cultivation of spices and medicinal plants a small report has been written in Denmark called "Cultivation and Trade with Spices and Medicinal Plants in Denmark".

2. In situ conservation

Conserving genetic diversity *in situ* wherever possible is essential because it relates to continuity of the evolutionary systems that are responsible for genetic variability. In the NGB context *in situ* conservation means the preservation without radical and regular interference by man, e.g. planting and harvesting. Consequently, planted clonal archives are not included while meadows are.

Species growing wild in the Nordic countries are entirely or partly to be conserved *in situ* in the following cases:

A. The species comprise cultivated as well as wild growing forms in the Nordic countries:
   I. The species is difficult to manage;
   II. the species is very widely spread in the Nordic countries, and

III. the species is endangered.

B. The species comprise only wild forms in the Nordic countries but is cultivated somewhere else.

C. The species is not cultivated anywhere (wild relative of a cultivated species).

There is a well established infrastructure for conservation of natural resources in the Nordic countries, based on multi-institutional arrangements of various categories of nature reserves as well as a non-governmental volontary sector (NGO). To avoid duplication of work and to minimize NGB's own costs, NGB prefers collaboration with those institutions to meet its requirements for *in situ* conservation. Preliminary contacts have been taken in each Nordic country but finalization must await the implementation of phase 2 of the Biodiversity Convention, i.e. the formulating of national strategies, plans and programmes.

The presently widely advocated on-farm-conservation of plant genetic resources is with all probability not applicable to the Nordic countries, since landraces are not in use in any part of the area and smallholders of the type required are long since gone.

3. Present and potential users

The use of the PGR material and information of the Nordic countries is presently utilized by breeders and researchers to the extent presented below. The general experience is that the utilization is proportional to the information about the material available, i.e. the more information, the better the utilization.

The knowledge and competence contained in the Nordic PGR programme is utilized in cooperation on different levels with other countries, programmes and genebanks.

3.1 Acquisitions

In 1992 the NGB acquired seeds from 1178 accessions. 823 accessions have been or will be added to the ordinary seed collection. 355 accessions are cereals belonging to the special collections.

3.2 Distribution

NGB received 94 requests for material in 1992. 40 were from the Nordic countries and 54 from abroad. Nine requests were forwarded to other genebanks and two were serviced by means of material both from the NGB and from other genebanks. In four cases it was not possible to supply the user with material. The total number of accessions distributed was 1479, including 221 accessions which were acquired from 22 other genebanks or institutes.

3.3 International cooperation

The Southern African Development Community (SADC) project to establish a regional gene bank (SRGB) in the SADC countries is funded as a joint Nordic development project with NGB as the executing agency. The project started in 1989 and is planned to run for twenty years. The SRGB is located in Zambia, at Chalimbana, about 20 kilometres outside Lusaka, the capital of Zambia. The plant genetic resources conservation network in the SADC countries now comprises the regional genebank at Chalimbana and national programmes and genetic resources centres in the ten SADC countries Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe. Two of the NGB posts are financed by the project.

A short course is held annually jointly with the Royal Veterinary and Agricultural University in Copenhagen for staff and potential staff of the SADC plant genetic resources conservation network.

3.4 Strategy

The future strategy of NGB is under preparation and will be discussed and possibly decided on by the NGB Board in December, 1993.

Conservation of Plant Genetic Resources in the United Kingdom within and without habitats

R.D. SMITH[1]

Conservation within habitats

The UK has a statutory framework of protection for important sites and threatened species.

At the international level; the "Bern" Convention on the conservation of European Wildlife and Natural Habitats and the EC Habitats and Species Directive (92/43/EEC) are of the greatest significance for plants.

At the national level, the UK has a long tradition of statutes to protect wildlife *in situ* starting in 1880 with the Wild Birds Act. Much of this legislation has been brought together and strengthened by the Wildlife and Countryside Act of 1981 and the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985. The Environmental Protection Act 1990 reorganised the way nature conservation is delivered in Great Britain by creating separate agencies for England, Scotland and Wales.

The country agencies, English Nature, Scottish Natural Heritage, the Department of the Environment (Northern Ireland) and the Countryside Council for Wales have among their duties the notifying of land of special interest for its wildlife, geological and natural features, and for managing National Nature Reserves. Through their Joint Nature Conservation Committee they provide a collective view on international matters and those questions which affect the UK as a whole. Together the agencies received £ 138 million in the current year.

The voluntary movement plays a conspicuous part, often owning and managing both National Nature Reserves and Sites or Areas of Special Scientific Interest. The National Trust is the largest private landowner in Britain and has wildlife conservation as an essential aim. The RSNC Wildlife Trust Partnership is the major voluntary organisation in the UK and has at its core 47 local Wildlife Trusts and 50 Urban Wildlife groups, a total membership of over 250,000 who own and manage over 2,000 nature reserves. The Royal Society for the Protection of Birds also has reserves, within which wildlife other than birds can also benefit.

Methods used for the Conservation of Biological Diversity within habitats

Many plants have widely dispersed populations. They are not generally amenable to site based conservation but instead require the retention of such features of the wider countryside as hedges, copses, ponds and flushes. Sympathetic land management is important to the conservation of these widely dispersed species.

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Rare and vulnerable species require more specific action. The Wildlife and Countryside Act gives specific protection to 168 species of plants. Action is concentrated when the species is classified threatened i.e. rare, vulnerable or endangered according to the IUCN system. There is a growing realisation that National Red Data books which list threatened species should also include those which are not threatened but are of international importance.

In 1991 English Nature launched its Species Recovery Programme to assist specific endangered species through focusing the efforts of all concerned with their continued welfare. Part of the plan for the plants listed in the Wildlife and Countryside Act is to conserve them off site *(ex situ)* in the Seed Bank of the Royal Botanic Gardens, Kew. Similar arrangements are developing with Scottish Natural Heritage and the Countryside Council for Wales. Plantlife (a voluntary body) is runnig a "Back from the Brink" campaign to save threatened plants. At present there are major gaps in our knowledge of a genetic variation within species or the genetic diversity of remaining threatened populations. This currently inhibits the development of complete conservation strategies.

Action plans for species in the future will be drawn up in the conservation agencies and the Joint Nature Conservation Committee working with the voluntary sector, for species that are globally threatened, endemic to the UK, of international importance (i.e. listed in annexes to the Bern Convention and the EC Habitats Directive), or are threatened to some degree (e.g. as identified in Red Data Books). This is also likely to be the order of priority.

Protected Areas

While protected species remain important, there is increasing emphasis towards a strategy designed to ensure that as wide a range of species as possible survive throughout their natural range.

The basic importance of the protected area system will remain, Sites of Special Scientific Interest (SSSI) are selected according to

1. Naturalness
2. Diversity of species present
3. Typicalness
4. Size in a measure of the ability to sustain available population
5. Rarity of species present or habitat type

By the end of March 1993 the following area and number of SSSI or ASSI had been designated.

	Number	**Hectares**	**% of territory**
English Nature	3730	858921	6,0
Scottish Natural Heritage	1360	838831	11,0
Countryside Council for Wales	870	205652	9,7
Northern Ireland (ASSIs)	40	47849	3,4
TOTAL	**6000**	**1951253**	**8,5**

Since 1949 it has been the policy to declare some of the land of highest quality as National Nature Reserves. These may be owned or leased by the Country agencies or voluntary bodies, or privately owned, but will be subject to a contractual management agreement.

Again in March 1993, there were:

6 NNRs in Northern Ireland (1,257 ha)
70 NNRs in Scotland (114,486 ha)
49 NNRs in Wales (13,397 ha)
140 NNRs in England (57,335 ha)

NB These areas are included in the above table.

While there is a presumption against harmful development in these areas, local planning authorities can allow development operations or changes in use, if after consulting the appropriate conservation agency, they decide it is in the wider public interest to do so. In such cases there will often be a requirement to provide for the creation of similar habitats nearby.

Local Nature Reserves

These are designated by the local authorities under the National Parks and Access to the Countryside Act 1949. They are not accorded as much significance under the planning system as SSSIs.

The LNR designation is made in consultation with the conservation agencies who provide advice on the suitability of the site. Most LNR are owned by local authorities but some are managed on their behalf by other bodies such as local wildlife trusts. At the end of March 1993 there were 2 LNRs in Scotland totalling 3,165 ha, 19 in Wales totalling 2,423 ha and 337 in England with an area of 13,977 ha.

The Wider Countryside

Many more nature reserves are owned by non-statutory bodies and individuals. This is a further tranche of land protected by a wide range of voluntary organisations and includes non SSSI land. These organisations are sometimes owners or lessees of LNR or SSSI land and work in partnership with the appropriate country agency.

Outside these formally and informally protected areas, environmentally beneficial management of farmland is encouraged through a number of schemes. For example, Environmentally Sensitive Areas (ESAs). These are targetted on areas of high conservation value and are intended to provide incentives to farmers and crofters to protect and enhance environmental features of their land. By December 1993 there were four ESAs in Wales totalling 358,700 ha, 10 in Scotland totalling approximately 1.4 million ha, 16 in England totalling approximately 832,000 ha, and 3 in Northern Ireland totalling 131,000 ha. Another 10 are in the planning stage - these total about 578,000 ha.

Agriculture Departments are also operating Farm capital grant and from woodland schemes that provide funding for specific environmentally-beneficial measures. They will also now be introducing in 1994, schemes under the EC Agri environment programme, for example, for moorland conservation, for habitat creation as long-term set-aside land, and for conversion to organic farming.

Conservation Outside Habitats

At the Governmental level, the UK policy on conservation of Plant Genetic Resources PGR is under the review of an Interministerial Group including representatives from

the Ministry of Agriculture, Fisheries and Food (MAFF)
the Scottish Office, Agriculture Food Division (SOAFD)
Department of the Environment (DoE)
Overseas Development Administration (ODA)
Agriculture and Food Research Council (AFRC)

Plant Genetic Resources are currently defined in the widest possible interpretation of the definitions appearing in the Biological Diversity Convention.

The current situation is devolved with many collections owned and controlled by the individual institutes yet fully funded or partially funded by a variety of government sources e. g. MAFF, SOAFD, DANI, the Forestry Commission and the AFRC.

There are 51 PGR collections within the UK of which 33 are in the main directly funded by Government, 13 are mainly indirectly funded by Government, 1 funded from International Bodies, 2 funded from industry and 2 are NGO funded.

Two governmentally funded collections, the vegetable Genebank at Wellesbourne and that for wild species at RBG Kew, are recognised base collections within the IBPGR/FAO network, the other governmentally funded collections are seen at present as working collections which directly support research breeding program.

In 1992, the total cost of the *ex situ* Conservation programme was just over £ 1m.

The UK Group on Plant Genetic Resources provides a forum whereby collections curators, breeding industry representatives and Ministry representatives can meet informally to exchange information at the technical level on matters relating to PGR policy.

The group also provides the opportunity of collection curators from Crop Research Institutions, Universities, Botanic Gardens and NGOs to meet and co-operation to develop. International organisations such as the International Board for Plant Genetic Resources (IBPGR) and Botanic Gardens Conservation International (BGCI) are invited to attend as observers.

Full details of the collections are provided in Appendix 1 and 2.

Conclusions

Increasing contacts between those involved in conservation of plant genetic resources inside and outside habitats is leading to a clearer understanding of the complimentarity between the two approaches.

Material held outside habitats is seen as:

1. underwriting the continued existence or that species of the genetic resources held in that population. For rare plants, this will provide the source material for reintroduction and enrichment planting. For more widely dispersed species where continued "development" will

eventually result in habitat fragmentation, the preservation of the genetic variation within populations will be of greater importance.

2. making genetic resources available throughout the year, and over many years, whilst controlling collecting to levels that are sound. This service cannot be provided as cost effectively by holding the material within the habitats where seed is only available over restricted periods and repeated recollection will be nesessary to meet each request. This service can add value to the collections by solving their germination requirements so that users can be assured of a supply of plants either for investigation to make good the information shortfalls which must be filled before complete conservation strategies can be developed to hold the plants within their habitats or as a basis for reintroduction.

3. most efficiently satisfying the Convention on Biological Diversity´s requirements for germplasm availability whilst allowing rigths to a "fair and equitable share of benefits to be easily attached to the germplasm distributed.

Report on plant genetic resources activities in Greece

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Introduction

Systematic germplasm collections started in Greece around 1923, a few years after the rediscovery of Mendel's laws and the foundation of scientific genetics and breeding. At that time all major crop breeding institutes (Cereal Institute, Cotton Institute, Institute of Fodder Crops etc.) of the country were established.

Successful utilisation of local and introduced germplasm collections led to the development of a series of modern varieties which made the country self-sufficient for a number of crops crucial to human and animal nutrition and industry (wheat and other cereals, fodder, pulses, vegetables, cotton etc.) as early as in 1957 and shortly afterwards to surplusses and exports.

However the early germplasm collections soon were lost for various reasons, most important being the limited scientific knowledge on the proper conditions for safe long-term seed storage and the total lack of appropriate storage facilities and equipment.

The modern era for Greece regarding genetic resources conservation began in 1981 with the establishment by the Ministry of Agriculture of the Greek Gene Bank in the Agricultural Research Centre of Makedonia and Thraki. This new establishment was amply supported in the first 5 years of its operation by UNDP, FAO, IBPGR and ECP/GR, for the construction and provision of the necessary facilities and equipment, for the training of its scientific staff and for carrying urgent germplasm rescue expeditions on priority crops.

Greek Gene Bank (GGB) constitutes today the scientific and administrative organ of the Ministry of Agriculture for the coordination and implementation of the national policies in the sector of Plant Genetic Resources. To this end it collaborates closely with all crop plant Institutes of the ministry and develops links with the major relevant University departments of the country. Recently contacts have been made with certain non-govermental organisations involved with closely related issues (protection of nature, environment etc. such as Goulandri Museum,WWF, etc.).

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Ex situ genetic resources conservation:

GGB safely conserves in its facilities seeds of approximately 7000 accessions belonging to 64 genera and 162 species of crop plants or economic plants in general that have "orthodox" seeds.

The collection is quite representative of the genetic diversity of the country as regards the germplasm of cereals, beets, tobacco, fodder crops and pulses, since these crops had received priority in the collections according to the mandate by FAO and IBPGR. On the other hand it is considered rather poor as regards wild and cultivated vegetables, medicinal and aromatic plants, ornamental plants etc.

At present, a first rough exploration of almost all the country has been completed. The plans for the immediate future put emphasis on the completion of the existing gaps of the collection (vegetables etc.) and on detailed explorations and germplasm collections in already identified areas of high species richness and germplasm diversity.

The collected germplasm is maintained in our Base Collection under conditions of long term storage (-20^o C temperature and waterproof seed packaging) as well as in our Active or working Collection under conditions of medium-term storage (O -5^o C temperature and 20-30% relative humidity of air).

Clonal material (Fruit trees, Grapevine) is maintained in field collections and so does most of the germplasm of medicinal and Aromatic Plants.

So, Pomology Institute in Naoussa has a field collection of 176 indigenous Prunus spp clones. Grapevine Institute in Athens maintains an almost complete collection of greek grapevine clones (567). The above grapevine collection is duplicated in the Agricultural Research Centre of Makedonia and Thraki, where a large field collection of Medicinal and Aromatic Plants also exists at its respective department.

Among the perspectives and priorities of the Greek Gene Bank are the development of a cryopreservation (preservation in liquid Nitrogen) and a tissue culture (preservation in minimum growth media) units for effective and efficient clonal germplasm storage.

In Situ and on Farm conservation

In situ protection and conservation of plant genetic resources is applied on a limited scale by the Institute of Forage Crops and Pulses and covers certain forage species.

GGB has identified, through its numerous explorations and collecting expeditions, certain areas rich in indigenous wild relatives of crop plants which merit particular care and protection.

Greece is extremely rich in such areas. The most interesting of them for Genetic Resources in situ conservation have been proposed for protective interventions and appear in Map 1 marked by circles.

a) The foothills near Mesti
 in Rodopi prefecture of Thraki region. Rich in cereal germplasm, progenitors of the cultivated wheat (Triticum boeoticum, Aegilops speltoides etc.).
b) The foothills near Anavra
 in Fthiotis prefecture, central Greece. Also rich in cereal germplasm (Triticum boeoticum, Haynaldia, Aegilops etc.).

c) The area of Kipourio

in Grevena prefecture of Makedonia region. Rich in Cereal germplasm (Triticum boeoticum, Aegilops spp, etc.).Certain species found there were unique and reported for the first time to occur in Greece.

d) The Aegean islands

(Limnos, Lesvos, Hios, Samos, Rodos etc.).Rich in germplasm of cereals, vegetables, industrial, medicinal,aromatic and ornamental plants (Triticum boeoticum, Hordeum spontaneum, Brassica spp, Aegilops spp, wild Legumes, Beta spp etc.).

e) The area of Mount Parnon

in Arkadia prefecture, Peloponnese region. Rich in gerplasm of cereals, vegetables and ornamental - medicinal plants.

f) The area of Mani

in Lakonia prefecture, Peloponnese region. Rich in germplasm of cereals and aromatic - medicinal plants.

g) The area of Omalos altiplane

and Samaria gorge in Grete. Rich in germplasm of Medicinal, Aromatic and Ornamental plants (Tulipa cretica, Crocus spp, Brassica species, espec. cretica, Sideritis spp, Origanum dictamnus etc.).

h) The area of Mount Aenos

in Cefallonia island, Ionian sea. Rich in indigenous flora, especially Beta spp, wild vegetables and cereals (Aegilops spp, Haynaldia spp), medicinal and ornamental plants.

i) The Gorge of Vikos

in Epirus region. Rich in spontaneous flora and in gerplasm of medicinal and aromatic plants.

j) The area of lake Prespa

in Florina prefecture of Makedonia Region. Rich in germplasm of forage crops and pulses.

k) The area of the Monastic State of Agio Oros (Holy Mountain).

It is the only area in Greece where nature has been left completely intact through the ages.It is among the richest areas of Greece in biodiversity and genetic resources. Also a large number of old greek landraces are still cultivated and preserved there.

l) The area of Mount Olympos

The holy mountain of ancient Greece is extremely rich in biodiversity and in germplasm of certain wild relatives of crop plants (Beta nana, Secale montanun etc.)

At the same time certain areas where traditional agricultural systems still survice, resisting the pressure of modern economy,were also identified. These areas where a significant number of old local varieties are still preserved, could be protected through a system of field conservation based on national or international support so that both the endangered local landraces and the associated traditional agricultural systems and landscapes are rescued from the imminent threat of extinction.

In these areas the protection of traditional systems and landraces could be further enhanced by combining it with parallel support schemes for ecological agriculture, given the strong affinity of ecological to traditional agriculture.

However this approach only a small part of the overall rescue and support scheme, which should aim at an intergrated protection of germplasm, cultural practices, landscape features and rural traditions and culture.

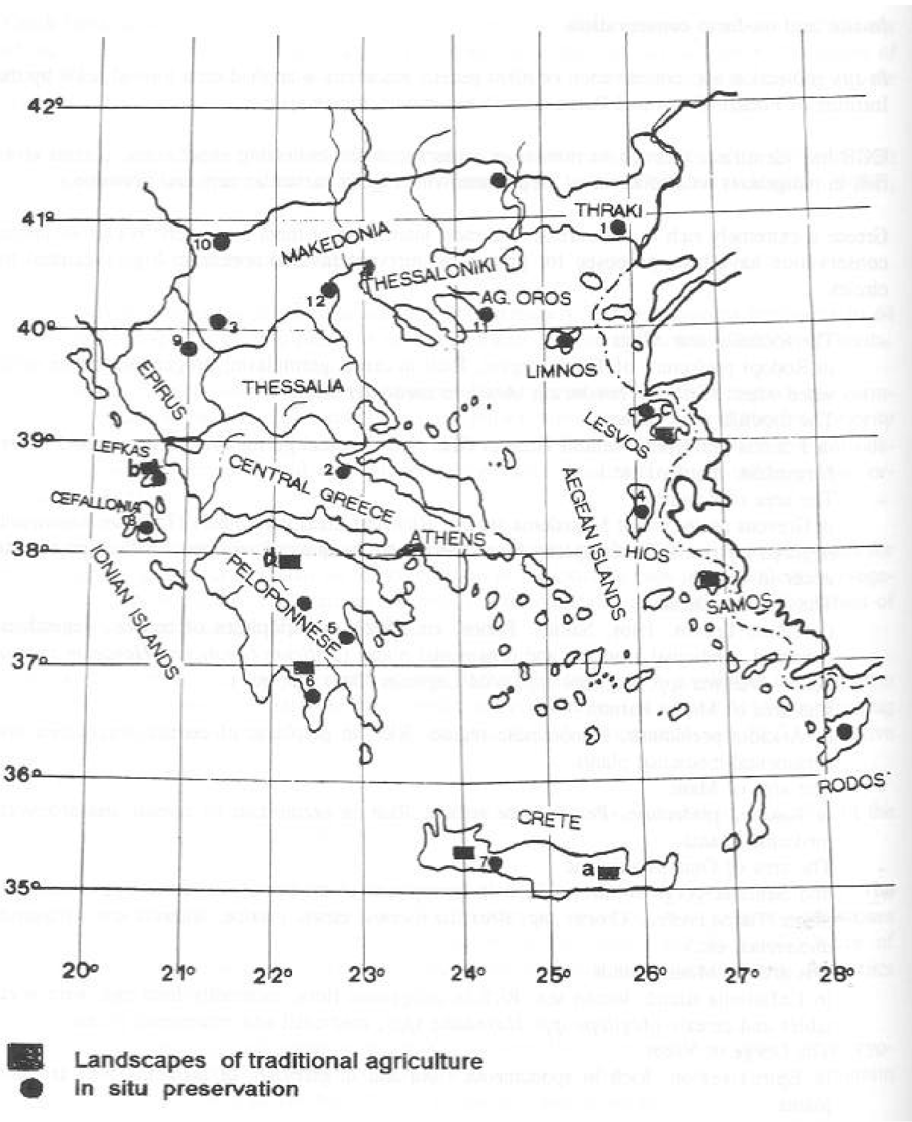

Fig. 1: **In-situ preservation areas and landscapes of traditional agriculture identified by Greek Gene Bank and proposed for protection**

Of the many places identified, the following merit special protection, having exceptional aesthetic, natural or cultural value and therefore should receive first priority.

The altiplane of Lassithi

An impressive agricultural landscape on Crete island. It is 4500 ha fertile plain situated at an altitude of 850 m above sea level. Traditional agriculture based on diverse local germplasm is practiced in a spectacular landscape of 1200 wind mills used to pump irrigation water for the crops. The area is mainly devoted to potato cultivation, but many other crops, i.e vegetables, cereals, are also grown.

The altiplane of Englouvi, in Lefkas island of the Ionian see.

It is a 300 Ha fertile plain cultivated with traditional cereal (wheat, barley,rye) and legume (principally lentil) landraces. Agriculture is practiced under harsh traditional labor intensive conditions.

The Aegean islands (Limnos,Lesvos,Samos etc.).
Characterised by their poor agricultural landscapes, cultivated with cereal landraces. These landraces give good yields despite of drought and warm winds, being tall and providing straw for the livestock and bearing awns to resist the attacks of migrating birds, of high quality and good adaptation to low-input ecological farming.

The Kalavryta area
of Ahaia prefecture of Peloponnese region, a mountainous area of approx. 1000 m. altitude, where landraces of cereals and pulses are still cultivated over large areas under traditional cultural systems.

Some of the promising landcapes proposed for protective interventions appear on Map 1 marked with a square.

Other activities

All information related to the conserved germplasm is recorded on a computerised Data Base of the Greek Gene Bank.

GGB carries out germplasm regeneration, multiplication, characterisation, evaluation and pre-breeding on a limited number of wild and cultivated species (cereals, vegetables, pulses etc.).
It also provides student training in these activities.

Finally, GGB collaborates with FAO,IBPGR,ECP/GR , EEC and other international bodies involved in genetic resources work. It also maintains links with other european Gene Banks in the framework of bilateral technical and scientific collaboration programmes.

At the same time several crop breeding institutes and University departments of the country undertake relevant activities on their breeding stocks, which eventually are handed over to GGB for long-term conservation.

Utilisation

Greek Gene Bank collaborates closely with all breeding institutes and relevant University departments of the country and make available to them all conserved material for scientific purposes.

As regards international collaboration, the maintained germplasm and the relevant information are freely accessible upon request for scientific purposes by all international institutes, on a mutual ***bona fide*** Basis under the rules elaborated by FAO, IBPGR and other International organisations (International Undertaking, Code of Conduct of Gene Banks etc.) to which Greece actively participates.

However, because of budget limitations , many accessions have not been properly regenerated, multiplied or further characterised and evaluated. Therefore,large part of the whole conserved genetic potential is still today inaccessible or unknown to breeders.

Despite the above shortcomings, worth-mentioning germplasm use is being made today by the main breeding institutes of the ministry of Agriculture, in particular by the Institutes of Cereals, Cotton, Fodder Crops and Pulses, Grapevine, Deciduous Fruit Trees, the Sugar Industry and the department of Medicinal and Aromatic Plants.

Legal Framework-National Programme.

Presidential Decree No 80/1990 provides the legal framework for the establishment of a National System for Plant Genetic Resources under aegis of the Ministry of Agriculture (Directorates of Research and Environmental Protection). Greek Gene Bank is the scientific and administrative organ for the implementation of this programme.

However, the National System on PGR has not been put into effect until now, because the introduction of the specific legislation coincided with a period of drastic reform and reorganisation of the agricultural research at the ministry of Agriculture and its transfer from the public to the private sector. The agricultural research of the ministry was assigned to a new scientific body, the National Agricultural Research Foundation (N.AG.RE.F.), which replaced and assumed the responsibilities and authorities of the Directorate of Research.

The legal, financial and administrative gaps and malfunctions that resulted from this change of legal framework delayed significantly the launch of the National Programme. At this time, though, there is a valid expectation that the outstanding problems will be soon solved and that harmonious collaboration will be eventially established between the public (Ministry of Agriculture) and private (NAGREF) sector as well as with other legal entities (Universities, Organisations of Environmental Protection,Botanical Gardens, Natural Museums etc.) that can potentially contribute to the protection, study and utilisation of the countries genetic resources.

Perspectives

Until recently the only active specific international body on plant genetic resources in Europe was the European Cooperative Programme on Plant Genetic Resources (ECP/GR), operating under the aegis of IBPGR and FAO. This organisation had however very limited budget, therefore its contribution was purposedly directed to low cost - though catalytic- activities ,such as the establishment of working groups and the organisation of scientific meetings aiming at promoting the scientific collaboration within Europe, the relatively low-cost germplasm documentation and the creation of general and specific Data Bases, and finally- and above all- the encourangment of initiatives for establishment of National Programmes in the respective European countries.

Recently certain non-governmental organisations (NGO'S) have been actively involved in this sector, contributing significantly to raising awareness and public interest on the issue.

However the most decisive step in this field is currently being made by EEC with the introduction of a specific Programme for Protection of Genetic Resources in the respective countries. Through this programme substantial funds are allocated to this end for the first time and they are expected to support relevant activities both within EEC as well as over all europe, through the enhanced scientific collaboration programmes of European Community with those countries.

This programme is expected lo allocate funds for the improvement and completion of the existing laboratories and storage facilities at national gene banks or other competent institutes and for speeding up evaluation and utilisation rate of untapped genetic potential of gene banks through the implementation of the advanced new biotechnologies currently available.

Another significant evolution in the european zone is the initiation for the first time of programmes for the protection of Forest and of Animal Genetic Resources, where genetic erosion over the last 50 years has been most dramatic. These approaches lead towards a more integrated conservation of the agricultural and natural ecosystems in Europe.

In conclusion Greece plans to support through its national programme or international collaboration schemes (EEC, FAO, IBPGR, ECP/GR, SIGMA N, etc) activities on germplasm collection, in situ conservation (primarily in National Parks and other protected areas, potentially in archeological sites and at a later stage in areas with high species richness), field conservation of endangered landraces, characterisation, evaluation, regeneration- multiplication,documentation, pre-breeding and utilisation.

Priority will be given to wild and cultivated cereals, fodder crops and pulses, industrial plants (beets, cotton, tobbacco), vegetables, aromatic,medicinal and ornamental plants, grapevine and fruit crops.

European Cooperation on Plant Genetic Resources: Towards Phase V of ECP/GR

E.A. FRISON, M. BOLTON[1]

The European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) is a pan-European collaborative programme with the aim of fostering coordinated activities in the plant genetic resources field; at the end of 1992 28 countries were participating. The Programme grew out of the 1975 Helsinki conference on Security and Cooperation in Europe and began operating in 1980 as a regional joint UNDP/FAO project with the name "European Cooperative Programme for the Conservation and Exchange of Crop Genetic Resources". Under Phase II of the Programme, which began in 1983, coordination was provided by IBPGR, as a special project, and this coordinating role continued throughout the subsequent phases III and IV, with the costs of the Programme being borne entirely by participating countries.

At the end of Phase I an evaluation mission recommended that the programme be organised around a number of crop-specific working groups, with members selected for their expertise in the particular species. Consequently groups were established for the following crops: *Allium*, *Avena*, barley, forages, *Prunus* and sunflower. At the end of the second and third phases a number of other crops were considered for inclusion in the programme. Beet, *Brassica, Pisum* and *Vitis* were recommended for *ad hoc* action during Phase III and the implementation of working groups for *Brassica, Pisum* and *Vitis* was recommended for Phase IV, an international network for *Beta* having already been established outside the framework of the ECP/GR.

Phase IV, which began in 1990, was primarily a continuation of previous work, based on workplans elaborated in Phase III. During the phase two of the 24 crop-specific databases created through the ECP/GR were transferred to new hosts: the *Prunus* database from the Nordic Genebank to INRA, Bordeaux, and the cultivated *Brassica* database from IHAR, Poland to CGN, Wageningen. The successful conclusion of both moves is an illustration of the high level of cooperation achieved within the ECP/GR. All the working groups were able to meet once; in addition a new working group was established for *Brassica* and contacts have been made to initiate a *Pisum* working group in early 1994. Phase IV was formally concluded at the end of 1992 but many parties, including all the working groups, had stressed the need for a continued coordination mechanism and consideration was therefore given to implementing a fifth phase.

Among the achievements of the ECP/GR to date are the following:

- European Databases

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Crop databases for some 24 species, groups of species or genera have been implemented, located in 13 countries. These have grown steadily through the different phases and for the most part are now considered very comprehensive in their coverage of European institutes' holdings. Some, such as those for wild and cultivated sunflower, have also included data from collections outside Europe.

The European databases have started to demonstrate that they can be a powerful, and indeed vital, tool for the efficient interactive management of collections. One important task for which a central database is indispensable is the identification of unduplicated unique accessions, that is those which are only held in a single collection. Curators have a particular responsibility in preserving such material and for arranging its safety duplication as a priority.

More importantly, however, the databases are essential to make germplasm and its related information available to users, either by means of printed catalogues or, increasingly, through direct access and searching of copies of the database files. All the databases contain passport data and to an increasing degree are including characterisation and evaluation data as well. Rationalisation of collections through the identification of "redundant" duplicates is another area where databases can be useful - for example the *Avena* database has estimated that about 48% of the named accessions in its files are duplicates, although at least some of these represent safety duplication.

Whilst database development has perhaps been the most striking advance it should not be allowed to overshadow significant developments in other areas:

- Coordinated collecting activities for filling gaps identified by working groups

The working group meetings have been important channels for the exchange of information on collecting plans and for the identification of regions under-represented in existing collections. Collecting missions for wild *Avena* species, for *Brassica* species and for forages, in particular, have been undertaken as collaborative ventures and much other collecting has been done at national level.

- Developing descriptor lists and priority descriptors for characterisation and evaluation

From the start the working groups have been aware of the need to record and make available characterisation and evaluation data in order to increase the usefulness of collections; much effort has been put into standardising the descriptors in use and identifying recommended sets of priority descriptors. Descriptor lists for sunflower, several *Prunus* species and *Avena* have been prepared and published with input from working group members.

- Selection of standard reference varieties

The Sunflower, *Prunus* and Forage working groups have identified common standard varieties to allow meaningful comparison of the results of evaluation trials from different locations. Efforts have also been made to multiply these reference varieties so that there is sufficient stock to meet requests.

- Establishment of core collections

A major achievement of the barley working group has been the development of a precise concept of a core collection. This initiative has been extended to the world barley collection in the framework of the International Barley Genetic Resources Network and the establishment of the barley core collection is making good progress. The forage working group has initiated the establishment of a core collection for *Lolium perenne* and plans to extend this initiative to other forage species. The *Avena* working group also decided to initiate the establishment of an *Avena* core collection based on the concept developed by the barley working group.

- Development of national programmes

The ECP/GR has played an important role in accelerating the development of national programmes in several countries through its efforts in raising awareness at Government level of the importance of plant genetic resources and through the bilateral and multilateral cooperation fostered as a result of working group and TCC meetings.

- Improved flow of information and germplasm

The development of databases and the increased characterisation and evaluation of collections, both major activities of the various working groups, have helped to improve the flow of both information and germplasm, in agreement with the principle of free availability. For example, the files of the European *Allium* database have increasingly been used for data screening, particularly in countries with active breeding programmes. Other working groups have also reported increased exchanges of information and material.

- Development of an International Beta Genetic Resources Network.

The European Beta working group of ECP/GR became an international network after Egypt, India, Iran, Japan and USA joined the group. The International Beta database is managed by the Institute of Crop Sciences and Plant Breeding, Braunschweig, Germany.

- *In situ* conservation

The development of proposals in this area has not been a priority for the working groups, however some actions have been undertaken. The *Allium* working group's latest workplan calls for ecogeographic surveys to be undertaken in Central Asia and west Siberia with the aim of *in situ* preservation of wild *Allium* species. Whilst a lack of funding and the local political situation have prevented any detailed survey work, some progress has been made on the production of distribution maps for various taxa. The forages working group has discussed *in situ* conservation at its last two meetings and is keen to participate in practical conservation projects. The group has noted the existence of studies on *Lolium perenne* in Germany and of a natural meadows and pastures conservation project in Sweden. The *Prunus* group has noted that surveys of wild cherry and plum have been conducted in a number of countries and recognises the need for such surveys to be extended and the information collated.

Towards Phase V

Development of crop databases - one of the main activities of Phases I-IV of the ECP/GR - essentially requires only the input of staff time, the cost of postage and diskettes being quite minor elements. Given a willingness to exchange data it is thus a relatively easy first step in cooperation and one which serves to unite collaborators and provide a focus; it can also be done 'at a distance'.

Nevertheless, and despite the significant achievements to date, there are still some important gaps in the databases' coverage; for example data from Russia and other newly-independent states have yet to be incorporated in most databases.

On the other hand, other important, long-term, collaborative activities - such as the rationalisation of collections, the enhancement of wild species, pilot studies for *in situ* conservation - are more complex, costly, and require more face-to-face planning. The working groups have made suggestions and proposals in these areas but in several instances the plans have not yet been realised. The ECP/GR has always been a coordinating mechanism with the actual work taking place within the countries themselves, with their own funding, and the relative lack of progress in some areas can therefore be partly attributed to scarcity of funds and also perhaps partly to a lack of real commitment from countries to the programme.

Such activities are important for the better conservation and use of plant genetic resources in Europe and it was felt that a key element of a fifth Phase would be the elaboration of projects in these areas and the search for donors to fund them.

In addition the political and economic changes in eastern Europe are putting at risk valuable collections of germplasm. An FAO/IBPGR mission in 1992 surveyed the security of collections in six countries and found that most programmes were experiencing serious difficulties as a result of drastic budget and staff cuts. Recommendations were sent to Governments of the countries visited to raise awareness of the problem and to try to increase their commitment to maintain the collections, and a special activity account has been opened at the CGIAR Secretariat to receive funds from various donors, for which IBPGR was requested to be the executing agency.

The collaborative links forged through the ECP/GR are an important safeguard for protecting these threatened materials and related research; the working groups are invaluable partners for IBPGR in its monitoring task as they serve as an effective early warning system for threats to particular collections and work programmes (as in the case of the *Allium* field genebank at Olomouc, Czech Republic). In addition, the authoritative voices of working groups aid IBPGR in its search for support for eastern European collections.

The ECP/GR, over the course of its first four phases, has greatly stimulated awareness among European nations of the benefits of collaborative activities on genetic resources. At the same time there has been a growing public realization of the need to take action in combatting the global loss of biodiversity. It is essential that this public awareness is maintained and developed in order to ensure wide recognition of the vital role that plant genetic resources play as a fundamental component of biodiversity. This will be a crucial factor in ensuring continued support for plant genetic resources activities.

Recently the European Community (EC) has proposed implementing a programme on the conservation, characterization and utilization of genetic resources in agriculture. This would involve action on characterisation and evaluation of existing collections, help for documentation activities and could include measures to encourage the wider use of material in collections. Pure research projects would be excluded. The proposed programme is broad in scope and general in nature, whilst the ECP/GR is essentially a coordinating mechanism focussed on specific crops, operating through expert working groups; the two programmes are therefore complementary. Indeed the working groups are ideal platforms for identifying priorities and developing proposals which could be submitted for funding to the EC programme; the proposals would cover joint activities among EC member countries but, at the same time, close links would still be maintained with activities in countries outside the EC.

With these considerations in mind a meeting in Bulgaria in August 1993 of the Technical Consultative Committee (TCC) - the body, composed of National Coordinators, which oversees the Programme - agreed unanimously on the need to continue the programme into a fifth phase. In view of the implementation of Agenda 21, the TCC also urged national governments to recognise that plant genetic resources are the most directly useful component of biodiversity and that resources allocated to the conservation of biodiversity should reflect this fact.

Operation of the ECP/GR in Phase V

Following a recommendation of the fourth meeting of the Technical Consultative Committee, held in 1989, the input of the IBPGR coordinator was reduced from full time in Phase III to one quarter time in Phase IV; with an enlarged programme this inevitably led to a less proactive approach. Whilst it was possible to keep members appraised of developments and to coordinate input to the various meetings it was not feasible to take the initiative in programme development. Nor was it possible to give as full a response as might have been desirable to working groups' suggestions and recommendations or to ensure all the follow-up necessary. The 1993 TCC meeting considered it essential that a full-time coordinator be appointed by IBPGR to serve the needs of working groups and maintain the necessary level of contact with national institutes and coordinators, and with the relevant ministries.

The TCC meeting formulated the following general objectives for Phase V:

- to ensure the long term conservation and to facilitate and encourage the increased utilisation of plant genetic resources in Europe;
- to increase the planning of joint activities;
- to develop joint project proposals to be submitted for funding to the EC and other programmes;
- to strengthen links between eastern and western European plant genetic resources programmes;
- to contribute to monitoring the safety of plant genetic resources collections and take appropriate action when required;
- to increase public awareness at all levels of the importance of plant genetic resources activities.

Operating through short phases of only 2-3 years duration has meant that there is relatively little time for working group activities to progress before questions arise concerning the programme's continuation. There is also little opportunity for the TCC to get feedback from the working groups, particularly from those that meet after the TCC. For this reason the meeting agreed that Phase V should be planned to last for five years, covering the period 1994-98. This would permit both a meeting of country coordinators in late 1995, at which they would be able to discuss the scope of the working groups and to address a number of key issues of relevance to the Programme, and also a TCC meeting towards the end of the phase in 1998 to review its operation.

Role of working groups

The concept of working groups has been found successful because it promotes direct contact between scientists actually working with the genetic resources, rather than general discussion at inter-governmental level. Besides the existing working groups consideration could be given to inclusion of other crops: those assessed during previous phases include *Citrus*, cotton, *Lupinus*, maize, olive, *Phaseolus*, potato, *Secale*, tobacco, *Vicia faba, Vitis*, wheat; a proposal has also been made to establish a flax working group. Other potential crops include *Daucus*, *Lactuca*, and *Malus*. Further cooperation with other networks such as those of FAO should be strengthened and consideration will be given to the possible broadening of some working groups to cover several similar crops such as small grain cereals and grain legumes. In each working group, one or several lead institutes take on the responsibility to develop and maintain the European database for a species or group of species as a contribution in kind to the programme.

An important role for the European databases and working group members will be to ensure that concrete steps are taken to increase the use of germplasm in collections. A key function of the databases is to analyse the data they contain so that working groups can take the necessary action to ensure that all unique accessions are duplicated, that primary responsibility for regeneration and long-term conservation is assigned to individual genebanks, and that measures are taken to reduce redundant duplication.

Although the working groups recognise that they may lack specific expertise in *in situ* conservation, nevertheless the members' broad knowledge of crop genepools represents an invaluable resource that can be drawn on in the formulation of integrated conservation strategies for particular species and groups of species.

Role of Country Coordinators

The Country Coordinators will continue to represent the ECP/GR to sponsoring Ministries and also act as a liaison point between IBPGR, Ministries and participating institutes. An important task is to maintain close contact with working group Chairmen or members to monitor progress and identify potential problems with databases and collections.

It is the responsibility of the Country Coordinators to obtain the necessary government commitment to the programme in general and more particularly to ensure that the required support is provided to institutes to allow them to make the contributions in kind (maintenance of databases, maintenance of collections, collecting, etc.) which are the basis of the success of the programme.

Role of IBPGR

As mentioned previously, it has been found that an input of one quarter of the time of the network coordinator was insufficient. A full time coordinator would allow the secretariat to better respond to the requests of working groups and would allow increased activity in terms of:

- support to the working groups and closer interaction with them between meetings to ensure that the planned activities are kept to schedule
- technical support to national programmes
- information gathering and distribution
- ensuring full complementarity with other initiatives, especially that of the EC.
- assisting in formulation of proposals for joint activities and in identifying partners
- searching for donors to support particular elements of workplans, especially for eastern European countries
- linking with other regions
- contributing to raising public awareness of the importance of PGR conservation.

The "informal sector"

It is now widely recognized that research institutes, universities and other organizations, often referred to as the "formal sector", are not the only ones playing an important role in the conservation and use of plant genetic resources. In many countries, associations, NGOs and private initiatives can contribute significantly to the overall plant genetic resources effort. The ECP/GR could usefully explore the practical means by which the best complementarity of both formal and informal sectors can be ensured and could investigate possible areas and mechanisms of collaboration. Working groups are felt to be the most appropriate fora to explore means to collaborate with both NGOs and the private sector.

Letters inviting Governments to participate in Phase V were sent out by IBPGR in September 1993 and, to date, positive replies have already been received from about half of the countries, and several others have indicated that a positive response can be expected soon.

Genetic resources in Europe

D. DESSYLAS[1]

1. Background

The Community now has totally reformed its Agricultural Policy, and adapted it to new conditions. The new policy continues to uphold the basic principles of the Rome Treaty, of the unity of the market, Community preference, and financial solidarity. It introduces important changes in market mechanisms for individual products. And it establishes a series of flanking measures, aimed at encouraging farmers to use less intensive methods and to take on a more explicit role in the conservation and management of the countryside.

Take, for example, the particular case of cereals. The target and the intervention prices for cereals. The target and the intervention prices for cereals will be reduced progressively over the next three years. These reductions will be offset by compensatory payments - provided that 15% of the farmed area is withdrawn from production (this applies to the larger producers). The aid scheme (*Council Regulation No 2078/92*) establishes a series of premiums for, for example, rearing endangered breeds of livestock and for the cultivation and propagaton of useful plants adapted to local conditions and threatened by genetic erosion.

The reform of the Common Agricultural Policy, more market-oriented, with lower intervention prices, with set-aside, quotas, and other regulations, establishes new constraints and new incentives for Community agriculture. Agriculture has in the past proved itself very responsive to policy requirements, and that one of its principle means of response was provided by its suppliers, such as plant and animal breeders. What are the implications of the reform of the CAP, and of other policy developments, such as the Treaty of Maastricht, for the future conservation, characterisation and exploitation of the genetic resources in Europe?

2. Genetic Resources

When policy called for higher levels of production the breeders gave farmers what they needed. Now we need a decreased reliance on chemical inputs and an increased quality of the end-product. There is every reason to believe that we can breed for these characters too. But genetic change requires sources of the appropriate genetic characters. Collection of germplasms exist, both *in-situ* and *ex-situ*; but keepers of germ plasm collections report that much of their stored material is under-characterised, for lack of funds and personnel.

Genetic resources are a truly international resource, extending from country to country across national borders. European collectors have gone across the world in search of germplasm for our farms and gardens. By the same token, collectors have come to Europe in search of germplasm; for example, an

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Australian collecting mission has been established in France for many years, collecting potential agents for biological control on Australian farms. These efforts have given rise to important national, and international, collections of stored material.

The first germplasm collections were set up by scientists interested in the study of genetic diversity. The collections soon took on a second role, of conserving material that is threatened with extinction in its native habitat. The argument was that such germplasm is irreplaceable - at least in the form of an integrated genome, and accompanying cytoplasm. It is a natural resource, and there is much evidence that the resource is disappearing.

Since the start of the first scientific research on the origin and extent of genetic diversity, scientists have made informal working contacts across national borders. As the number of workers increased, various international secretariats have been set up, to establish standards and to help coordination of effort in germplasm collections. Important efforts in these areas have been and are made by, for example - the Food and Agriculture Organisation, Rome; the International Board of Plant Genetic Resources, Rome; the European Asssociation for Animal Production; the World Council for Nature and the Botanical Gardens Conservation Secretariat; the United Nations Environment Programme. The early workers would be amazed to see how far their subject has advanced. Indeed genetic diversity, and genetic erosion, have become important subjects of political debate; see, for example the *Convention on Biological Diversity*, signed by the Community and by its Member States on June 9 1992 at the United Nations Conference on Environment and Development, in Rio de Janeiro. The subject has been debated in European forums for more longer; see the European Parliament's *Resolution of the genetic diversity of cultivated plants*, of 20 February 1986, and the discussion in the Council of Agricultural Ministers on the conservation and utilization of plant genetic resources, on 26-27 March 1990.

3. The Proposed New Regulation

In 1992 the Commission made a report to the Council on the conservation and utilization of plant genetic resources (*SEC(92) 874 final of May 1992*). The report lists a wide range of actions already taken by the Commission, in various programmes of scientific research and technological development. It also lists various problems that had become apparent during these programmes. The report that there was a certain overlapping of programmes between the Member States, with a duplication of effort and of conserved material. There was also a tendency to put material into store without information on the detailed characters that are of interest to potential users. Almost all collections report that they need more facilities and staff simply to finish the job of characterising the material already in store.

There is thus a need for action. The principle of subsidiarity in the Maastricht Treaty lays down that responibility for action at national level lies primarily with national authorities. Much of the effort in germplasm resources lies in this category. But there is also a need for action at Community level, in order to coordinate the existing efforts, to fill gaps, and to improve the efficiency of the work. These are the objectives of our proposed new Regulation, currently under discussion in the Council of Ministers and in the Parliament.

The proposed Regulation would lay the basis for a five year programme, complementary to the work already being undertaken in the Member States. The Programme would be oriented exclusively towards practical actions; scientific research, and technological development, are excluded (these are in principle already covered by the Community Framework Research Programmes). The programme would aim to help the routine tasks of conservation, characterisation and utilisation: provided that they be undertaken on a Community basis (the support of individual collections is a matter for the individual Member States). The work programme has been written in such a way that each project will follow a logical pathway.

Step 1 Establish a Conservation and Documentation workplan.

Step 2 Characterize the various collections which make part of the project, and assemble the passport data.

Step 3 Evaluate other characteristics; in particular, run screening tests.

Step 4 Sort the collections; identify duplicates and gaps.

Step 5 Harmonise and rationalise the collections.

Step 6 Acquire and collect missing germplasm.

At the same time, each project will include practical work on the evaluation and utilisation of stored material. We hope that at the end of five years, there will be concrete results in the form of a better knowledge of what is available in the European collections, and a better utilisation of that material, to the benefits of European agriculture, the consumer and the environment.

Man and the Biosphere (MAB)
A Global Programme for the Environment: Biosphere Reserves a National and International Contribution to Support Sustainable Development

W. GOERKE[1], K.-H. ERDMANN[2]

1. Biospere Reserves - Component of the MAB Programme

In 1970, the 16th UNESCO General Conference adopted the interdisciplinary and problem-oriented programme "Man and the Biosphere" (MAB); MAB is directed to improve the partnership of humankind and environment. It is therefore the task of the programme to overcome scientific deficits for facilitating more environmentally compatible uses or sustainable protection of natural resources. This requires a systematic approach which comprises natural scientific, economic, social, ethical and cultural aspects.

The German National Committee for the MAB programme was founded in 1972. The chairmanship falls into the responsibility of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. The 43 members represent different scientific disciplines, Federal and State Ministries, the Association of National Research Centers, the German Commission for UNESCO, and the German Research Council (Deutsche Forschungsgemeinschaft, DFG). The tasks of the National Committee are the following:

- Advising of the Federal Government in the area of UNESCO-MAB policy
- Identification of new MAB relevant areas of cooperation
- Scientific and operational assistance of the worldwide MAB programme
- Implementation of national projects and studies
- Realization of MAB-symposia or workshops
- Promoting the MAB-philosophy by public relation

The affairs of the National Committee are conducted by a secretariat which consists out of four persons. The secretariate is located at the Federal Agency for Nature Conservation (Bundesamt für Naturschutz, BfN).

In the founding phase of the MAB programme, UNESCO determined project areas for the coordination of the Programme. In this context, a special position is held by the 8th project area the aim of which is the "Conservation of natural areas and of the genetic material they contain"

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(MAB 8). As early as at the first meeting of the MAB Coordinating Council (ICC) which has held from 9 to 19 November 1971 in Paris, the future work was specified for the first time and the term biosphere reserves was defined for those natural areas to be designated by UNESCO to have available a global network for developing protection and sustainable land use on a practicle and long term basis (cf. UNESCO 1972).

Biosphere reserves are spacious, protected, internationally recognised areas connected to a global UNESCO network which are of paramount importance for nature conservation and sustainable development. Biosphere reserves represent certain natural areas defined in terms of biogeography. They are graded on the basis of interference by human activities, constituting different zones: one or several minimally disturbed core areas, one or several buffer zones and the surrounding transition zone (UNESCO 1984).

Ever since the first biosphere reserves were recognised in 1976, they have become the key element of the MAB programme and today, they are an important component of international environmental protection, nature conservation and development of sustainable land uses. At present, the international network comprises 311 biosphere reserves in 80 countries.

2. Zoning of Biosphere Reserves

Biosphere reserves have various functions (cf. Chapter 3). In order to meet these different requirements, a differentiated zoning concept has been developed for them which comprises three graded zones depending on the intensity of human interference (cf. ERDMANN & NAUBER 1990; ERDMANN 1991).

2.1 Core Area

Each biosphere reserve has at least one core area of particular protection in which human disturbance is to be minimized to the maximum extend. The protection of these natural and/or minimally disturbed nature-like ecosystem is of paramount priority. Research activities are only allowed to the extent that they do not interfere with the ecosystem. Examination of structure and function are to be conducted in the core area. However, this requires that the core has the adequate size in order to be able to identify long-term developments and trends in the composition of the natural balance.

2.2 Buffer Zone

The concept of biosphere reserves determines that the core area is to be surrounded by a buffer zone which protects its from adverse effects. Interferences with the natural balance of the buffer zone are only allowed if they are compatible with the protection of the core area(s). A deliberate change of the ecosystmes, e.g. for scientific purposes is only allowed if implications on the core area can be excluded. Moreover, the development of tourist activities is to be geared towards the protection criteria for the core area. Core area and buffer zone often constitute one administrative unit (e.g. a national park).

2.3 Transition Zone

Core and buffer are surrounded by a transition zone which is primarily determined by human activity. The concept aims at preservation and/or further development of primarily traditional land use systems according to the potential of the relevant area. In devastated areas, the focus of measures is recultivation. Special attention is given to the traditional cultivation methods of the indigenous population. Due to the cultivation of biosphere reserves sometimes lasting for centuries, cultural landscapes (managed) have evolved as a result of the various uses. Due to their enormous biodiversity in general they belong to the ecologically most precious regions of the world. In these areas possible solutions can be achived only in cooperation among administrations, regional population, scientists and private enterprises to optimise land use and preserve natural resources at the same time. The target is development and implementation of sustainable management which meets needs of man and nature at the same time. These managed areas which are primarily used traditionally have a significant aesthetic value. This aspect is of great importance for the development of tourist industries. The promotion of "soft" tourism which contributes to the conservation of the environment and nature is of great importance.

3. Purpose of Biosphere Reserves

In 1983, the USSR hosted the "First International Congress on Biosphere Reserves" in Minsk. UNESCO organised together with UNEP and the participation of FAO and IUCN the meeting. The consultations resulted the "International Action Plan for Biosphere Reserves" (UNESCO 1984). It calls upon the participating countries and international organisations to initiate concrete steps

- to improve and expand the global network of biosphere reserves,
- to support the compilation of basic knowledge on measures to protect ecosystems, biodiversity and genetic ressources and
- to use biosphere reserves as instruments to protect and/or develop landscapes.

3.1 Protection of ecosystems, biodiversity and genetic ressources

There seems to be general agreement that it will be impossible to preserve the entire diversity of organisms and ecosystems globally and forever. However this shall be achieved in a basic number of ecosystems designated as biosphere reserves. The concept of a biosphere reserve is that of an open protected system. It provides for areas of undisturbed natural and/or natural-like ecosystems to be surrounded by areas determined by human activities. The latter are to be managed in such a way that they fullfill long-term conservation of these ecosystems. In this context, the term "reserve" stands for an ecologically representative landscape in which measures for total protection extensive or intensive but sustainable use are being combined. This graded zoning of the landscape makes it possible to take account of the individual regional circumstances into the concept of the individual biosphere reserve.

Each biosphere reserve represents a majority of the indigenous fauna and flora; hence, they represent an important reservoir of genetic material. These resources are becoming increasingly useful for the development of new medical drugs, industrial chemicals, construction materials, food and other products that might contribute to increasing human well-beeing. Moreover, they serve as a pool of genetic material for the repatriation of indigenous species in those areas where they had already become extinct.

This way, biosphere reserves contribute to improving the stability and diversity of regional ecosystems of global or regional importance.

3.2 Development and Land Use

A major aspect of the biosphere reserve concept is, if necessary the development of new land use systems or reintroduction of uses passed on from one generation to the next. They illustrate the traditional connection between the indigenous population and surrounding environment. These systems often reflect centuries-old human experience of handling nature and the environment. They often provide valuable information for rational further development of land uses. The partnership of
regional population, administrations, scientists and private enterprises accellerates the application of new scientific and technological knowledge to reach a sustainable basis for the existence of man and nature without destroying social traditions with their ruling values.

3.3 Environmental Research and Monitoring

Due to the conservation of ecosystems - including areas of human use - biosphere reserves provide ideal sites for monitoring changes. Biosphere reserves are suitable areas for studies in particular in the fields of ecosystem research - stucture and function - through an ecological monitoring. Since these areas are partly subject to unlimited protection, long-term research projects can be conducted there in a unique way. The collection of data in geographical information systems (GIS) - which are sited at the administrations of biosphere reserves - provided the basis for safeguarding large and continuously increasing quantities of data and making them accessible for interested parties. Due to the inter- and intra-specific complexity of the ecological issues, only long-term research an observation programmes allow to detect the kind of data that meet the information demand of the regional population, management, administration and science at the same time.

The incorporation into the international biosphere reserve network provides a basis for implementing the global "ecological environmental monitoring". This requires a harmonized and coordinated continuation of national and regional ecological monitoring endeavours as well as the technical improvement of more efficient DP-systems. Standardisation, scaling and sharing environmental data and the issues concerning the establishment of a coordinating central body will be a task of the near future.

In other concept of protected areas - such as e.g. national parks, nature parks - research and observation is regarded as a secondary objective and it serves primarily the collection of direct information on the issues that are associated with the objectives of protection.

Entering the field of sustainable development in practice one has to confess that new - mostly unknown - horizones have to be reached. The only way to do this scientificly sound is through research programmes which are appropriatly considering the diversity of parameters governing the relations of man and the biosphere. Biosphere Reserves are ideal sites to conduct those nessessary interdisciplinary studies which must cover the sciences and humanities. Their aim is to develop models for measures to improve the protection of ecosystems, biodiversity and genetic ressources within wide regions and to find avenues for the implementation of sustainable rational land use procedures.

3.4 Training and Environmental Education

Biosphere reserves are predestinated to supply practice-oriented training of administrative personel, staff working in protected areas, visitors, local populations and scientists. The specific content of programmes have to consider possibilities as well as needs of the individual biosphere reserves and their surrounding area with their specific conditions. Activities focus on: scientific and technical training; environmental education; practical demonstration; information of the local population. The inclusion of anthropologists, behaviourists, educationalists and psychologists in the working programmes will be imperative.

4. Biosphere reserves in Germany - national contributiones to an international programme

Germany has been involved in the development of the international biosphere reserve network since 1979 (cf. illustrations 1 and 2).

<u>Illustration 1:</u> Biosphere Reserves in Germany (01. January 1994)
<u>Illustration 2:</u> Biosphere Reserves in the Federal Republic of Germany (01. January 1994)

The German biosphere reserve network now comprises 12 areas with an overall surface of 11,589 km2 (01. January 1994) which amounts to 3,3% of Germany's total surface. The national committee for the MAB programme has installed a "Standing Working Group on Biosphere Reserves in Germany" to

- prepare a national action plan ("Guidelines for the Protection, Management and Development of Biosphere Reserves in Germany"),
- harmonize development plans,
- concert management plans,
- exchange experiences,
- develop and produce harmonized data basis,
- outline a national contribution to the international network of biosphere reserves (e.g. global ecological monitoring)
- promote cooperation within the UN-Euro-Region (EURO-MAB),
- organize and make use of an exchange of experiences and information gained in the global network

The German MAB national committee established a panel for developing criteria for evaluating biosphere reserves in Germany.

The German MAB-secretariat is assisting the relevant authorities in negotiations for the establishment of transboundary biosphere reserves, e.g.:

- Wadden Sea (Netherlands, Germany [Lower Saxony, Hamburg, Schleswig-Holstein], Danmark),
- Bohemian-Bavarian Forest (Czech Republic, Germany),
- Vosges du Nord-Palatine Forest (France, Germany).

4.1 Wadden Sea of Lower Saxony

The Wadden Sea of the North Sea shore is one of the most populated ecosystems on earth. Its extention is unique. Apart from the Alps it is the last large natural area in Central Europe. The Wadden Sea encompasses many diverse habitats: permanently subtidal channels, salt marshes and different dune islands. The Wadden Sea has great international importance because it serves as a breeding and resting area for many birds, as nursery for different North Sea fishes and as a habitat for seals. Increasing pollution of the North Sea and mass tourism are a big threat to the Wadden Sea.

The biosphere reserves of the Wadden Sea perform the main ecosystem study for coastal areas in Germany. An ecological programme is beeing performed since years. A tripartite (NL, D, DK) monitoring programme will be introduced in the near future.

4.2 Wadden Sea of Hamburg

The Wadden Sea of Hamburg with its three islands represents an important habitat for many threatened plants and animals. The naturally high inputs of nutrients into the delta of the river Elbe favour a rich bird and fish fauna. There alone you find more than 10.000 pairs of breeding tern species on the dune island Scharhörn. But strong pollution of the river Elbe threatens this richness.

4.3 Wadden Sea of Schleswig-Holstein

The biosphere reserve "Wadden Sea of Schleswig-Holstein" is the largest protected area in Germany. It amounts to about 285.000 hectars. It represents Europes most important resting area for migrating birds. The biosphere reserve sometimes is populated by more than 1.3 million birds at the same time. Dunlin, curlew, avocet and oyster catcher live here together. More than 30 other bird species breed in the biosphere reserve. The main element of the landscape are the "Halligen" (dune islands) and the almost natural salt-marshes. Common salt-marsh grass and sea lavender grow there. More than 2.000 animal species find sufficient food. Among those are numerous endemic species which only can be found in the Wadden Sea.

4.4 South East Rügen

A multifold landscape shaped by ground moraines gives the biosphere reserve South-East Rügen its present image. Sea, islands and shore host a magnifold flora and fauna. Fishery and agriculture, often in combination, dominate human economic activities. The importance of tourism is steadily growing to ceiling values. The beech forests of the island Vilm belong to the oldest and most precious natural forests in northern Germany. On the island of Vilm the German Federal Government has situated ists International Nature Protection Academy. A priority task of this institution is to deal with the ecological problems of the Baltic Sea and relevant problems of the neighboring states.

Fig. 1: Map of the Biosphere Reserves in Germany (1 January 1994)

4.5. Schorfheide-Chorin

The landscape of the biosphere reserve Schorfheide-Chorin was formed by the last ice age. In close neighbourhood different landscape elements can be found: hills and plains, lakes and swamps. Most impressive is the high number and the diversity of lakes and rivers and of wet areas. However, only one third of the many hundred lakes are ecologically sound. Orchids, globeflower and crystal tea ledum are rare plants which can be found in the biosphere reserve. Beaver, otter, crane, black stork, European pond terrapin and white tailed eagle which are very rare in other areas still can be observed. As Berlin is very close to the biosphere reserve the impact of tourism is considerable.

Biosphere Reserves in the Federal Republic of Germany

Biosphere Reserve	C (ha)	B (ha)	T (ha)	R (ha)	Total area (ha)
Bayerischer Wald (since1981)	138	4.871	8.902	-	13.100
Berchtesgaden (since 1990)	16.920	3.450	25.920	430	46.720
Hamburg. Wattenmeer (since 1992)	8.200	3.500	-	-	11.700
Mittlere Elbe (since 1979)	624	6.171	26.325	9.880	43.000
Nieders. Wattenmeer (since 1992)	128.000	110.000	2.000	-	240.000
Pfälzerwald (since 1992)	1.400	40.000	138.400	-	179.800
Rhön (since 1991)	12.327	33.628	84.533	-	130.488
Schleswig-Holstein. Wattenmeer (since 1990)	85.500	6.400	193.100	-	285.000
Schorfheide-Chorin (since 1990)	3.502	23.082	99.307	4.200	125.891
Spreewald (since 1991)	920	9.800	22.745	14.135	47.600
Südost-Rügen (since 1991)	360	3.800	18.640	-	22.800
Vessertal/Thüringer Wald (since 1979)	305	2.131	10.234	-	12.670

Fig. 2: Details of the Biosphere Reserves in Germany (1 Januaty 1994)

4.6 Spree Forest

The biosphere reserve Spree Forest consists of lowlands with a park-like flood-plain landscape. Small channels, called "Fliesse", ramify in this area, with a total lenght of 700 km. Hundreds of years of traditional agriculture created a small scale mosaic of the landscape including semi-natural forests with a high richness in species. The Spree Forest hosts marsh-gentian and sibirian iris. Black stork and osprey find retreating areas here. In order to preserve this cultivated landscape concepts for ecologically sound agriculture and for "soft tourism" (2 million tourists per year) have to be realized.

4.7 Middle Elbe

The biosphere reserve Middle Elbe includes one of the biggest flood-plain areas of Central Europe. Flood-plain forests today belong to the most threatened ecosystems in Germany because of the frequent artificial regulation of rivers. Typical animals of the flood-plains are Elbe-beaver and red kite. Other rare species as white tailed eagle and short eared owl spend the winter in the biosphere reserve. Vegetation is characterized by fluvial forests rich with field maple. The pollution load of the rivers Elbe and Mulde threatens these ecosystems. But in the last years water quality was improved considerably. For the first time on the European continent - in the 18th century - an artificial park-landscape was created in the Dessau area. This "Dessau-Wörlitzer cultivated area" was included into the biosphere reserve 1988. In this biosphere reserve there is a strong programme to keep old orchard trees and crop seeds from ulmus minor and shoots from pyrus pyraster.

4.8 Rhön

The biosphere reserve Rhön covers parts of the three Länder Bavaria, Hesse and Thuringia. Origin of this low mountain range is the basaltic vulcanism of the tertiary. The special features are about 50 big basalt cones with semi-natural forests and screes as well as the plateau of the "Long Rhön" with high moors and mountain meadows rich in species which still remains without forests. Characteristic species of the Rhön are black grouse and blessed milk thistle. They only can survive with environmentally sound agriculture. But for economic reasons agriculture mostly is intensfied or even totally abandoned today. In both cases precious habitats are in danger of beeing lost. One of the tasks will be to reintroduce Thuringian goats together with sheep to keep the area open and preserve the high diversity of plants and insects.

4.9 Vesser Valley-Thuringian Forest

The biosphere reserve represents a low range mountain landscape in the Thuringian forest. It is covered to a large extent by forests - natural beech forests dominate the image. Many different sites allow a high level of biodiversity. This was supported by the ecologically sound management which was traditional during the past few centuries: Many additional habitats evolved. Examples are multicoloured mountain meadows which only can be maintained by continuing respective forms of land use.

4.10 Palatinate Forest

A low mountain range on new red sandstone which is almost completely covered by forests. It is planned to design a cross-frontier biosphere reserve together with the French biosphere reserve "Vosges du Nord". Many bizarre sandstone rocks are spectacular characteristics of the Palatinate Forest. Viniculture has given the agricultural landscape its special feature. Especially the walls of the terraces of old vinyards offer habitats to species attracted by warmth. A specific long term monitoring programme of natural wood plots is performed there.

4.11 Bavarian Forest

The Bavarian Forest and the adjacent Bohemian Forest form the largest unitary forest in Central Europe. The biosphere reserve lies in the centre of this low mountain range. About 95 % of its surface is covered with forests, partly with natural mountain forests (mixed mountain forests and

mountain spruce forests). Among many protected animals also lynx and capercaillie can be found in the Bavarian Forest. Plenty of the rare birds, insects and fungi depend on the jungle-like forests of the biosphere reserve. It is still suffering from heavy transboundary airpollution.
It is planed to unite this area with the neighbouring area (Bohemian Forest) to a very large biosphere reserve.

4.12 Berchtesgaden

Mighty mountains of the limestone Alps tower the high mountain landscape of the biosphere reserve Berchtesgaden. In higher altitudes of the biosphere reserve still large scale natural areas exist. In the valleys grassland farming dominates. It is necessary to preserve this combination of natural and cultivated landscape in order to maintain it as a living, working and recreational area. It is the site where the first modern German ecosystem study was performed and many tools for sampling, analysis, evaluation and prognosis elaborated.

5. Overview on ongoing international activities

5.1 EURO-MAB

Its goal is to organize exchange of experiences, improve cooperation and harmonize activities. The programme "Biosphere Reserve Integrated Monitoring" (BRIM) was installed. The first result of this activity is the issue of "Access. A Directory of Contacts, Environmental Data Bases, and Scientific Infrastructure on 175 Biosphere Reserves in 32 Countries" (EUROMAB 1993).
The second step is directed to perform an inquiry on existing permanent plots for ecological monitoring in biospere reserves. This shall give a basic information for the future construction of an observation system.
Third step: a base set of monitoring parameters is being discussed and will be developed in 1994.
Fourth step: In preparing an ecological monitoring on EURO-MAB level a strong harmonization with the UNEP bureau of "Harmonization of Environmental Measurement" (HEM) is being excercised to ensure an adequate harmonization with UNEP actions and plans for environmental monitoring.

5.2 UNESCO MAB-secretariate

After publication of EURO-MAB-"Access" the MAB-secretariat of UNESCO was highly impressed by the information supplied by EURO-MAB. It considers the extention of "Access" to a worldwide document.

6. Summary

Biosphere reserves represent a global network of areas which will support the development of environment and nature conservation policies and will be of paramount importance for the foresighted development of natural resources. Due to their internationally recognised concept of protection, biosphere reserves enjoy great esteem worldwide. Biosphere reserves will also gain increasing significance at national level by promoting environmental protection and nature conservation in Germany.

7. Concluding remark

Due to the long-term protection, outlined structure and location of biosphere reserves in Germany.-...
Due to their task to protect and/or manage wildlife as well as life as result of long periods of cultivation ...
Due to cooperation with the regional population concerned ...
... biosphere reserves are - in cooperation and with the guidance of experts concerned - ideal regions for sites to in-situ conservation of plant genetic ressources, reaching from wild species of cultivated plants and old cultivated breeds of agricultural plants, fruit crops and trees.

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Ex-situ conservation and the informal sector

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Introduction

In this paper I start with a discussion of the use of such terms as "informal sector" and "ex-situ conservation" before examining in more detail the work of one particular element in the informal sector, my own organisation. I then look at some of the problems facing the informal sector before finally proposing some solutions and ways in which the formal and informal sectors might work more closely together in future.

Semantics

The informal sector is as diverse as the plant genetic resources it seeks to conserve. There is wide variation in the approaches used and the commitments exhibited. Nevertheless, it is possible to discern three basic patterns.

The first is what may loosely be called the enthusiasts. These are individuals who have a deep interest in diversity, often of a particular crop. Thus there is a gentleman in Sussex, England, who collects cucurbits. He has a large collection of varieties but, as far as I am aware, acts entirely on his own. He does not make seed available to others, who would, in fact, find it difficult to contact him. Other enthusiasts, such as the late Donald McLean, combine their obsession with business; Mr McLean offered one of the largest lists of potato varieties in the UK, a practice continued by his widow. These enthusiasts are often very knowledgeable about their chosen crops, and may have very large collections, but they tend to work in isolation. They are often known only to other enthusiasts and seldom belong to more formal organisations.

Organisations that are concerned with the conservation and utilisation of plant genetic resources tend to fall into two classes; those in which PGR is part of a broader remit and those in which PGR is the main thrust (though these may have other interests too).

In the first group fall such organisations as ABL in Germany, Geyser in France and the Henry Doubleday Research Association (HDRA) in the UK. These groups tend to undertake a range of activities aimed at small-scale and hobby growers, often with a strong undertone of sustainability. The conservation and utilisation of plant genetic resources is just one of their activities, given greater or lesser prominence in each such organisation.
The second group comprises organisations such as Hof van Eden in The Netherlands, Arche Noah in Austria, Pro Specie Rara in Switzerland and the National Council for the Conservation of

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Plants and Gardens in the UK. These organisations have the conservation and utilisation of plant genetic resources as their main aim, although each approaches this goal in an individual way.

While all informal sector activities -- individual and organised -- approach the task in their own ways, they are united by a strong belief in conservation **through** utilisation. That is, their aim is to make varieties available to growers. This is based on the firm belief that not only does this represent a beneficial activity in its own right, because the varieties they maintain are in many senses better than others that may be available commercially, but also that by stimulating demand for diversity they are helping to counter the structural forces that favour uniformity and underpin genetic erosion.

One of the great difficulties faced by the informal sector, and any elements of the formal sector who wish to work with the informal sector, is the lack of information. I know of no exhaustive directories of individuals or organisations dedicated to the conservation of plant genetic resources, and there is certainly no compendium of the holdings of the informal sector. *Saving the Seed*, by R. Vellvé (Earthscan Publications, London. 1992) offers an overview of the spectrum of informal sector activities in Europe, but is accepted to be incomplete. This makes it extremely difficult to plan future work, to co-operate, and to exchange information and ideas that would make us all more effective. I have singled out a few examples that I happen to be aware of, but there is no comprehensive source of information.[2]

Although every member of the informal sector has their own reasons and their own methods for conserving genetic resources, they share a common concern that diversity is best conserved by being used. Their "clients" are growers, not breeders.

That provides some insights into the next semantic question, that of ex-situ conservation. While I cannot speak for the entire informal sector, I sincerely believe that none of them would characterise what they do as ex-situ conservation. For myself, I reject completely the false dichotomy between in-situ and ex-situ conservation. The distinction is a hang-over from the conservation of species in the wild, where some kind of useful distinction can be made between "the wild" or "nature" -- characterised as in-situ -- and "captivity" in zoos, on breeding stations, or in botanic gardens -- characterised as ex-situ. Applied to crops *sensu latu* the distinction is both sterile and meaningless. Indeed, when one considers one of the defining characteristics of in-situ conservation -- that the species are conserved without human interference -- it becomes clear just how meaningless the concept is.

The natural habitat of crops (and domestic animals, though they do not concern us here) is on farms and in gardens. There, they **rely** on human interference to survive; having bred plants for certain characteristics, such as non-shattering, we now need to take an active part in their life cycle to ensure that they are capable of reproducing. Thus it is clear, to me, that the conservation through utilisation of crop plants is, if anything, in-situ conservation. Not even the NCCPG, whose members account for 500 collections of 400 genera, encompassing some 50,000 taxa, is involved in ex-situ conservation, for the natural habitat of garden plants is in gardens.

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[2] As a result of the Gatersleben meeting, HDRA and IPGRI are collaborating on a survey of the informal sector in Europe, which should provide the kind of information currently lacking.

What distinctions can one usefully draw? In my view, the most useful characteristics concern the time scale over which genetic resources are conserved. For the formal sector, exemplified by gene banks, long-term storage is the goal. In that the plant material is usually not growing (accepting exceptions such as clonal orchards and *in-vitro* collections), this is the closest one comes in crop plants to ex-situ conservation. The informal sector, by contrast, is generally concerned with relatively short-term conservation, and more with ensuring that genetic material remains available for use by growers. In that the plants spend most of their time in their natural, cultivated habitat, this is the crop plant equivalent of in-situ conservation. But, as I say, the distinction is sterile, and I would hope that it will soon be replaced by a distinction between long-term and short-term conservation, while accepting that the notion of short-term conservation will take some getting used to.

HDRA Heritage Seed Programme

I come now to examine in more detail the work of one element of the informal sector. The Henry Doubleday Research Association is dedicated to researching, demonstrating and promoting environmentally friendly growing techniques. It claims to be Europe's largest organic organisation, with some 20,000 members. The Department of Genetic Resources is the smallest of HDRA's five departments, but has a historic link with HDRA's founder, Lawrence Hills. He campaigned vociferously for the conservation of plant genetic resources starting in the 1960s, and later was instrumental in gaining support for a National Vegetable Seed Bank at Wellesbourne. At the same time, Lawrence Hills established a Seed Library for members of the HDRA, a library that I now manage.

The Seed Library contains more than 500 accessions from about 50 crops; it is hard to be more accurate because some of the accessions I discovered when I took over the Seed Library have not yet proved themselves to be viable. We have three main sources for our accessions. The minority come from seed companies who were the registered maintainers of commercially available varieties. When these companies drop a variety from the National List they sometimes supply a sample for our Seed Library. Another small group of accessions are varieties that are commercially available somewhere in the world. By far the largest proportion, however, come to us from other seed savers in the UK and elsewhere in the world. Some of these are definitely commercial varieties that have been maintained by amateurs. Others are definitely heirlooms that, as far as their donors know, have never been offered commercially. And a few have been treated as heirlooms but are probably (or possibly) of commercial origin. As a general rule, we do not turn down any variety we are offered.

The Genetic Resources department's stated mission is: to conserve as much crop biodiversity as possible and to make as many varieties available as we can. This formally embodies the joint goal that typifies the informal sector, of conservation through utilisation. However, the very legislation that makes the existence of the Seed Library necessary also makes it impossible easily to fulfil our mission, because the simple sale of seeds of unregistered varieties is illegal. For that reason, the department operates what is essentially a club, the Heritage Seed Programme. For an annual fee, members receive a quarterly newsletter and other information, discounts on publications and activities, and the choice of up to five varieties each year.

We frankly acknowledge that many members regard the Heritage Seed Programme as no more than a somewhat unusual seed supply merchant, and no more, a source for varieties that happen to be unavailable elsewhere. The club is then simply a legal nicety. Others have an interest in wider issues of plant genetic resources. But all probably regard the annual offerings of the Seed Library catalogue as the most important thing the Programme does. Because of this, our primary activity beyond conservation is to produce enough seed for distribution to members. As an idea of the scale of this enterprise, in 1993 we distributed about 15,000 samples. In 1994, having harvested more than 50 kg of assorted seed, we plan to distribute about 25,000 samples.

We use two techniques to ensure ourselves of a good supply of seed. At HDRA's headquarters we grow, each year, a subset of the complete library. This grow-out consists of about 100 varieties each year, selected on the basis of routine germination testing, popularity with users, and the requirements of good horticultural practices. Varietal purity is maintained by the use of standard techniques. In addition, some of our members agree to become Seed Guardians. They choose to take responsibility for multiplying up one or two of the Seed Library varieties and returning bulk seed to us for distribution to members. Seed Guardians receive no additional reward, except our gratitude and, sometimes, offers of varieties that are in too short supply to make generally available. We do give Seed Guardians training, verbally on request and in the form of published Seed Guardian Guidelines that offer practical advice on seed saving in general and specific crops in particular. (These guidelines are also made available to ordinary members of the Heritage Seed Programme who want to know more about saving their own seed without committing themselves to becoming Seed Guardians.) We also plan, from 1994, to organise one-day practical training seminars.

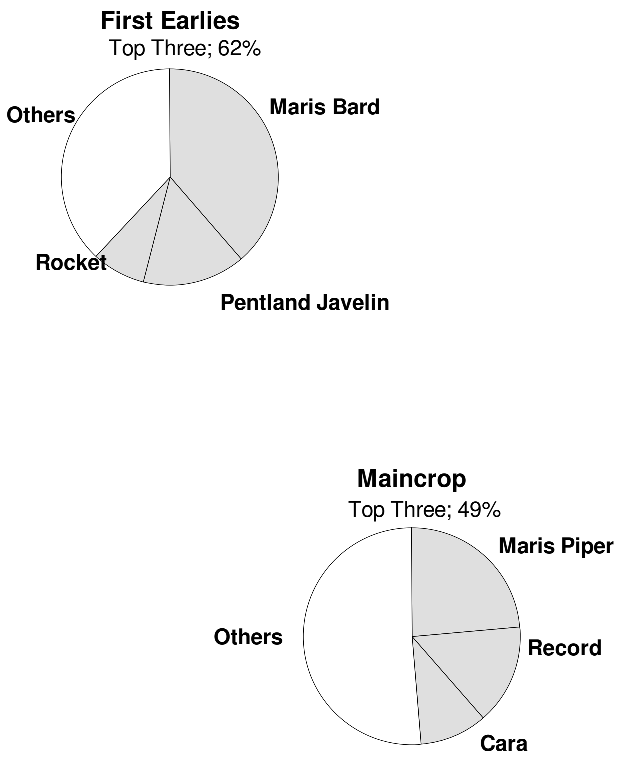
While the conservation and dissemination of the Seed Library varieties is the primary activity of the department, we are also concerned to gather information and campaign on issues of plant genetic resources. Our primary publication is *Leaflet*, a newsletter published four times a year and sent to all members of the Heritage Seed Programme. We also publish an annual compilation called *The Vegetable Finder*. This is effectively a catalogue of catalogues; it lists mail-order sources for every vegetable variety commercially available in the UK, and descriptions for almost all the open-pollinated varieties. As such, it is useful to all vegetable gardeners, but is also offers the Heritage Seed Programme an interesting window on the commercial trade in varieties and enables us to say interesting things about crop biodiversity as part of our ongoing campaign.

Availability of Diversity

The graphs (Figure 1) show the area planted to different varieties of potato in each of the three maturity classes. One can see that the top three varieties account for most of the area in each case. Leaving aside the wider implications of this very clear manifestation of genetic erosion, the obvious corollary of this is that these varieties will be the easiest for the consumer to buy as eating potatoes in the shops. What of the gardener? Figure 2 plots the availability of the 150 seed potato varieties listed in *The Vegetable Finder*. Note that every one of the top three varieties in each maturity class is available from 5 or more suppliers, unlike the vast majority of varieties. (The discrepancy would be even more marked if we extended the analysis to the top four or five).

The point is simply that the potato varieties that are easiest to buy in the shops for eating are among the easiest for the gardener to find as seed potatoes for growing in the garden. It seems quite certain that the requirements of the commercial potato grower are bound to be different from those of the amateur, and yet the amateur has to exercise considerable skill and effort to find

Figure 1: Potatoes: Availability of Eating Potato Varieties
Data show the area planted to each variety in Great Britain in 1993, based on figures supplied by the Potato Marketing Board.



more appropriate varieties. This is partly an issue of consumer choice, partly one of food security, and it applies to almost every type of crop.

National Lists

The real problem is that there is a single set of rules that applies right across the European Union, saying which varieties may be sold as seed and young plants. Only those varieties registered on the Common Catalogue (which is a compilation of all existing National Lists) may legally be sold. That, in itself, is not a problem. Indeed, the existence of National Lists can be a good thing if it helps to prevent the proliferation of synonyms that has plagued the seed trade in the past. The problem is that the requirements for National listing -- DUS testing and the fees charged -- apply equally to all sizes of suppliers and purchasers. The regulations do not distinguish between the commercial grower who wants a high yield of uniform plants that can be mechanically harvested and packaged and the amateur or small grower who wants, for example, flavour and a long season of maturity.

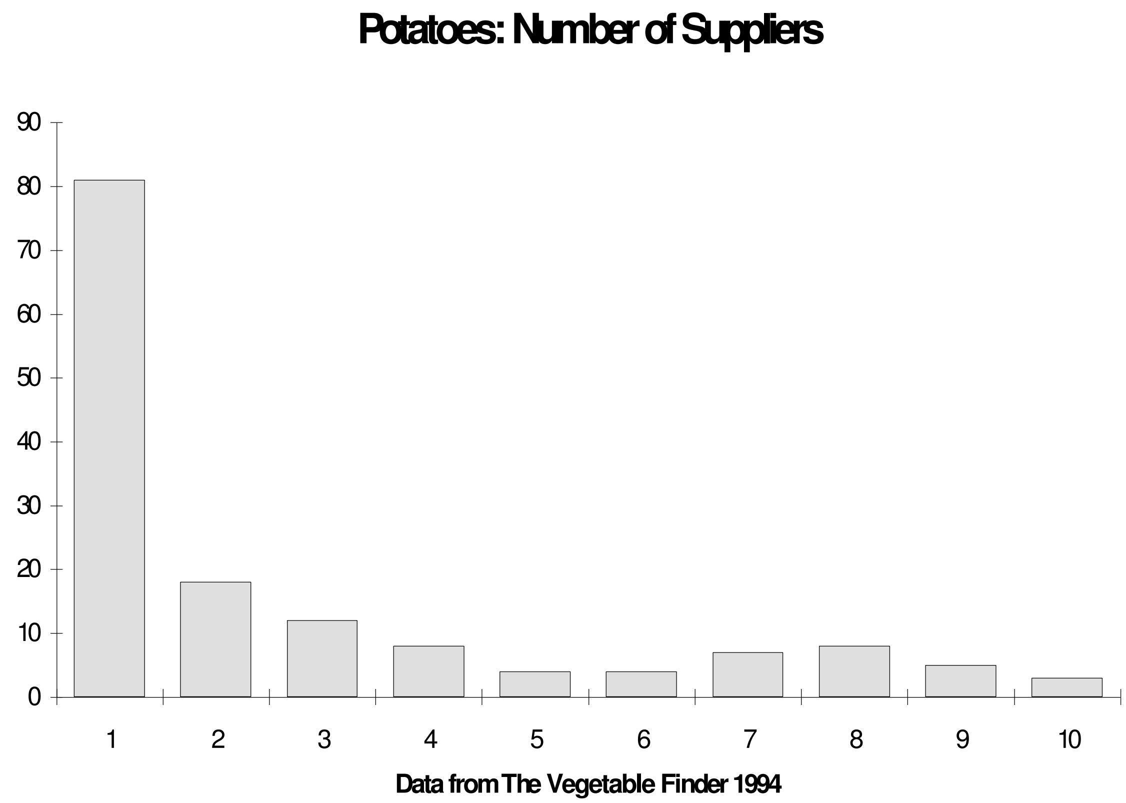


Figure 2: **(alternative) Potatoes - Availability of Seed Potato Varieties**
Each variety listed in *The Vegetable Finder* 1994 edition is plotted according to the number of suppliers it is available from. Most varieties are very hard to find, but those named in Figure 1 are all available from 5 or more suppliers. (NB: many of the varieties available from a single supplier are sold as eating potatoes, not seed, because of the cost of inspection.)

The directives and national legislation that form the foundation of the National Lists and Common Catalogue are, therefor, the single biggest obstacle to the informal sector's desire to conserve plant genetic resources through utilisation. It is not far fetched to assume that if this structural barrier could be removed, there would be almost no need for NGO activity in this area as market mechanisms -- formal and informal -- would quickly take over.

Two types of grower

Recognising that there is in fact a distinction between amateur and commercial growers the British and French authorities have recently proposed a new EU registration scheme specifically aimed at gardeners. Unfortunately some governments do not accept the distinction. Without knowing the detailed basis for their objection it is hard to know what evidence might be adduced to combat it. However, a cursory examination of available statistics indicates that there are indeed at least two vegetable-growing constituencies.

In the UK, for example, the total area of commercial vegetable production (excluding potatoes) in 1990 was 142,000 ha. The total described as kitchen garden was 16,000 ha. While "kitchen garden" is not defined, it would seem that amateur growers represent some 9.5% of the vegetable land. Specific crops make the point more clearly. Tomatoes, for example, occupy 700 ha of commercial land in Britain. Based on my own, not atypical, habits, optimistic gardeners probably grow about one-tenth the number of plants that commercial growers do, which is reflected in the pages of *The Vegetable Finder* by a preponderance of thick-skinned, uniform, F1 hybrid tomatoes developed for the commercial greenhouse grower. Varieties that suit the amateur are either, like the renowned Carters Fruit, extinct or, like Harbinger, almost so.

Peas provide another example. The total area of professionally grown fresh peas in Britain is 40,500 ha. By extrapolation, the area in the British Kitchen Garden is somewhere around 250 ha, 160 times less. Is it any wonder that short, leafless, uniform varieties -- traits developed for the mechanised professional -- dominate the market?

Commercially, given that legislation recognises only one kind of market, it makes sense to concentrate on supplying the needs of the larger growers, not gardeners. As a gardener, I personally find it hard to believe that anyone can fail to appreciate that the qualities that make a variety desirable to the commercial grower are often completely distinct from those that the gardener wants. The almost insatiable demand from members of the Heritage Seed Programme for tall Victorian peas that crop over a long season is just one small piece of evidence. And yet the law treats us all alike, with the result that amateurs cannot buy the varieties that suit them and so have to turn to the informal sector.

A way forward

One solution is simply to ignore the law. This certainly goes on in casual black economy sales by people throughout the EU who choose to disobey domestic legislation. Some countries certainly enforce that legislation more conscientiously than others, which undermines the idea of harmonisation. Another solution is to skirt the law with schemes such as the Heritage Seed Programme. But this too is of dubious legality, and in any case devalues the efforts of the informal sector by denying them a due reward for their work. The answer is surely a change in the law, which the recent Anglo/French proposal aims to set in motion.

This initiative is at least a step in the right direction, even though it still has many inadequacies. For a start, the proposed time limit of 15 years common use is arbitrary and does not allow for the commercialisation of new varieties developed specifically for the amateur market. For another, the maximum quantities allowed for sale are far too large for a supposedly amateur market. But perhaps the biggest failing with the proposal is that it does not protect either the supplier or the consumer from accidental or deliberate sharp practice.

It is in response to this perceived lack that I have drafted an additional proposal for a Registration Scheme directed specifically at the amateur market. In outline, this scheme recognises that the most important thing about a variety is its name, which is effectively a shorthand description of its distinctive qualities. The proposed scheme aims to protect the good name of a variety at minimal expense, through the operation of a deposit system similar to the American Type Culture Collection. Samples of seed, along with a full description and name, would be deposited with a central authority. This authority would maintain a register of names and would ensure that there is no duplication. Disputes would be handled in the first instance by Trading Standards Officers (or their local equivalents) and only if absolutely necessary would the expense of a comparative grow-out be incurred. Stringent financial penalties would deter malpractice. (The full draft scheme is attached as an Appendix; I would welcome comments.)

The implementation of such a scheme would be the biggest single improvement in the conservation and utilisation of plant genetic resources by the informal sector, for it would revitalise the localised seed supply industry whose demise creates the need for conservation. I sincerely believe that some sort of "amateur" system is inevitable, given the groundswell of opinion in favour of biodiversity.

Co-operation between gene banks and seed savers

Conservation, however, must continue while we await a legislative change, and in the meantime there are many aspects of the work on which formal and informal sectors could co-operate. To list a few, in no particular order:

- We could share your technical skills; seed savers would like to offer virus-free stocks of clonal crops such as potatoes and some Alliums, but few have either the skill or equipment to do so.

- You could share our enthusiasm and people. Seed savers can perform preliminary characterisation of accessions. The Memorandum of Understanding between Agriculture Canada and the Canadian Heritage Seed Programme offers a model agreement. Seed savers can regenerate samples, even to the high standards demanded by gene banks. Finally, of less relevance to gene banks directly, seed savers could provide material for, and take part in, trials of extended agricultural diversity.

- Both sectors would benefit from a comprehensive directory of people in the informal sector, their holdings, and their special interests and expertise. The HDRA (with help from IPGRI) is making a start on this, but has much to learn from the operation of existing co-operative programmes.

- Gene banks could make space available for the safe long-term storage of duplicate collections from seed savers. Some NGOs already have casual agreements with their local gene banks, but this could be put on a formal footing and made more widespread.

- We could make efforts to share information more widely. Seed savers often receive requests for specific varieties. Gene banks, and breeders, may be interested in material held by seed savers. It would make all of our lives easier if we were able to share data and interrogate one another's records through user-friendly interfaces, but the informal sector will need support if it is to reach the same level of data management as most gene banks. An on-line network is a reasonable goal.

- Most all, both sectors would benefit from a new legal basis that recognises the difference between small-scale and amateur growers and large professionals. If the formal sector could throw its weight behind the desired changes it would help enormously. Once we have a new legal basis, conservation through utilisation will surely follow.

Conclusion

Obviously, co-operation can take many forms, but two factors will be paramount. First is the development of trust; no progress will be made if either sector regards the other as in any way inferior. The key distinction is not between informal and formal, or in-situ and ex-situ, but between final users; big professionals -- whether growers or breeders -- need access to plant genetic resources just as surely as amateurs. It happens that gene banks, with their emphasis on long-term storage in the absence of selection, are better suited to supply professional breeding programmes, while seed savers, with their emphasis on conservation through utilisation, are better suited to supply growers. But both sectors are absolutely essential to the preservation of plant genetic resources.

Second is the question of financial support. With very few exceptions, the informal sector is involved in a constant struggle for its own survival. Long-term funding for curatorial conservation is just as hard, if not harder, to find outside national programmes as inside them. A little official recognition of the true value of crop biodiversity -- manifested perhaps by changes in legislation and funding -- would go a long way to ensuring its continued availability.
Appendix

Alternative List for Amateur and Garden Supplies of Vegetable Seed:
Proposal for discussion

1 There is growing acceptance of the unfortunate impact on the availability of varieties to gardeners and small growers of existing crop variety registration legislation at home and in the EC.

2 We therefore welcome the Anglo/French EU initiative, which seeks to open up the process of marketing certain varieties.

3 The HDRA has already commented (to MAFF PVRO UK) on some aspects of the proposal, such as the arbitrary time limit and the overlarge maximum allowable seed weights. Although we have had no feedback on this, we assume that the validity of our comments has been recognised.

4 The greatest outstanding problem remains that of consumer protection. Varietal identity, seed purity and seed quality all need to be controlled. In this paper I put forward the outline of a working system that is intended to save the valuable baby of quality control while throwing out the bathwater of unnecessary, costly, and burdensome regulation.

5 The current system of DUS testing is too restrictive, not least because the lack of uniformity in, for example, maturity dates is often a desirable quality. It is also, as currently operated, too expensive for the scale of enterprise envisaged. In its place, I propose a deposit system, analogous to the American Type Culture Collection (ATCC).

6 This scheme could easily apply to the entire European Community, with a single designated body.

7 For each variety, each person marketing seed would be required to lodge a name and description of the variety with an approved designated body.

8 The person would also be required to deposit a bulk sample for storage and several aliquots for germination testing. These samples would be used only in the case of a dispute over varietal identity.

81 The samples would be prepared for long-term cold storage, i.e. dry and foil packed.

82 The designated body would keep the samples in cold storage.

83 Germination would be tested by the designated body on a regular basis

1ai In the event of germination dropping below some pre-arranged level (not necessarily the same level as for marketed seed) the designated body would inform the supplier, who would be required to deposit a fresh set of samples in order to continue marketing the variety.

9 Seed purity would still have to conform to existing standards.

10 Germination standards could be lowered slightly, although there is no compelling reason why gardeners should have to suffer lower quality seeds.

11 Disputes would be pursued through local Trading Standards Officers. Questions of seed purity and germination are relatively easily resolved. Questions of varietal identity would pose greater problems, and might require recourse to the stored samples on deposit.

12 Disputes could take two forms; that the variety is not what it claims to be; and, two varieties being marketed under different names are, in fact, identical in all salient particulars.

13 These disputes would be resolved by the designated body growing out a portion of the seed deposited with it. The designated body would assess the varieties under question and report on their identity or otherwise.

14 Penalties would need to be established in advance. Marketing seed that is not true to name surely ought to attract a relatively stringent fine. Marketing a variety that is essentially identical to another deposited variety is a greater offence and would call for a fine and some sort of restitution to the prior registrant.

15 Costs, in the absence of disputes, would be minimal.

151 Preparation and deposit of the samples would fall on the supplier and be part of the cost of doing business, just as the cost of depositing a copy of a book with the Copyright Libraries falls on a publisher.

152 Preserving deposited samples and routine germination testing would be relatively inexpensive. They could be funded directly through MAFF (or the EU), recognising the importance of this work to the maintenance of biodiversity. Other schemes might include a percentage levy on the turnover of all seed suppliers, not just those that use this scheme.

153 In the event of a dispute, if both parties agree that there is a need for arbitration, then each should deposit with the designated body the entire estimated cost of conducting the tests. After judgement, the winner's costs would be paid by the loser.

16 In conclusion, this scheme offers several advantages over any others I have seen.

161 It maintains a high level of consumer protection, and should discourage sharp practice.

162 It is easy to administer.

163 It is inexpensive.

17 I would welcome comments on these proposals.

In situ conservation and the formal sector

M. CHAUVET[1]

What is *in situ* conservation ?

Much has been said about *in situ* conservation. It has become a common topic of nature conservation, and is considered as the central aim of a conservation strategy. But in order to implement such a concept for cultivated plants, we need know clearly what it means, and above all, what it implies.

Usually, we conservationists consider wild species of plants or animals. Conserving them *in situ* means that we will maintain their natural habitats and apply some management practices on their populations. In other words, *in situ* conservation is a kind of ecosystem management oriented towards the survival or the reinforcement of some target species.

When we deal with cultivated plants or weeds, the problems arise from the fact that the habitat is a field or a pasture, or any kind of habitat deeply transformed by the farmer's activity. It is no longer a natural ecosystem, supposed to evolve without human pressures. Its conservation implies the maintenance of cultivation, with the same agricultural practices, the same farmer's know-how and a continuous use of the crop. The basic prerequisite is that farmers are willing to do so, and that they find their own interest. Apart from human groups isolated from our mainstream society, the consequence will probably be that some technical improvements have to be considered for the crop to remain competitive, unless some authority is able to compensate for the difference.
This kind of conservation has been called on farm conservation. With regard to clarity, I propose to restrict the use of *in situ* conservation to wild species, and to use a new latin wording : *in agro* conservation, for domesticated plants (including weeds) and animals.

This method makes sense if the crop is a population. In such a case, natural and artificial selection pressures are allowed to act at each generation. We can include sophisticated systems of clonally propagated crops, such as cassava, where farmers go to the "forest" and select new clones from semi-wild populations. But in the case of plants for which no sexual propagation is allowed in the multiplication of cultivars, such as most fruit trees, the distinction between *in agro* and *ex situ* is meaningless.

Another kind of emerging technique is called dynamic conservation. In classical static conservation, regeneration is intended only to secure a quantity of viable seeds, trying to avoid selection pressures. On the contrary, in dynamic conservation, we create artificial populations and we grow them at a large scale, allowing natural and human selection pressures to act. This can be done in a farmer's field, but also in whatever experimental field.

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Finally, all these methods of conservation share a common feature : the processes of evolution are working. This is their fundamental interest, as the very long term of a conservation strategy is not to freeze the genetical landscape of yesterday, but to maximise the probability of new traits to emerge in response to changes in the environment.

How to implement *in situ* conservation?

Although genetic resources specialists now agree about the necessity of *in situ* conservation, very few real actions are documented. The main reason lies in the fact that geneticists and breeders are used to work in laboratories. Genebanks, as annexes of research centers, are a type of facilities which is part of their usual job. But *in situ* conservation is a more complex activity, needing to integrate many disciplines and many groups of people. A good understanding of the different tasks to be done, and their necessary integration into a strategy is a preliminary step if we want to reach our objectives.

Establishing a strategy and defining objectives

The genetic resources community has to express clearly which are its priorities. This begins by chosing a set of species of interest for different economic sectors, and covering different eco-geographic and reproductive patterns. Then, we need to define criteria to identify the hotspots of genetic diversity, or to sample diversity in the cas of widespread species.
In this first step, it will be found that in most cases, chorological data gathered by field botanists need to be made more readily available, but also combined with more refined data coming from geneticists and ecologists.

Owning or controlling the land

Although it is common sense to say that no *in situ* conservation is feasible if the status of habitats is not stable, it seems crucial to insist upon such a statement. Protecting an area is such a difficult and lengthy task that the only practical way to implement a strategy is to begin with a very pragmatic approach, by checking where populations of our target species do exist in the existing network of protected areas. In many cases, this network benefits with the minimum scientific and technical staff encharged of inventorying and monitoring tasks, and able to implement management plans.
Only after this first step will it be useful to stress the gaps, and try to influence the creation of new protected or managed areas. This process involves discussions with local and national authorities, and the achievements and challenges of our activities need to be publicised if we want to convince that it is as important to protect a plant than to protect, say, a bird or a big mammal, or to compete with a development program.

Defining and implementing management practices

On the basis of the information available, we need to define which kind of management practices has to be implemented in the protected areas. Managers need guidelines now, and not in an indefinite future. Of course, this plan will be better if we include several kinds of managements for similar areas. But it has to be stressed that there is no perfect management plan, and that letting things go without control is simply a kind of management, but with the severe drawback that no lessons can be drawn from failures.

Monitoring

It will be the rôle of monitoring to evaluate the results of management plans and propose changes to enhance their efficiency. Monitoring the evolution of *in situ* habitats and species is as essential as checking the viability of seeds in a genebank. It is the basic component of an alert system. More generally, information of all the agencies acting in the field, and training of their staff, is of utmost importance if we want to avoid unwanted or indirect destruction of protected populations. We have to remember that destruction is irreversible, whereas conservation is a permanent struggle. Low input techniques of monitoring will also prove valuable on a long term basis for fundamental studies on the evolution of populations. Researchers usually have very few opportunities to observe long term processes, due to the limited time frame of their research programs.

Developing research programs

I deliberately put this aspect of the strategy at the end, in order to make clear that researchers need to change their usual way of thinking. When biologists are asked to answer a conservation problem, they legitimately and regularly say that their knowledge is scarce, and that they need several years of research to establish the scientific basis of their proposals. The problem is that in most cases, the result of their research is that they discovered new fascinating problems, and that they need another research program to ascertain their findings. A lot of problems arise from this difference of approach : the job of researchers is to find new questions, whereas the job of managers is to obtain better answers.

The necessary dialogue with a large array of land managers

Perhaps it is necessary here to enumerate the incredible diversity of people and agencies who play a rôle in land management, and could participate in a global strategy. Most of the time, this diversity is largely underestimated, and people believe that a small group of specialists would be enough to reach a satisfactory conservation strategy. This belief fails to recognise that in the real world, no funding source will be enough to meet the multifacetted challenges of conservation, and that on a long term basis, no strategy will prove viable if we don't reach the support of public opinion and mainstream society.

Protected areas

The network of protected areas will of course form the core of any in situ conservation system, as it is their primary objective. According to countries, we find national parks, regional parks, natural reserves. We must add national or regional trusts, such as the Conservatoire du Littoral in France, the mandate of which is to buy coastal areas and ensure their ecological management. NGO's may also be very effective in creating private trusts ; in this last case, motivations are very diverse : the aim will be to protect a spectacular landscape, or the surroundings of an architectural or historical complex, or a particular target species.

Legal persons having an interest in biodiversity

Forestry agencies and hunting and fishing agencies or syndicates may play a significant role. They control or manage very large areas of natural habitats, and are interested in maintaining the global functioning of ecosystems, as the life base of the species of their mandate. In particular, foresters have historically been one of the few social groups committed with long term management constraints. For them, the challenge of global change is meaningful. They are well organised, with an numerous and skilled staff, and their contribution can prove very efficient.

Legal persons having no direct interest in biodiversity

In this loosely defined category, we find the army, and the railway and highway companies. They will often have no precise opinion in favor or against biodiversity, but their management practices may have very negative consequences. There is room for finding and implementing ecologically sound management techniques, as those companies may be interested in improving their image in society by participating to a noble cause. In particular, the extension of the transportation system creates large areas of "common nature" which can no longer be forgotten in a global strategy. Other categories are local communities, and the commons.

Private owners

Agriculture is by large the main kind of land use, and its influence on biodiversity is essential. But it is particularly difficult to establish a long term conservation policy for agricultural lands, because of the complex and indirect effects of agricultural policies, and the fact that we need to rely on the willingness of particular farmers to follow recommended practices. More attention should be paid to policies of subsidies and taxes, because slight changes may have broad effects.

Conclusion

An *in situ* conservation strategy appears to be much more than a scientific field of activity. That is why it has not developed as rapidly as we wish. As scientists, we are confronted to a new challenge : we need not only to establish the scientific base for action, but above all to promote dialogue between many different social groups, and organise them.

One of the most crucial issues is to link genetic resources groups, which have been historically agriculture oriented, with nature conservation agencies, which are environment oriented. Fortunately, the integration of both perspectives is now being done under the flag of biodiversity. This offers fascinating possibilities. If our primary interest is the conservation of wild relatives of crop plants, we must have in mind that, due to the great number of researchers in crop biology, any achievement in this field may act as a good model for the great many living beings which share much smaller interest in public opinion and funding agencies.

As an exemple of what can be done, I put as an annex some information about the working group supported by the Council of Europe. The results will be soon made available to the conservation community, and we hope it will help promoting a network of concrete actions.

Only through dialogue will it be possible to reach an agreement and combine different objectives.

IPGRI, EUCARPIA, Biodiversitas

IUCN, WWF, MAB-UNESCO

Annex

Council of Europe Specialist group "Biodiversity and biosubsistance"
"Conservation of wild relatives of European cultivated plants:
elaboration of integrated management plants"

Schedule

Strasbourg colloquy, 27-29 November, 1989
Faro workshop, 8-11 November 1992
Neuchâtel workshop, 14-17 October 1993
Palermo workshop, planned september 1994

Objectives

publication of a synthesis of the workshops
publication of a catalogue of the wild relatives of the cultivated plants of Europe
recommendations to the Council of Ministers

Further steps

maintaining a permanent group acting as the node of a European network
developing pilot programs on the field
promoting interest in the scientific community

Scientific fields identified as relevant

Ecogeographic studies
Demography
Reproductive biology
Interactions between organisms and at the ecosystem level
Gene flows in species with a large distribution pattern
Autecology
Towards an integrated management strategy

In situ conservation of plant genetic resources: the view of WWF

R. TAPPER, A. HAMILTON[1]

The Convention on Biological Diversity

The Convention on Biological Diversity was signed by over 154 states in Rio de Janeiro in June 1992 and will come into force on 29 December 1993. The Convention places an obligation on those states which have ratified it to conserve biological diversity. Plant genetic resources are a part of this biological diversity and can be defined as consisting of that part of the plant world which is of actual or potential value to people. There are many existing uses of plants (for example, over 35,000 plant species, about a tenth of the total, have been used medicinally) and new uses are continually being discovered. It is thus wise to define the whole of plant diversity as a genetic resource.

Plants are living things and conservation of plant diversity necessitates the continuing existence of those ecosystems of which plants form a part. Today, virtually all ecosystems have been, and continue to be, modified by people, who therefore must be considered integral ecosystem components. Furthermore, plant populations are not, and never have been, static entities; they have always been subject to evolutionary forces. Conservation of plant diversity does not imply that people should not cause alterations to ecosystems nor that plant diversity should remain unchanged, but rather that human interventions are of such a nature that a balance is struck between meeting human needs and safeguarding those irreplaceable genetic resources which are essential to meet these needs, both now and in the future.

The Convention on Biodiversity emphasises the importance of *in situ*, as contrasted with *ex situ*, conservation. This is not to deny that *ex situ* preservation is not sometimes very important. The collection and maintenance of samples of plant germplasm in living collections, seed banks and other types of storage is clearly very useful for the rescue of genetic materials in cases where plant genetic diversity is being lost, whether this be in natural ecosystems or through the loss of traditional agricultural or forestry practices.

However, *ex situ* preservation cannot replace the role of intact ecosystems in the maintenance of genetic diversity. Conceptually, *ex situ* preservation should be viewed as a temporary measure, necessary at a time of crisis. If conservation is intended, then *ex situ* preservation must sooner or later be linked with re-introductions into natural and appropriate agricultural or forestry ecosystems, so that genetic diversity forms, as in the long run it must, part of actively functioning and continually evolving ecosystems.

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Threats to conservation of plant genetic resources

Biological diversity is under threat, with large-scale extinctions and severe genetic depletion forecast for the coming decades. Some of the major threats to the maintenance of plant diversity arise from:

- land-use change, ecosystem change (eg. caused by intensive application of agrochemicals) and genetic change (eg. through the spread of monocultures and, potentially, through the spread of genes from bio-engineered organisms into natural ecosystems);
- over-harvesting of natural resources or other forms of over-use (eg. overgrazing);
- the generation of pollution and wastes.

Threats to conservation of plant genetic resources - Habitat conversion

Loss of habitat is one of the biggest threats to plant diversity. An example is the conversion of more natural habitats into those highly simplified and chemically augmented ecosystems used for the production of large quantities of food, timber and other products for human consumption using modern agricultural and forestry techniques. The genetic diversity of these replacement ecosystems is extremely low, but the cultivars used require continual replacement or enrichment with new genetic material, for instance to overcome, at least temporarily, the deprivations of evolving pests. Thus, modern agriculture and plantation forestry depends fairly immediately on the existence of other ecosystems as sources of new genetic material, including natural ecosystems containing wild crop relatives (Hoyt 1992).

The spread of more intensive systems of agriculture and forestry causes loss of genetic diversity, not only in natural habitats, but also through the loss of more traditional farming systems, with their large numbers of cultivated plant species and many local land races. The FAO and many agricultural specialists recognise that the conservation of crop and livestock genetic resources is inseparable from the ways they are used by farmers, especially traditional farmers practising low-input agriculture. *In situ* conservation of land races, to be successful, must include measures to support low-input, sustainable agriculture, based on traditional farming systems.

The spread of invasive species is another threat to the conservation of plant diversity. The best documented cases come from oceanic islands, southern Africa and Australia, but invasive species are not confined to such places and the threat is growing as the rate of movement of germplasm around the world increases.

The continuing spread of built-up areas is also a threat to plant diversity. For example, urban developments, mainly associated with tourism, have contributed to the disappearance of three quarters of European sand dunes along the coast between Gibraltar and Sicily and, as a result of this, over 500 Mediterranean plant species are threatened with extinction.

Threats to conservation of plant genetic resources - Overuse

Unsustainable harvesting of "wild" plants, especially for commercial purposes, is a major threat to biodiversity. Harvesting for local subsistence use is not generally a major issue, at least in less degraded more mesic environments [for instance, Cunningham (1993 a,b) reports that over-exploitation of medicinal plants in Africa is overwhelmingly associated with trade not subsistence gathering, the trade being mainly to local and regional urban centres, but also for external markets]. Similarly, the great majority of the more than 600 species of medicinal plants imported into the European Community are collected from the "wild" by a process of scavenging, with no regard for the sustainability of supply from particular localities (Lewington 1993).

Likewise, much logging in tropical forest is carried out with little or no regard to regeneration of the timber stock, the conservation of genetic diversity of valuable timber trees or indeed conservation of forest biological diversity as a whole. It also often disregards the value of existing economic uses of forest resources by local communities, and the value of 'ecosystems services', such as stabilisation of soils, the maintenance of soil fertility and catchment protection.

Market forces are such that, both with timber and medicinal plants, traders simply switch to new sources of supply as shortages occur, leaving behind successive areas of degraded habitats and associated environmentally impoverished rural communities, one after another.

Threats to conservation of plant genetic resources - Generation of pollution and wastes

Growing levels of pollution and wastes threaten biodiversity. The magnitude of threats from these sources is rising, as the absolute levels of consumption increase in industrialised nations and as human population mounts. Injection of greenhouse gases into the atmosphere, through the burning of fossil fuels and from other man-made sources, will have major impacts on ecosystems during the coming century, placing the survival of many species and local populations of plants in jeopardy. Ozone depletion in the upper atmosphere, resulting from CFC emissions, has led to increased levels of ultra-violet radiation at the Earth's surface, which, in turn, are thought to be damaging to phytoplankton and which may also have adverse effects on terrestrial plant species. Acid rainfall is causing damage to large areas of forest in Europe and elsewhere. In Europe alone, the costs of forest damage from pollution has been estimated at $30 billion each year during the 1980's.

Waste dumping also damages biodiversity. The pollution problems associated with waste disposal are well-known and include contamination of both land and water, including ground water. Wastes, apart from their sheer volume, present enormous problems of environmental persistence and toxicity. Many synthetic chemicals have been developed specifically to be inert and unreactive to other materials and, once they enter the environment, they tend to be resistance to decay. PCBs, some pesticides and heavy metals are all examples of such materials. The accumulation of these substances in either the physical or biological components of ecosystems can cause great damage, even at extremely low concentrations. Toxic chemicals inhibit growth of more sensitive species, leaving opportunities for invasion by less sensitive species and consequent ecosystem simplification.

The importance of land planning

The great and increasing human pressure on the Earth makes it essential that land is used efficiently to produce required quantities of products and services. This means that the use of land must be planned, a process which cannot be left entirely to individual people, with their sometimes short-term or personal mercenary interests, but which must involve higher authorities, such as national governments, acting to achieve objectives of long-term benefit for communities as a whole.

Conservation of biodiversity should be a consideration in all land management plans, from the level of the homestead or farm upwards. Local land use plans should always consider the wider environmental context. For example, the presence of a very rare plant on a farm property places a special obligation on the owner; a decision to convert a mountain forest to cropland, of benefit to land hungry local people, should be considered with reference to possible adverse effects on people downstream, such as loss of a secure water supply.

Under the Convention on Biological Diversity, prime requirements for states are to investigate patterns of distribution of biological diversity, identify key sites of particular biological value, legislate for the protection of such sites and install effective systems of management. It is essential for states to be aware of the global significance of their national biodiversity and in this context the International Council for Bird Preservation (1992) has produced a list of key sites for conservation of bird diversity worldwide, while WWF and IUCN will soon produce a guide to about 250 of the most significant global plant sites, drawing on expertise from all over the world (Davis, Heywood & MacBride in prep.). There are a number of techniques of floristic and vegetation survey which can be used to help identify patterns of plant distribution and important plant sites, relevant to different geographical scales, and WWF is currently preparing a practical manual for the use of field workers.

How can management of protected areas be made effective?

A protected area, which may variously be designated as a national park, forest reserve, nature reserve or a number of other categories, implies that restrictions are placed on certain human activities. In the case of some national parks, this has sometimes been interpreted as meaning exclusion of traditional activities and consequently local communities have often left alienated. Relatively recent recognition that conservation cannot normally be successful in a social vacuum, excluding local communities, has led to the development of the "conservation and development" and "core area and buffer zone" approaches, which seek to achieve conservation of biodiversity through meeting some of the aspirations of local people.

Plant diversity will only be conserved in protected areas if people wish to do so. Poor rural people in many countries rely heavily on plant resources harvested from the wild, for fuel, building and craft materials, medicines, ropes and many other purposes. What sense is there in denying use by these people of the plant resources on which they depend, while allowing access to the same plant resources to scientists, plant breeders and industrialists interested in developing new types of cultivated plants, pharmaceutical drugs or other products of commercial value? What is the justification for allowing access to rich tourists to view wildlife and scenery, if the people who traditionally use the land are kept away or do not receive any other benefits from tourist activity? In general, what are the incentives to local people and communities to conserve biodiversity, if they do not receive any of the benefits from its continued existence and sustainable use?

The inclusion of local people in the conservation equation entails an analysis of the links between people and nature, identification of positive links (which can then be reinforced) and identification of negative impacts (for which solutions can then be sought). This work should be done as a collaborative venture between local communities and ethnobotanists or other plant resource experts, recognizing the need for the full participation of local communities if proposed solutions are to be effective, as well as acknowledging that some specialists within the local communities are likely to be more knowledgeable about many local plant resources than any outside scientist. Weaknesses in the links between local people and biodiversity include cases where harvesting is endangering the conservation of biodiversity, cases where rates of harvesting are greater than the growth rates of species and cases where there is a loss of local knowledge about the natural world, severing links between cultures and nature, with the danger that nature will no longer be valued locally, removing a motive for its continuing existence.

There is a shortage of trained ethnobotanists and plant resource experts in many countries capable of working with local people on conservation issues. In the past, ethnobotany has too often meant compilation of lists of species used by different ethnic groups, especially as medicines. Such preservation of cultural knowledge has its values, but, in itself, it serves no conservation purpose. In recognition of the urgent need to augment the capacity in many countries to work with local people for conservation, WWF, UNESCO and the Royal Botanic Gardens, Kew have launched a 4 year programme "People and Plants". The approach is to develop a number of model projects (in Malaysia, Madagascar, Tanzania, Uganda, Mexico, Brazil and Bolivia), to provide technical manuals in ethnobotany and related subjects, and to hold training workshops.

There is considerable commercial interest in the development of new natural products, such as pesticides and pharmaceuticals. Over 200 firms worldwide are said to be interested in exploring the plant world in the search for new drugs, sometimes using local knowledge about plants as a guide. Geographically, most research and related commerce is based in the richer "northern" countries, while many of the plants and other organisms under inspection come from the biologically rich countries of the tropics. The Convention of Biological Diversity recognizes that this type of exploitation of biodiversity must be undertaken in ways which benefit conservation of biodiversity, recognizing also that a priority in many source countries is alleviation of poverty. There is a need for equitable partnerships, in which a fair share of the benefits accrue to the countries and local areas which are the sources of the plant samples. The benefits should be used in ways which increase the motivation at these levels to conserve biodiversity and which increase the capacity to do so. WWF has prepared a working paper outlining the issues and with guidelines as to how fair deals may be struck (Cunningham 1993c).

Similar arguments hold in the case of use of germplasm for crop breeding. The main areas of debate relate to local knowledge, farmers' rights and equity in the distribution and control of genetic resources from crop plants (Mooney 1983). The issue was partially resolved when the Commission on Plant Genetic Resources revised the FAO Undertaking for Plant Genetic Resources to recognize both plant-breeders' and farmers' rights (WRI 1992).

Benefit sharing and intellectual property rights

As indicated earlier, benefit sharing to ensure that local communities benefit from conservation and sustainable use is a priority in achievement of biodiversity conservation. This is recognised in the Convention on Biological Diversity. Examination of incentives (and counter-incentives - for example, some of the structural issues associated with reform of the EC's CAP) for conservation and sustainable use is also crucial.

In this context, it is WWF's view that current trends towards extending intellectual property rights (IPRs) regimes could exacerbate the loss of biodiversity. The patenting of novel biotechnologies for agriculture will accelerate the trend towards monocultures and the narrowing of the genetic base of resources used for agriculture, because, in conjunction with other policy settings (eg. bank lending policies, government subsidies, extension services, and corporate marketing strategies), it will increase the pressures on farmers to use patented seeds and animals and so further undermine the biological diversity associated with traditional and low input farming systems.

Furthermore, current IPR regimes do not recognise and reward the knowledge and innovations of local communities, especially indigenous peoples, in conserving, breeding and experimenting on the diversity of cultivated and wild organisms - for instance, those with medicinal or agricultural values - despite the fact that these very characteristics often form the basis of the IPRs issued to others. In consequence, such IPR regimes undermine the benefit sharing provisions, recognised as crucial to the conservation and sustainable use of biodiversity, of the Convention on Biological Diversity.

Conclusions

The conservation of plant genetic resources makes sense both economically and ecologically. There should be a fully integrated strategies combining *in situ* conservation and *ex situ* preservation, with focus on the former.

Governments should ensure that conservation of plant genetic resources forms an integral part of economic, social and environmental objectives at both national and local levels.

Governments should develop national strategies for conservation of plant genetic diversity. Such strategies should be based on knowledge of national plant genetic resources, including their values to local communities and their values in wider regional and global contexts. A key requirement for *in situ* conservation is the identification and protection of key sites and the establishment of effective protection, which normally will involve the participation of local communities.

Organisations holding *ex situ* plant genetic resources should establish equitable benefit sharing agreements with the countries and communities from which their holdings have originated.

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Ex situ and on farm conservation and the formal sector

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Introduction

Whereas ex situ conservation is closely connected with the formal sector, it is not so easy to indicate linkages between on farm conservation and the formal sector. This is a field which has still to be developed. But there are strong indications that increasing cooperation is necessary to cope with the global problem of genetic erosion.

Ex situ conservation and the formal sector

Ex situ conservation is generally done by the formal sector using genebanks. This well known relation will be explained demonstrating the achievements of the Gatersleben genebank. Fifty years ago the Institute of Crop Plant Research was founded within the Kaiser-Wilhelm-Society (now: Max-Planck-Society) of Germany. An integral part of this institute has been from the beginning a collection of plant genetic resources (Hammer 1993b, Hammer and Begemann 1993, Hammer and Gäde 1993). Scientists in Germany have been early aware of the importance of genetic resources for plant breeding (e.g. von Proskowetz 1890, Schindler 1890, see also Lehmann 1990). In 1914 E. Baur published the key paper on "The importance of primitive landraces and wild progenitors of our crop plants for plant breeding" (Baur 1914). Baur was influential with respect to scientific thought in Germany. In the 20ies he himself was greatly influenced by the convincing new ideas and concepts of N.I. Vavilov. But only long ager his death in 1933 the above indicated institute was founded in 1943 with the included plant genetic resources collection definitely as a basis for plant breeding under the first director H. Stubbe (Stubbe 1982) in Vienna (Austria). During the war the institute was transferred to the Harz Mts. in the centre of Germany and just after the war it came to the nearby village Gatersleben where it is still located.

The developing of material in this plant genetic resources collection, since the beginning of the 80ies called genebank, is shown in table 1.

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Table 1: Development of material in the Gatersleben genebank

Year	No. Accessions	
1945/46	3.500	(estimate)
1950	12.550	
1955	15.652	
1960	20.197	
1065	29.120	
1970	32.489	
1975	40.628	
1980	48.959	
1985	57.888	
1990	68.840	

Source: Hammer (1993b)

Table 2: **Material in the Gatersleben genebank (1992), including the new stations**

Crop groups	No. accessions
Cereals[a]	34.805
Grasses[b]	8.187
Potatoes (Station Groß Lüsewitz)	4.494
Beets	1.485
Pulses	16.006
Clover and related crops[b]	3.785
Oil- and fibre-crops[b]	6.953
Medicinal plants, spice plants, technical crops	3.646
Vegetables (incl. Cucurbitaceae)	9.962
Mutants and genetic stocks (Lycopersicon, Glycine, Antirrhinum)	2.614
Fruits (Stations Dresden-Pillnitz	1.405
and Müncheberg)	1.878
Ornamental plants	
Total	**95.219**

[a] Includes Secale and triticale (Station Gülzow)
[b] Includes grasses, clover and oilseed collection (Station Müncheberg)

Source: Hammer (1993b)

The present overview on the material is shown in table 2. After the political and economic changes in

Germany the Gatersleben institute was newly founded in 1992 as Institute for Plant Genetics and Crop Plant Research including stations in northern (Groß Lüsewitz, Malchow, Güstrow) and southern parts (Dresden-Pillnitz) of eastern Germany with special collections comprising now nearly 100.000 accessions.

The material in the genebank derived to a large part from collecting missions. After relatively scanty activities in the first years the Gatersleben genebank carried out an intensive collecting programme in the 70ies and 80ies (table 3).

Table 3: Collecting missions conducted by the Gatersleben staff, 1974-1990

Collecting area (year)	No. Accessions
Czechoslovakia (1974, 1977, 1981)	1.153
Eastern Germany (1975-1984)	694
Poland (1976, 1978, 1984)	442
Spain (1978)	344
Italy (1980-1989)	2.077
Libya (1981-1983)	468
Georgia, former USSR (1981-1989)	2.709
Austria (1982, 1983, 1985, 1986)	265
Ethiopia (1983, 1984)	186
Korean DPR (1984-1989)	530
Mongolia (1985, 1987)	67
China (1986, 1988)	67
Iraq (1986)	141
Cuba (1986-1990)	517
Central Asia, Former USSR (1987,	141
1988)	112
Colombia (1988)	37
Peru (1988)	
Total	**9.950**

Source: Hammer (1993b)

The material in the genebank is offered to the user community by publishing Indices seminum (table 4). For the special use of plant breeders since 1981 an extensive supplementum of cultivars is published every four years (Supplementum cultivarorum). The indices also contain information on the results of evaluations.

Thus the genebank material is accepted by the users, as can be seen from table 5. The number of accessions provided directly for plant breeders is relatively low. But we have to consider that material from genebanks is often of little direct use for plant breeding. In most cases germplasm enhancement is necessary which is usually done by groups of scientists engaged in breeding research. The material ordered by these groups has been put into the category "Research institutes, collections etc." in table 5.

Table 6 shows the amount of material which underwent a further evaluation (Blixt and Williams 1982) in departments of the Gatersleben institute or in other institutes (Hammer 1991c). The evaluation work reflects the economic importance of the crop groups for plant breeding. Cereals have been intensively evaluated, in vegetables there is still a lot of work to be done. An overview on the intensive evaluation work in the Gatersleben collection is presented by Hammer et al. (1993).

Further evaluations are the precondition for the use of genebank material in plant breeding. Table 7 shows the number of released cultivars in eastern Germany for which material of the Gatersleben genebank was used during the breeding process. There are quite similar relations between the crop groups as in table 6 stressing the close connection between further evaluation and released cultivars. The brief demonstration of the main activities of the Gatersleben genebank shows that they are concentrated toward collecting, maintaining and use of plant genetic resources for plant breeding although there has been developed a considerable part of research for genebanking itself (see Hammer et al. 1993) which, in turn, is useful and necessary for all programmes that deal with the maintaining of biodiversity.

The paradigma of plant genetic resources work

A critical survey of ex situ conservation (Hammer 1993a) is necessary to develop a new and more integrated approach toward conservation and use of plant genetic resources. The main facts of criticism are connected with what has been described as the paradigm of plant genetic resources (Hammer 1993c). This paradigm is based on the fact that the diversity of landraces is displaced with increasing speed by a few modern and uniform cultivars. Accordingly the only possibility for conserving the tremendous variation in cultivated plants threatened by genetic erosion should be the inclusion of the material in genebanks. Even at the beginning of the 80ies there have been prognoses that landraces and local material under farm cultivation will have disappeared by the end of our century. Now we known that this prediction has been guided by the paradigm and gradual change was already visible in the second half of the 80ies mainly because of the activities of the NGOs and the growing awareness of genebanks that the future of plant genetic resources is not exclusively connected with ex situ reproduction.

Some critical issues of genebank activities

Critical issues of genebank activities cover a broad spectrum from political-economical and sociological to natural-scientific reasons. Only a few will be mentioned here which seem to be of importance in the context of this paper.

1. Genebanks are extremely dependent on the financial possibilities (Shands 1991) and willingness of the state. A political and/or economic change can destabilize whole genebank systems as it could be recently observed in eastern Europe.
2. In many cases the ex situ conservation of material in genebanks had to be concentrated on long-term cold storage of seeds simply because of financial constraints. Accordingly other methods of ex situ conservation have been neglected, e.g. the proper handling of cross pollinating crops and of races propagated vegetatively.
3. There was too much optimism at the beginning of the 80ies (because of the paradigm) concerning the amount of material present in genebanks. Unfortunately this was a time when genetic erosion proceeded extremely fast and therefore additional material was lost.

4. There are more than 5.000 crop species globally but only a few hundred are present in genebanks. Additionally the number of species with a more or less sufficient variation maintained in genebanks is rather limited. Another problem in this direction is the ever increasing possibility for using material from the secondary and even tertiary genepools. Only a global concept of in situ including on farm conservation complementary to genebank collections can meet the growing demands.
5. Maintaining of material in genebanks should exclude, in the ideal case, further evolutionary changes (Hammer 1993a). On the other hand, evolution of new adaptations (e.g. disease resistances) should be allowed in crop plants. Here we find another reason for in situ and specifically on farm conservation.

At least the last two of these five points can be much better handled by inclusion of the informal sector and should be, therefore, discussed in more detail.

Table 4:
The Index Seminum Gaterslebensis through the years

Year	No. pages	Year	No. pages	Supplementum cultivarorum, no pages
1948	32	1971	161	
1949	45	1973	170	
1951	54	1975	182	
1953	56	1977	189	
1955	60	1979	193	
1957	70	1981	41	174
1959	84	1983	62	
1961	87	1985	73	166
1963	103	1987	78	
1965	120	1989	82	173
1967	135	1991	87	
1969	150			

Source: Hammer (1993b)

Table 5:
Accessions provided by the Gatersleben genebank, 1991

Receiving institutions	Country	No. accessions
Botanical gardens	Germany	742
	Other countries	2.414
Research institutions, collections etc.	Germany	4.043
	Other countries	3.990
Plant breeders	Germany	494
	Other countries	26
Other departments of the Gatersleben institute	Germany	148
Subtotal	Germany	5.427
	Other countries	6.430
Total		**11.857**

Source: Hammer (1993b)

The amount of plant genetic resources

When Mansfeld published his "Verzeichnis" (Mansfeld 1959), which contained about 1.430 species he estimated the total amount of cultivated plant species (excluding ornamentals and forest trees) with 1.700 to 1.800. The new edition of the "Verzeichnis" (Schultze-Motel 1986) contains about 4.800 species and meanwhile further information was obtained particularly by field work in formerly neglected areas (Hammer 1993c).

It became clear that our global information was quite comprehensive but area dependent studies (e.g. Hanelt and Beridze 1991) were rare. The developing of the checklist-method for selected for selected areas (Hammer 1991a) resulted in new input also on the species level as can be seen from table 8. More than 1.000 cultivated species have been found in Cuba alone, i.e. more than one fifth of the known global number from a comparatively small area.

Another factor for estimating the amount of plant genetic resources is the infraspecific variation, particularly of old and important crops with a wide geographical amplitude. Some results from the Gatersleben school of taxonomists have been compiled by Hammer (1981) and are shown in table 9. These results are based on morphological traits but they provide a certain impression on the wealth of infraspecific variation.

Table 6: Number of accessions evaluated in the Gatersleben genebank 1975-1990

Group	No. accessions
Cereals	44.548
Pulses	16.221
Vegetables	3.557
Total	**64.326**

Source: Hammer (1993b)

As a third factor the genepool has to be mentioned. When Harlan and De Wet (1971) published their concept it was rather difficult to include the secondary genepool in breeding work. Today we known numerous examples involving even the tertiary genepool and the range of usable material became rather high (see e.g. von Bothmer et al. 1992).

In this way maintaining and use of plant genetic resources is ever more becoming a global problem, approaching to and merging with the efforts trying to manage biodiversity. This task calls for the inclusion of a whole range of possible inputs in a concerted action including the formal as well as the informal sector.

Table 7: Released cultivars bred using accessions from the Gatersleben genebank (1973-1990)

Crop	No. cultivars
Spring barley	30
Winter barley	3
Spring wheat	1
Winter wheat	12
Peas	9
Lettuce	1
Total	56

Source: Hammer (1993b)

Ongoing evolution

Ongoing evolution within the populations of a genebank is a serious problem (see Hammer 1993a). Vavilov recommended the reproduction under ecologically and climatically similar situations as the collecting sites and created a net of stations all over the former Soviet Union. Other genebanks without such tremendous possibilities had to rely on line-splitting to avoid the loss of rare and non-adapted genotypes within populations (Lehmann and Mansfeld 1957). Genebanks try to maintain the original variation particularly by effective methods of long term storage of seeds. In this way they try to reach a static equilibrium. Whereas a dynamic equilibrium, including also the important host-parasite-interactions, can be only achieved under on farm conditions.

The most spectacular cases of ongoing evolution under farm conditions are connected with introgressions. Therefore, in many cases not only are on farm conditions involved but also more generally in situ situations when wild plants (progenitors, related races) are included (Hawkes 1991).

In the following some recent examples for introgressions are mentioned. Introgressions have been observed by us between

- wild (Secale strictum) and cultivated rye (S. cereale) in southern Italy (Hammer et al. 1985a);
- wild/weedy (Hordeum vulgare subsp. spontaneum) and cultivated barley (H. vulgare) in Libya (Hammer et al. 1985b);

- wild (e.g. Brassica rupestris) and cultivated cabbages (B. oleracea) in Sicily (Perrino and Hammer 1985);
- wild/weedy (Beta vulgaris subsp. maritima) and cultivated beets (B. vulgaris) in Calabria (Hammer et al. 1987);
- wild (Pyrus amygdaliformis) and cultivated pears (P. communis) in some parts of southern Italy (see e.g. Hammer et al. 1987).

Exclusively within on farm situations introgressions could be observed in several cases from which wheat in southern Italy should be particularly mentioned (Hammer and Perrino 1984).

Table 8: Results of the work with checklists

	Italy	Libya	Korea	Cuba
Taxa	541	280	473	1.045
Species	522	276	456	1.029
Genera	300	187	314	531
Families	86	67	99	117
Synonyms	347	50	358	727
Vernacular names	2.833	223	530	1.671

Source: Knüpffer 1992, Hammer et al. 1988, Baik et al. 1986, Hammer et al. 1992

A special case are crop-weed-complexes in which the related species grow as weeds in the field of the crop (Hammer 1991b), e.g. Avena fatua in fields of Avena sativa (Kühn et al. 1976).

In all these cases ongoing evolution is evident and should be supported. On farm conservation is the most effective way. Other examples are not so evident but nevertheless of great importance, as the possible loss of resistance genes with the absence of a specific selection pressure (Knolle 1989, Hammer 1991b).

Table 9: Number of infraspecific categories in cultivated plants following the treatment by Gatersleben taxonomists

Species	Number of different taxa at the lowest taxonomical rank
Triticum aestivum L. s.l.	404
Hordeum vulgare L. s.l.	192
Pisum sativum L. s.l.	101
Glycine max (L.) Merr.	97
Papaver somniferum L.	52
Brassica oleracea L.	31
Linum usitatissimum L.	28
Lycopersicon esculentum L.	24
Beta vulgaris L.	17
Vicia faba L.	6
Nicotiana rustica L.	6

Source: Hammer 1981

On farm conservation and the formal sector

The formal sector, because of its specific expertise, has to play a more active role in on farm conservation, e.g. finding out areas for case studies and helping in the monitoring of the systems. In may cases seeds have been provided for NGO activities. Collecting and conservation of this material by genebanks was the precondition for a successful reestablishment of traditional crops in European farms. After the redetection of Triticum monococcum and T. dicoccon as relic crops in parts of southern Italy (Perrino et al. 1981) a public awareness for these traditional cereals was obtained by publications and in scientific and other meetings. The proposal to create field reserves with financial support from the EC (Perrino and Hammer 1984), following an earlier more general proposal of Kuckuck (1974), obviously came to early. But farmers in several parts of Italy started to cultivate einkorn and especially emmer wheats again, partly in projects together with the Bari genebank, so that now an increase of cultivation of these traditional wheats can easily be observed together with new scientific input (e.g. D'Antuono 1989, D'Antuono and Pavoni 1993).

A special system has been developed by the Hungarian genebank in Tápiószele (Holly and Unk 1981) which is called "backyard multiplication" and includes now about 100 people in ten districts (Anon. 1993a) who distribute seed samples from the genebank to farmers for multiplication. In this way the original composition and genetic diversity of Hungarian landraces could be successfully maintained. In eastern Germany where there was hardly any sector of private agriculture left after the establishment of collective farms, the Gatersleben genebank developed an effective cooperation with open air museums which maintained and reproduced local fruit trees (Heller 1993) and cross pollinated crops as e.g. rye (Hammer 1990). It is interesting that in the western part of Germany despite of the private ownership of land, genetic erosion proceeded equally fast because of other economic pressures, so that similar solutions with open air museums have been developed (see e.g. Sukopp 1983, Plarre, 1985).

A relatively new development can be observed with biosphere reserves (Anon. 1993b) where in the marginal zones there is often need for a certain type of agricultural production and this production should be based on traditional landraces.

The few examples indicated can be seen as first steps into the right direction. An integrated system is necessary to serve the present and future human subsistence and particularly nutrition. There is no real alternative for an integrated NGO - GO approach in conserving plant genetic resources (Hammer 1993c).

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On farm conservation of fruit trees and the informal sector in Italy

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Abstract

The present contribution deals with two research projects concerning on farm conservation of local, old and archaic fruit varieties, carried out, by regional associations and other institutions, in selected areas of Central Italy.

The paper deals also with the utilization and improvement of local varieties possessing interesting traits for the market, and for which there are strong links with the sociological, economical and historical knowledges of the territory.

Methods and strategies to search for old varieties and their conservation are presented and discussed in the light of the results obtained during the present research work.

The status of on farm conservation, through the informal sector in Italy, is shortly described. A direct or indirect influence of the formal sector is inevitable.

Introduction

The high hills of North and North-East Umbria, is an area characterized by calcareous soil and long lasting summertime drought.

In this area, for centuries the traditional crop system has been multicrop, otherwise said vertical multicrop, since cereals or tobacco were cultivated in association with olive trees or, more often, vine trees, which were supported by elms, maples and, occasionally, fruit trees. An ancient adage said that farmers had to cultivate "high and low" to better indicate the vertical crop differentiation (Desplanques, 1969).

The great diffusion of metayage (mezzadria) intensified the tendency toward multicrop and characteristic plantations of trees (alberata), sometime fruit trees, supporting vines (Sereni, 1961). All this was the consequence of the landowner habit, that was to encourage metayager's family to settle on the farms, often very isolated, with the hope to prevent major seasonal emigrations, once typical of the large landed estates of Southern Italy; in this system farmers and their family had to secure themselves with all the necessities for survival. The result was a closed economy, largely dependent on multicrop. (Deplanques, 1969).

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Within the metayage system, farmers made into cultivation also very difficult and poor soils, resulting from deforestation, often turning to be unprofitable.

Staying this situation, farmers used to grow fruit trees which, in general, grown in association with other crops, were more resistant to every kind of pest or climatic adverse conditions, providing fruits for the whole year around, since they could be conserved very well in the fruit storage.(Canevari,1884)

These fruit trees were an integral part of the economy, landscape and nutritional needs. Even, they became part of the daily spirit and social life (Marchenais, 1984). In fact, women who got married, brought, as part of their dowry, some useful plants from their native area.

Some fruit trees were important for monitoring the growing seasons, as, for instance, the medlar: "If you see the medlar, cry, because it is the last fruit of the summer", says a popular proverb. Some of these fruits were more important than others in traditional culinary culture, as the quince, which was used to produce quince jam or to preserve grape mustard (Tamaro, 1905). Moreover, almost all of the cultivated fruit species had more than one use, as, for example, figs. Because of their light wood, figs were utilized to made wooden clogs, especially for children, or adopted to shade the manure sites; all this in addition to their primary aim of producing fruits twice a year. Figs have a symbolic value for fertility from the Roman time.

Generally, fruit trees were not intensively cultivated in the orchards. They were grown near the house building, supporting the vines or delimiting the edges of the field. Usually they were very vigorous, since they were left to grow their full size.

With the decline of metayage, the most difficult soils, in the high hills, became abandoned, while in the plains the trees were cut down as a consequence of the economical advantages of a mechanized agriculture and more intensive cultivation.

In some cases the metayers, at the expiration of their contract, in a sort of revenge, due to the great poverty in which they had lived, to spite of the landowner, cut all the fruit trees down.

Notwithstanding the great changes that agriculture has undergone during the last 40 or 50 years, it is still possible to find some old fruit trees; occasionally, old farmers still live and work on their little farms in a traditional way, conserving an inestimable amount of resources. (Perna; Dalla Ragione, 1992)

Thus fruit trees are still present in farms of the high hills , where changes were less profound; often it is possible to find very old plants and sometimes more than one century old; this is especially true for pears, near the house or at the edge of the field or in the middle of abandoned vineyard. This genetic treasure should be preserved together with the traditional and popular culture.

Materials and Strategies

This research was started about ten years ago in collaboration with the Folk Museum of Città di Castello. It concerns the territories of the high valley of the Tiber, between Toscany and North Umbria (Fig. 1).

Research was started in places still inhabited by old farmers, where it was possible to find both the fruit and the traditional knowledge regarding trees and their cultivation. At the beginning of this work, the species that the team research looked for, were primarily: apples, pears, plums, figs and cherries.

Little ancient villages, abandoned farms, isolated houses, former large land properties, ancient villas, obsolete vineyards or previously cultivated fields, already become woods, were visited (Dalla Ragione, 1992).

It was useful to visit the monasteries, especially cloisters, where an economy independent from the outside influence was perpetrated for long time. The monasteries reflected, in a urban environment, the same subsistence system that was present in the isolated farms. The friars who begged to the central Italian farms, were the typical character, of the countryside, in the past; often the farmers gave them, as alms, some fruits or seeds. Friars always were great divulgers and especially great keepers of plant species. Special permits were needed to enter in their large gardens, where old varieties of pears and figs were found.

A farm, famous for the production of the same old fruits, since 40 years, was occasionally met. This farm, close to an ancient road (Salt Road), between Umbria and Toscany regions, is situated in an area which was densely inhabited in the past and is now almost completely abandoned. The farmer, 85 years old, is still alive. He knows every tree of its farm and he grows many varieties which consecutively produce fruits, almost every 15 days, from May to November. An example of this sequence is the following. **May**: cherries "Maggiaiole"; **June**: "Giugnina" pears; **July**: "Verdacchia" plums; "Corniola" cherries; "Lugliesca" pears; **August**: "Moscatella", "Bianchina" and "Garofina" pears; "Agostina" apples; **September**: "Brutta" and "Buona" and "di S.Maria" pears; **October**: "del Castagno", "Roggia", and "Rosona" apples; "Vernia" pears for cooking; **November**: sorbs and medlars.

Apples, gathered in October with the declining moon, are conserved in the fruit storage until May. In this way the annual- circle is completed. In many other cases isolated and abandoned trees were found, from which it was very difficult to obtain material for reproduction, as a result of being very old and no longer cultivated.

Simultaneously with the field studies, historical research was carried on, examining old agricultural handbooks or material from the ancient Farmer Teaching Travelling (Cattedre Ambulanti Agricole), documents from convents and local toponymy.

Results and discussion

Arboreal Archeology project

Since 1983, on a private farm, in the hills around Città di Castello, a private fruit collection was established: "Archeologia Arborea" (Arboreal Archeology).

The soil in this farm is a typical one, arranged in terraces, where fruit trees, propagated by grafting or budding on wild rootstocks, are cultivated by traditional methods.

At the moment the collection consists of 312 plants with 22 old varieties of apples, 12 of pears, 8 of cherries, 8 of plums, 3 of peaches, 5 of figs, some sorbs, medlars, almonds, walnuts; some other unusual plants which were, once, well known and are now almost forgotten, as, for instance, the jujube tree or the azarole tree, are also preserved. In this way the traditional chronological sequence of fruit production is maintained (Boni,1925) and some old methods of grafting were tried: sour black cherry (amarelle) on plum, pear on oak, peach on willow (Berti;Cavazza, 1883; Cantoni,1884). On the other hand identification, classification, description and reproduction work is carried on.

Every part of the trees, flowers, leaves and fruits have been documented by photography; an atlas, with the double aim of indicating the geographical distribution of indigenous fruit trees and of protecting them, was produced.

The surveyed varieties have been catalogued using a simple card method, with a description of the main characteristics of the plant, flowers, leaves, fruits, together with information on ethnobotany and history.

The private association "Archeologia Arborea", devoted to the advancement of the knowledge related to old varieties and to their protection, was then established also as a consequence of the present work. The results of this first project clearly show that there was a need to integrate on farm conservation with field collections of as many old varieties as possible.

Farmer Archeology project

In 1991 a new project, "Archeologia Agricola" (Farmer Archeology), was proposed within the framework of a collaboration between the Leader Program of the European Community and the Comunità Montana "Alto Chiascio" di Gubbio and Gualdo Tadino cities c/o Peripheric Regional Office for Forestry. Part of the work takes place in a hatchery of the Comunità Montana, located in the same research area. This is located in North-East of Umbria, near Gubbio and Gualdo Tadino cities (Fig. 1). It was historically part of the Duchy of Montefeltro of Urbino, experiencing a great deal of influence from the neighbouring region: Marche.

Archeologia Agricola has the objective of preserving and use local fruit varieties on the market at any level. One of its most important functions is to sustain connection among farmers of the planned area and other economic sectors that could be interested in these fruit crops, as, for example, that of the modern rural tourism.

One of the products will be a map of the locations where old varieties have been found. An official proposal to the Regional Office for Agriculture and Forestry concerning the protection of these old plants will then be submitted. At the same time studies on: the historical backgrounds; the ancient and local traditions; the relationships between farmers and plants, have been carried out. To cite an example it was possible to find a characteristic farm still dealing with the following traditional chronological harvesting:

May: "Maggiaiola" cherry; **June**: "Limoncina" cherry, "Cherry" plum; **July**: "Lugliatica" pear, "Ghiacciola" pear, "Cantiano" cherry, "Pacchiarella" plum; **August**: "Cannella" pear, "Moscatella" pear, "Stratarina" apple, "Regina" plum; **September**: "Renella" apple, "Gesù Cristo" apple, "Vigna" peach, and various grape varieties; **October**: (to maintain in the fruit storage until April) "Conventina" apple, "Pagliaccia" apple, "Rosa" apple, "Ciucca" apple, "Costarella" apple , "Broccaia" apple, "Burro" pear, "Vernia" pear, walnuts, almonds, sorbs and quinces; **November**: (to store until the following May) "Rosa in pietra" apple, "Polsola" apple and medlars.

Traditionally fruit trees grow in different positions of the farm land: walnuts and figs are close to the house, sorbs and some apple trees are far in the garden, some grow in the vineyard used as supporters and finally, some various others are grown at the boundary of the fields. This farm exchanged plant material with many other farmers of the same research area.

A second farm, with a lot of outmodel fruit trees, belonging to a great landowner was met. A new little orchard with the old varieties found on his land was constituted. In both farms, the development of fruit trees was kept under constant observation.

In the whole area, visited within the framework of this second project, 16 local varieties of apples, 5 of pears, 4 of cherries, 5 of plums and 2 of peaches were catalogued and reproduced. A collection consisting of two plants for each variety was created. In the nursery of the Comunità Montana the varieties are grafted on wild rootstocks, and some of these are reproduced for distribution. In fact in this area it was possible to recognize several interesting fruit varieties that could be directly introduced to the market.

Two experimental fields were established: the first devoted to testing different rootstocks (apple: wild, MM106, M26; pear: wild, quince BA29, OHF333; cherry: wild, mahaleb, St.Lucia 64); the second dedicated to evaluating the different period of flowering as compared to "Golden" apples and the "William" pears.

The project also includes the establishment of three demonstrative orchards, cultivated with traditional local practice, in places different for pedology and exposure.

Last summer (1993) exploration proceeded on the Chiascio Valley, between Gubbio and Gualdo Tadino cities. This is a particular area because in a few years it will be submerged by several million of cubic meters of water, due to the imminent construction of a big dam in Umbria region. In this perspective, the most crucial item of these years is to achieve the protection of as much germplasm as possible, before this event occurs. As a consequence of this prompt action it was possible to collect 40 local varieties of pears, apples and plums which will be evaluated in the near future.

Description of few ancient fruit varieties

Within the framework of both projects, Arboreal Archeology and Rural Agricultural Archeology (Archeologia Agricola), for some of the local and old varieties, identified, catalogued, protected, reproduced and considered more ancient, a short description is here given.

Within the project Arboreal Archeology

Mela del Castagno: native to a particular farm near Città di Castello and diffused on all the near-by farms which have very old specimens. It is a medium-large, green, a little acidulous apple, being very resistant to fungin diseases, and above all , it is stored very well and very long in fruit storage.
Mela Roggia: it probably comes from Toscany. It is an autumnal fruit, proving to be very resistant to the most widespread diseases and insects. The skin is completely rusty and the pulp is white and acidulous. It can be conserved very well and very long.
Pera cocomerina o briaca (drunk): it is a medium-sized fruit from the mountains between Toscany, Romagna and Umbria. It ripens at the end of August. Its main characteristic is that its pulp is light red, almost the same colour as watermelon. It is sweet and good tasting.

Within the project Farmer Archeology

Mela conventina: it is very characteristic and well diffused in this area. It is a large autumnal apple, yellow and thick skin, and white, and sweet pulp. It maintains for a long time. The name comes from the word convento (monastery) where this variety was very popular.
Mela ciucca: it is an autumnal variety, very singular for its pear-like form. It preserves well for winter time.
Mela Polsola: winter variety, gathered in November, it conserves until the following May. It is of medium size, with a long stem and a conical oval form.
Pera Cannella: summer variety, it has a very good spicy flavour, similar to cinnamon, from which it takes name (cannella=cinnamon). It is small in size, with a dark red skin and a very sweet pulp.

The results of the plot tests are not available yet, since these varieties were planted two years ago. Observing the old trees, a great resistance to fungin diseases could be ascertain; they adapt to unfavourable habitats by means of morphological and physiological characters. For example many apples have a thick pericarp and are often rusty in colour; this enables them to better resist the conditions of drought.

The informal sector in Italy

Several figures of the informal sector are, apparently, contributing to conservation of fruit trees diversity. They are almost uniformly distributed all over the Italian regions. The sector is too heterogeneous to be called simply informal. There are many different levels, interests, roles and aims. Everything that is not official is considered informal. Even so this great spectrum is highly fragmented, without organization and a common policy, deserves to be considered
and praised . Moreover it seems that there is no connection among the various elements of this sector; therefore, often, research and conservation activity is done exclusively for the devotion and the awareness of single persons or farmers. Nevertheless it was possible to identify different groups of active subjects from the informal sector. In order to give a general picture about it, the main groups are here listed and briefly described.

Farmers

As it is highly recognized today, farmers have been the principal protagonists of plant conservation, especially those working in marginal areas, hills and mountains. They are the sole left witnesses of the popular knowledge. They have conserved some varieties as a consequence of the bond of affection with plants, even when plants have lost their economic importance. Thus farmers, preserving local genetic resources, should be considered cardinal figures for future conservation actions.

The European Community Regulation n. 2078 /1992 promotes the preservation of the traditional rural landscape and the local varieties. Though this regulation has been produced late, it is still on time to save what remains from a much richer genetic patrimony. Old varieties may be reintroduced in cultivation by old and young farmers not only in virtue of the above mentioned low, but because of a constant pressure, of many social components, towards conservation of biodiversity. In Italy there is still a large number of traditional farmers, and often young too, willing to live closer to nature rather than in big industrial cities. Few but strong and convinced farmers of any age are waiting the right actions from a more adequate and updated politics.

Biological farmers

They are generally organized in local cooperatives and/or regional associations. They are sensitive to conservation problems but sometimes they are novice farmers, with no connection with the previous generation of farmers, who have gone back to agriculture too late to save most of the old and local varieties. With difficulty they find plants or trees to be conserved or reproduced; moreover, they often buy modern varieties to be grown under biological methods.(Recchia,1992).

Nevertheless, there are some important activities carried out by these associations, which, directly or indirectly, are serving the cause of on farm conservation of old fruit variation.

Biodynamic farmers

Farmers belonging to farmer associations. This category of farmers by using and cultivating only local varieties plays a very important role in their conservation. As for the previous category the number of associations increases every year. It seems there are already many farmers working on cereals, vegetables and fruit conservation.

Local and regional institutions
They are not exactly in the informal sector but neither belong to the formal one. They could represent a bridge point between the formal sector and the farmers, also as a consequence of their distribution on all territories and regions.

There are many interesting activities carried out by the several Regional Agricultural Developmental Bureaus (Enti di Sviluppo Agricolo Regionale) of different regions. Since 1984, some of the Bureaus have searched for old and local fruit varieties and,
eventually, constituted a collection of these varieties. (Virgili; Polidori, 1002).

Organic projects to appreciate those varieties appearing more promising for the market and to involve, in the conservation program, the local farmers and experts are in preparation in collaboration with the Comunità Montane and in some cases with public Research Centres (Perrino, 1992).

Amateur Clubs
This group of organizations is in itself very heterogeneous; sometimes single elements have no direct connection with agriculture, though often they grow and maintain interesting plants. In this group private collections may be included. All over Italy a certain number of clubs are known to be active for different groups of plants.

Private nurseries
As far as Umbria region is concerned, at the moment about 20 hatcheries propagate and sell plants of fruit trees and vines of old varieties. There are, certainly, many others, throughout the peninsula, but, as explained, it is non easy to discover and list them out. The Germplasm Institute of Bari is creating a data bank including information concerning nurseries too.

In conclusion, from this short analysis, it appears evident that the informal sector needs a sort of co-ordination in order to improve exchange of information between sectors, of genetic material among farmers and experts, keepers and amateurs and set up a minimum of organization. To reach the above mentioned gols it is necessary to promote training and education. Finally farmers should be contacted and involved, but keeping in mind that any development has to be economically sustainable. Financial support or contributions, from any source may help only for studying, understanding and solving difficulties linked with the problem in hand, but not the problem itself.

Conclusions

All of the research carried out in these few years, confirms the existence of a very rich genetic patrimony for fruit trees in Umbria region. The most difficult task is, however, to maintain an entire millinery popular knowledge which was at the basis of the existence of these old species and varieties.

Separated from their sociological, economic, etnobothanical, cultural context, fruit crops may loose their function.

The present project succeeded in saving only part of this complex heritage. The last witnesses of this culture have disappeared and the post-war agricultural generation has lost the kind of knowledge proper of the former generation. In the last 10 or 15 years, there has been a return of emigrants together with the arrival of many foreign families. This phenomenon has led to a positive repopulation of the countryside but it has not helped in maintaining the traditions. Braking the direct relationship with the territory and its history It accelerated the erosion of traditional culture and, deftly, that of the local and old varieties. However it is possible to verify a great interest of the younger local farmers who know these species or varieties only from the stories of their grandfathers. Keepers of rural touristic farms, who wish to offer to their guests traditional and typical products, are also highly committed. In addition a great interest in starting cooperation with some farmers of the biological and biodinamic sector was noted. Some fruit varieties, like Conventina apple, still diffused and known in the local market, are conserved, without problems, by farmers and consumers. One way to reintroduce, cultivate, save and add economical value to local varieties, is to certify them as "typical product" or "local" or "traditional products".

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Integrated approaches to *ex-situ* and *in-situ* conservation

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Introduction

Biodiversity is the main strategy of survival of natural ecosystems and species within ecosystems. Through processes of inter-specific competition and at the species level migration, mutation, recombination, and selection dynamic equilibria are established with existing natural resources, while maintaining genetic options for plasticity and change in response to diverse and sometimes changing environments.

Traditional farming systems were and are based on similar concepts. Through mixtures of crops and genetic variation within crops, yield security is a major objective. This is essentially achieved through natural balances between crops and both biotic and abiotic stress factors at least partly by maintaining appropriate levels of genetic diversity within and between crops. This process has led over time to a multitude of landraces, resulting from both human and natural selection. These landraces provide adaptation to a wide range of different environmental conditions. In these cropping systems genetic diversity is naturally maintained in an evolutionary manner. Areas where traditional agriculture is practised are therefor important reservoirs of still existing and evolving genetic diversity.

The importance of landraces as a source of genetic diversity to plantbreeding is obvious. However it should be realized that the objective of such cropping systems is not conservation *per se*. These systems employ genetic diversity as a strategy for yield security and thereby maintain genetic diversity. However there generally is a constant turn-over of different landraces, often obtained by exchange within and between farming communities, combined with introgression and selection. As agricultural systems change, so does genetic diversity within such systems. And agricultural systems are changing due to cultural changes as a result of economical and social development, but also due to environmental changes, inflow of modern and exotic varieties, and due to calamities like droughts, floods or wars. Traditional agriculture is also increasingly being affected by modern agricultural practices based on the use of external inputs to cope with rising population pressure in many areas. Hence from the point of view of conservation, even traditional farming systems are not secure, more so since changes in such systems are difficult to monitor. The obvious conclusion is, that *ex-situ* conservation is essential as a back-up system to *in-situ* conservation.

The basic changes affected by modern agriculture are, that rather than adapting crops and crop complexes to different environments, the production environments are adapted to the requirements of specific crops. Abiotic stress factors are dealt with by soil management, fertilizers,

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irrigation etc. reaching their ultimate level of control in greenhouse production. Biotic stresses are met by chemical control combined with in time often temporary resistances and tolerances obtained through breeding. The main objective changes from yield stability and sustainability to maximizing bulk production. The latter has led to selection for uniformity within varieties as a natural consequence. Maintaining genetic diversity within varieties and between crops is thus not any more practised as part of the farming systems. Hence, modern agriculture doesn't contribute to maintaining genetic diversity. *Ex-situ* conservation in such situations becomes not just desirable but absolutely essential.

Geographical differentiation

A geographic distribution of modern and traditional agriculture will parallel the distribution of relative importance of *ex-situ* and *in-situ* conservation strategies.

Developing countries

In most developing countries introduction of modern varieties and high in-put agriculture is limited to a number of major crops and concentrated in limited areas with generally favourable production environments. Modern plant breeding has successfully raised the genetic yield potential of crops, mainly by increasing the amount of dry matter diverted to harvested product and less through an increase of total biomass. The expression of a higher yield potential of modern varieties compared with traditional landraces is generally based on a better utilization of external inputs, notably fertilizers and irrigation for harvested product. In addition plantbreeding has been effective in improving specific characteristics that have a high level of qualitative genetic control, such as single gene controlled disease resistances. Breeding for the required tolerances of or adaptation to complex and variable (in time and over small distances) environmental stress situations without the use of costly compensating external inputs is extremely difficult and often has a low cost/benefit ratio in terms of overall production increases. Also many minor crops often do not justify in terms of realized improvements the high cost of institutional breeding programmes.

Hence in these regions essentially two systems of crop improvement and seed production can be recognized.

1 A Formal Institutional System linking *ex-situ* genebanks with institutional and private industry breeding, seed production and ultimately distribution of improved varieties to farmers. Such farmers thus benefit from genetic diversity in a linear model of transfer.

  Modern improved varieties appear to have their main impact in the more favourable production environments and generally require for full exploitation of improved yield potential the use of external inputs such as fertilizers and additional control of both biotic and a-biotic stress factors.

2 A Non-institutional Informal System, consisting of farmer households and communities still growing landraces and integrating utilization and conservation of genetic diversity in a dynamic system of crop improvement and seed production based on local knowledge systems.

  This system is responsible for maintaining a large source of still available genetic diversity of direct importance to the institutional system and covers a majority of farmers in developing countries. Nevertheless it does not benefit in any substantial manner from advances in plant breeding or from ex-situ genebanks.

These definitions represent the extremities of what in reality is more of a continuum. Many farmers will, pending on the crop and/or the environment participate to a greater or lesser extent in both systems.

Most major centers of diversity of crops are located in the tropics and sub-tropics. This is fortunate, because for that reason there is still a lot of genetic diversity *in-situ* maintained in the informal system. The need to integrate in such regions *in-situ* and *ex-situ* conservation is obvious and has received attention in the Biodiversity Convention and in funding made available through the Green Environment Fund managed by the World Bank. It forms the basis of a number of new initiatives that are being developed by some international institutes of the Consultative Group on International Agricultural Research (CGIAR), notably IRRI (rice) and CIP (potatoes and minor Andean crops) and a programme proposal prepared by the genebanks of the Netherlands and Ethiopia together with regional Non-Government Organisations in Latin America, Africa and Asia. Such programmes are concentrated on areas where the adoption of modern varieties is low because farmers prefer for a variety of reasons their traditional landraces. The objective of such programmes is to better understand farmers practises in management and use of genetic diversity and combine *in-situ* conservation with improved agricultural technology within the environmental and socio-economic constraints prevalent in such regions. The basic assumption is that the informal system will continue to play a role for some time.

Industrial countries
It is obvious that in Western Europe together with North America and countries such as New Zealand and Australia modern agriculture and the formal institutional system is dominant.

In this system farmers have become dependent on the formal institutional system for the supply of varieties and have by and large stopped to play a role in conserving genetic diversity, either directly or indirectly. This institutional dependence is further strengthened by legislation such as Plant Breeders' Right (PBR) and Registered Lists of Varieties protecting the interests of a largely commercial seed industry. This is considered essential to attract private investment in plantbreeding. Farmers are still free to choose what varieties they want to grow . However this choice often does not include local landraces since they usually do not satisfy requirements set for official approval in registered lists and for most major crops the sale of such seeds is prohibited by law.

There is no question that modern agriculture and plantbreeding have made important contributions to a very productive agriculture in Europe. In this process however a large diversity of local landraces of traditional crops in European agriculture have been replaced by a more limited number of uniform modern varieties even if the actual varieties may have resulted from crosses between materials of very diverse genetic origins. As a result local landraces of most crops have become rare in Western Europe and are mainly restricted to some economically and environmentally more marginal areas of Southern Europe.

As a consequence, in Western Europe conservation of genetic diversity relies largely on *ex-situ* genetic resources programmes. In the past a very commercially oriented plantbreeding industry in Western Europe has given low priority to conservation. Hence it is fair to say that genetic erosion has taken place on a large scale in the past. In fact, it remains a serious problem. In spite of all the political rhetoric in the United Nations Rio Conference, few countries in Western Europe have responded with giving adequate attention to the conservation of genetic resources even today.

Systems of genetic conservation in Western Europe

Compared with other industrial countries like the US and Japan, Western Europe as a whole is lacking behind in government support to genetic conservation. However there are signs of improvement, not the least through recent initiatives by the European Commission. Also at the national level there are a number of initiatives that give some cause for optimism.

Genetic conservation requires a number of activities, all concerned with a common objective, but reaching such objectives in different ways.

Government programmes
Ex-situ genebank programmes provide a base-line activity to insure continued genetic diversity for the purpose of plantbreeding now and in the future. Most countries have such programmes, although there are still large differences between countries in organisation, level of funding and standards of operation. The need for international cooperation is becoming accepted, as is evident from the European Cooperative Programme on Plant Genetic Resources Networks (ECP/GR). There is some way to go, but also at policy levels there appears to be increasing support for such developments.

These programmes cover collections of seed of many crops important to European agriculture, some crops as part of institutional genebanks but others as working collections in plantbreeding institutes. For crops that can not be maintained as seeds, living collections are kept for roots and tubers and as collection orchards. Also in forestry there is an increasing awareness that knowledge of still available genetic diversity and ways of conserving such diversity, either in natural stands or in special collection orchards is important. The limiting factor for such programmes to be effective is not lack of institutions or know how, but rather the allocation of funding for such programmes and institutional priority.

Non-government activities
There are a growing number of private initiatives to promote conservation and use of genetic diversity. NGO activities are concentrated on awareness building on the important role genetic diversity can play at the level of communities, users and consumers as a reaction to an industrial society guided by efficiency and commercial markets. Unlike the government programmes of *ex-situ* genebank programmes, their objective is not support of plantbreeding, but rather to maintain and/or make available traditional crops and cultivars to interested growers. NGO's do so by establishing collections in seedbanks, by stimulating and organising interested growers to maintain specific cultivars and so on.

Concluding remarks

The given title of this paper is mis-leading. It must be concluded that in Western Europe true *in-situ* conservation of genetic diversity of crops has been largely lost. Exceptions are old cultivars of fruit trees still found in gardens of farms, olives throughout the mediterranean region and traditional cultivars of some vegetables in isolated regions. The security of such conservation is however low. The conservation of old cultivars of fruit trees could be stimulated by monitoring and encouraging farmers to maintain or rejuvenate such specimen. The conservation of genetic diversity of olives will require programmes at the national and regional level. It is doubtful wether conservation of traditional varieties of vegetables can be done reliably outside genebank programmes. Hence instead of *in-situ* conservation, perhaps the objective should be to re-introduce traditional varieties of cultivars, not as a means of conservation but as a means to widen their availability and use in the interest of both growers and consumers. Such actions are important in themselves in a society ruled by commercialism and ever increasing cultural uniformity.

It is a curious phenomenon that while both the government and NGO programmes have a shared concern to maintain genetic diversity, there actions are often carried out in an atmosphere of distrust and competition. Government genebank managers tend to emphasize what they consider as lack of professionalism in NGO programmes. NGO's by and large see government genebanks as static frozen repositories of materials that threaten the control of people over their natural heritage. It is our opinion that such conflicting views are unnecessary and even damaging and require change. We suggest that integration of both approaches is to the general benefit and warrant serious attention. This requires a change of attitude and structural measures to promote a more collegial type of cooperation.

NGO's should consider Government genebanks for what they are; a means to provide security in conserving overall genetic diversity for present and future use and provide genetic information on such collections. Government genebanks should see NGO's as a means to promote availability and maintenance of genetic diversity at the community level.

Jointly, government genebanks and NGO's should argue for the need of changes in present legislation to promote rather than complicate and discourage the widest possible use of genetic diversity. Such legislation should stimulate NGO's to make planting material of traditional cultivars available to interested growers to increase genetic diversity. Like commercial breeding, community programmes should be allowed recover their cost and sell their products rather than be prohibited to do so by national and European regulations. Farmers and especially small growers and household gardeners should, if they want to, be able to have a wider choice of planting material than just the products of modern breeding. It is a sobering thought that past efforts of farmers have given us almost all the crops in the form we grow them today. This should be recognized if genetic resources are to be truly a common good.

Efficiency of different conservation methods in forestry for conservation and utilization

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1. Introduction

Forests are the most natural part of our environment, but in industrialized countries drastically influenced by mankind since long in the past and even more today.

The problems for conservation are very different in the tropical rainforests as compared to temperate regions. This is true for differences in the knowledge of the species, the distribution of the species in their natural range (e.g. as many as 180 tree species per 1.6 hectare in Malaysia),the flower biology and the capacity of the seed to survive. At present the most logical way to conserve species in the tropics is to conserve biotops. Only in very few cases a specific conservation program seems to be feasible. But this is unimportant as compared to the number of tree species occuring. In Malaysia e.g. 2800 tree species and 25.000 flowering plant species are recorded. Germany - for comparison - has 35 indigenous tree species and another 10 exotic species of interest. Therefore the following considerations are valid only for temperate forest regions.

Forest trees are longliving organisms with a span of life up to more than some 1000 years which can include quite important climatic differences. They face variable ecological conditions during ontogenesis. They show up a higher degree of heterozygozity than all other organisms as a response to this situation and comparatively little fine-grained adaptation patterns. The natural range of trees is given often not restricted by their ecological adaptability but by the competition of other tree species and by historical events. The competition is however drastically influenced by silvicultural treatment.

There is increasing concern about the conservation of forest gene resources due to immission damages and the influences of global warming. As well during the United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, in June 1992 as in the Conferences of European Ministers for the protection of forests in Straßburg and Helsinki (June 1993) this topic was of central interest. In Helsinki 37 European states participated and another 14 observers were present (e.g. USA, Canada).

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All participants signed three resolutions concerning the management of forests as a sustained yield base, guidelines for the conservation of biologic diversity of European forests, and the cooperation in forestry with East European states. All except Sweden and France signed a resolution concerning strategies for the long term adaptation of forests in Europe to climatic change.

In Germany there was an unanimous resolution of the Federal Assembly in 1985 which gave the conservation of forest gene resources high priority. A program was developed in the subsequent years (Bund-Länder-Arbeitsgruppe 1989), which is under execution. This program became part of the Federal Program for plant genetic resources (BOMMER and BEESE 1990).

The topic was discussed in different meetings and publications (e.g. National Research Council 1991; ARBEZ 1987; MÜLLER-STARCK and ZIEHE 1991; SEITZ and LOESDECKE 1991; FALK and HOLSINGER 1991; PETERS and GROVEJOY 1992) on international level and a lot of research emphasis was put into this field.

At the same time there was a reorientation of forest management in Germany and other European countries in direction of a more ecologically oriented forestry with stronger emphasis on hardwoods, natural regeneration and unevenaged stands. Parallel to this more and more abandoned farmlands come into forestry production.

Due to FAO (1985) 400 tree species are worldwide endangered in whole or in significant parts of their gene pools. This figure does however not include species, where local populations are already extinct or extremely reduced like *Taxus baccata, Sorbus domestica, Pyrus malus; Malus sylvestris* in Germany.

2. Forest tree species and conservation methods

Forest tree species are generally wild populations not yet affected by artificial selection or breeding with few exceptions like *Populus, Salix, Cryptomeria*. Some of the economic important species are however included into more intensive breeding programs during the past 40 years which includes collections of material, seed orchards and limited clonal propagation.

The basis of our knowledge of variability and adaptability of tree species originates from provenance and progeny studies starting as early as 1745 by DUHAMEL DU MONCEAU (LANGLET 1964) and summarized by STERN and TIGERSTEDT (1974) and STERN and ROCHE (1974). Morphological and physiological studies were supplemented by biochemical and genetic studies during the last 15 years. The links between morphology and biochemical analyses are however not well established and in most cases we do not know to what degree the variation revealed by electrophoretic susveys reflects genetic differences in the capacity of an individual tree to compete or adapt.

Diverse environment throughout the range leads to genetically variable species. Patterns of inherent variation follow environmental variation. Species with a continuous range thus show clinal variation, species with discontinuous ranges more ecotypic specialization. But both patterns can occur in the saime species side by side depending on the characters under consideration.

Variation within subpopulations can be quite different due to historical differences in size of founder population and selection pressure. Generally within population variation exceeds between population variation, which may be due to the heterogeneous environment in time and space.

Exploration of forest gene resources should follow major environmental gradients (elevation, temperature, day-length). Marginal populations may be of special importance.

Trees themselves conserve genetic information over centuries. This is a basis difference compared to all other organisms and an obvious advantage for conservation work, as it is a disadvantage for breeding and selection. Between germination of the seed and flowering usually some decades pass, which restricts immediate utilization of plants after establishment.

After germination and during the early stand development intensive natural selection is going on, under natural conditions reducing the numbers from some hundred thousands to few hundreds. This process is accompanied by an increase of heterozygosity of the surviving part of the population.

In situ conservation therefore has a high priority. The genetic system is maintained in a dynamic way under the pressure of natural selection where evolutionary processes are continuously going on. This method does not guarantee the conservation of all material however. Rare tree species often do not form breeding populations but only exist as single individuals or small groups. They must be concentrated in seed orchards. Catastrophes like fire, storm, ice rain or snow break often endanger whole populations. The immissions influence the selection processes already before seed formation by differential influence on pollen survival and they can endanger survival of whole forest areas in exposed locations.

Therefore ex situ conservation is necessary as well as a main activity in rare species, as a supplement in more common species. A main obstacle for efficient conservation work are the poor inventory data for rare species and the lack of knowledge of genetic variation between and within populations.

The following conservation methods are used in forestry:

In situ:
- protected areas and specific conservation stands
- plantations
- single trees

Ex situ:
- plantations
- seed orchards
- clonal collections
- seed storage
- pollen storage
- tissue storage
- propagation methods.

3. Efficiency for conservation and utilization

3.1 In situ methods

The efficiency of in situ conservation methods depends very much on the tree species and the speed of environmental changes; in natural reserves in addition from between species competition and legal restrictions. Minor, especially rare species (or relict provenances of major tree species) often can be found only with one or few individuals in specific locations. Here in situ conservation can only guarantee the survival of the respective trees until they reach their natural end. For the conservation of the natural diversity of the species and especially for utilization it is necessary to concentrate the scattered individuals in grafted seed orchards to reconstruct breeding populations. By this ex situ method the survival and the utilization of the whole existing gene-pool of the species is possible even if the relict trees in situ died: This ex situ method has the additional advantage, that hybridization with other species or nonadapted provenances can be prevented. For major tree species, still existing in extended populations, in situ conservation stands will be the main conservation method with about 2 % of the actual area. The single populations are selected due to their structure, the heterogeneity of the site and the main ecological gradients. However fast environmental change or catastrophes like fires, storms, ice- and snow break, insects or fungus diseases can endanger in situ populations too. Therefore an additional ex situ conservation - usually as seed in storage - is necessary. However the tree species with recalcitrant seed cannot be stored for long time. Therefore ex situ plantations or storage of embryos in liquid nitrogen are alternatives.
The utilization of the in situ stands is possible by seed collection directly, therefore a combination with seed stands seems to be a practical advantage quite often.

The conservation stands are naturally regenerated or planted with seedlings grown from seed of the same stand. Degradation of the soil due to immission can be partly counterbalanced by fertilization.

Natural reserves do not necessarily guarantee the survival of a specific species. Since no human influence is allowed, a species of interest can be extinct by competition. Usually no seed harvest is possible in these areas, therefore utilization is very restricted. However especially in climax species they can be an interesting addition to in situ conservation stands.

Seed stands are the major source of reproductive material in forestry. They are however only of limited use for conservation of genetic diversity. There is no genetic information available, no follow up of the single stand identity, no obligation to collect seed from many different populations, no guarantee that local material is used locally. The only option is to guide commercial seed collection in a way that many stands are included.

It is however a good practical solution to select some of the seed stands as conservation stands and to have a thorough evaluation and utilization of these specific stands with a follow up until plantation establishment. In situ methods are of course a main part of conservation for forest gene resources but they must be supplemented by ex situ methods.

3.2 Ex situ methods

Ex situ methods are the main option for minor tree species and a necessary addition for major species. Ex situ plantations are under the dynamics of natural selection and evolutionary processes, however selection pressure may be different from in situ plantations if the ecological conditions of the respective sites are very different. Therefore the selection of the ex situ sites has implications on the efficiency of this method. It is possible to combine selection and improvement with ex situ plantations.

Utilization is regularly only possible after flowering started, which may last some decades in many tree species. However vegetative propagation is directly possible in some tree species but more expensive.

Seed orchards are necessary for minor tree species and endangered populations of major species, they are an additional option for major species if improved material from selection is to be used. The comparatively intensive management excludes natural selection and reduces dangers arising from fast environmental changes and catastrophes. Depending on the species seed can be harvested soon, economically and - depending on the composition of the seed orchard - with high or low genetic diversity. Compared to the options discussed above the costs of seed orchards are comparatively high, since they are not integrated into regular forest management operations. Due to the improvement, which is possible, and to the easier access to seed they can be nevertheless economical for utilization.

Clonal archives have - as compared to seed orchards - the disadvantage, that a direct utilization is not possible or much more expensive. Therefore they are more an intermediate method until a sufficient high number of clones has been collected to establish a seed orchard.

Seed storage plays a major role under the ex situ methods in forestry with those species where seed can be stored for long time. This is true for most forest tree species. It is an additional security for in situ conservation stands, plantations and seed orchards and quarantees the conservation of high genetic diversity with moderate costs. It is however a static conservation method and sensitive to technical defects. Seed can be immediately used, however it is exhausted after utilization.

Pollen storage is an efficient method to store a high amount of genetic information. However the utilization depends normally on the existance of female flowers. Only in first pilot experiments the direct utilization of early pollen stages for haploid embryogenesis was possible (JÖRGENSEN 1990). This would theoretically open the option of hybridization by protoplast fusion and direct utilization. This is however an expensive and up to now not practicable way.

Tissue storage can be used as an intermediate tool in such cases, where in situ conservation does not work, as for example in Ulmus spec., and where no other option is possible. It is however expensive and can probably not be carried on over centuries. The amount of genotypes which can be handled is quite limited. An obvious advantage is however the possibility for immediate utilization which is especially interesting with improved material.

Propagation methods are no conservation by themselves, they are however of outstanding importance for fast utilization of material in forest trees which otherwise cannot be used. Therefore flower induction and vegetative propagation by cuttings and in vitro culture have importance for conservation and utilization.

4. Summary

The specific situation of forest tree species is outlined. The different in situ and ex situ conservation methods are described under conservation and utilization aspects. In situ and ex situ conservation are regarded as complementary, each having advantages and disadvantages. The main emphasis is however on in situ conservation.

Conservation methods and potential utilization of plant genetic resources in nature conservation

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1. Introduction

With the Convention on Biological Diversity (CBD), issued June 5, 1992, conservation *in situ* of genetic resources, i.e. the genetic diversity of cultivated plants, has again become an open question and a matter for discussion since the CBD and the previously followed FAO Undertaking on genetic resources differ in several places. However, the discussion of the matter is clouded by several ambiguities, many of them concerned with definition of terms, some of them going back to the fact that the CBD, for different reasons, is in itself a vague document.

In the Nordic countries there is a well established infrastructure for conservation of natural resources in general, based on multi-institutional arrangements of various categories of nature reserves as well as a non-governmental volontary sector (NGOs). To avoid duplication of work and therby to minimize costs, NGB prefers collaboration with those institutions to meet its requirements for *in situ* conservation rather than going into reserve establishment on its own.

The Nordic Gene Bank (NGB) has been commissioned to conserve valuable plant genetic resources (PGR) of agricultural and horticultural plants which are indigenous to the Nordic region, wild forms and wild relatives included. NGB has up to now worked in accordance with FAOs Undertaking of 1983, but with the changes introduced by the CBD, particularly the implied widening of the *in situ* concept, it is probably time to review and reappraise the underlying scientific principles.

2. Background

According to the NGB definition, plant genetic resources comprise material of actual and potential value for Nordic plant breeding and plant research programmes. The CBD defines genetic resources thus: *"Genetic resources* means genetic material of actual or potential value." This is well in accordance with NGB use, keeping in mind though that NGB has a restricted mandate and limited resources.

First priority is given to species indigenous to the Nordic countries and presently cultivated, and second to indigenous species previously grown and therefore possibly of interest also in the future. A third group comprises indigenous plant species not presently cultivated in the Nordic countries, but cultivated in other areas of the world. Some overlapping between the second and the third priority exist.

In addition to indigenous Nordic species, there are plant species, which were introduced in the Nordic countries, some of them several thousands of years ago. These include species such as barley, wheat, rape etc. Some of those species of the so called exogenous gene pool are economically extremely important, and therefore share the first priority.

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The definition in CBD which reflects on origin reads: "Country of origin of genetic resources means the country which possesses those genetic resources in *in-situ* conditions."

In situ preservation is defined in different ways. NGB has since the beginning of the 1980s worked with three categories of conservation, *ex situ, inter situ* and *in situ*. *Inter situ* has come closest to what is to-day generally meant by on-farm-conservation. With *in situ* conservation has been meant the conservation without radical and regular interference by man, i.e. activities such as planting and harvesting. Consequently, planted clonal archives are not included while meadows are. Virgin land is included as well as natural land for pasture husbandry.

The definition of the CBD is: "*In-situ conservation* means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties."

3. *In situ* and *ex situ* conservation

3.1 Control of genetic resources

We may then discuss what should be the objectives of *in situ* conservation in relation to genetic resources in particular, i.e. cultivated plants and their wild relatives. For several reasons, genebanks established in the past are generally not equipped nor funded to deal with *in situ* conservation according to CBD, particularly when considering Article 8 of the convention, expressing the content of *in situ* conservation, or Article Article 15, concerning access to genetic resources.

Particularly with respect to Article 15, the following overall objective may be discussed:

For the genebank to have full control of the plant genetic resources within their area for its mandate species.

This may be achieved as follows:

- All territorial activities, such as forming natural reserves, or obtaining information on plant taxa and other information on the species level, should be performed by governmental or non-governmental organisations for natural resources conservation and sustainable utilization active in the area.
- the Genebank for PGR to contribute mainly with the specific competence within its mandate;
- the Genebank to represent the country/region in recommending measures for considering PGR in forming natural reserves in agricultural districts;
- the Genebank to have, through due permission from authorities in the country(ies), superintendence of license for collecting plant genetic resources in areas under tutelary laws;
- the Genebank to be able to give information and guidelines to users/collectors of plant genetic resources in areas in the country/region, according to A-C below, of interest for collection i.e. where wanted material occurs or is expected to occur;
- the Genebank does not, as a rule, keep in its *ex situ* collection those materials which are conserved *in situ*;
- the Genebank to gradually be able to give information about diversity within the species;
- the Genebank to contribute - within its mandate to preserve plant genetic resources - to the utilisation of of the PGR in a way adeqate for sustainable farming as part of sustainable development;

- the Genebank keeps, in the first place, such information on plant genetic resources within its mandate which is necessary for taking this responsibility.

3.2 Species to be considered for *in situ* conservation

Species endemic and indigenous in the country(ies) and within the mandate of the Genebank can be recommended to be entirely or partly conserved *in situ* in the following cases:

A. The species comprise cultivated as well as wild growing forms in the area of Genebank responsibility:
   I. the species is difficult or expensive to manage;
   II. the species is very widely distributed in the area of Genebank responsibility;
   III. the species is endangered.

B. The species comprise only wild forms in the area of Genebank responsibility but is cultivated somewhere else.

C. The species is nowhere cultivated (wild relative of cultivated species).

Arguments for conserving material as presented above *in situ* are:

A.I. To conserve perennial species such as *Prunus, Rosa*, etc, as *ex situ*, in clone archives or similar, is often too costly. Accessions of seeds from various populations can, however, be conserved *ex situ*, in cases where the storage of seed fit into the standard used at the Genebank.

A.II. Many important herbage plants are often included in this cathegory. Such a conservation approach may provide a less expensive protection than *ex situ*, particularly as extensive collecting and multiplication is a heavy burden. Only for material used for research and plant breeding programmes, or when an important species is threatened, *ex situ* conservation should be considered justifiable.

A. III. The material will become extinct if measures are not taken.

B. By international undertakings, such as the CBD and the FAOs Undertaking for the conservation of genetic resources, the Genebank may be tied to the international network of gene banks. However, collecting, conserving and multiplying even species of little or no interest for the country(ies) for which the Genebank has responsibility may be too costly to manage. To meet the demand from other parts of the network, these species can be conserved *in situ*.

C. Wild species (including wild forms of cultivated species) with a functional mechanism of seed dispersal are in general more complicated to handle *ex situ*, than cultivated plants. Therefore *in situ* conservation, being less costly, can be recommended for wild species.

3.3 Variability within the species

Nature conservation in general, including *in situ* reserves, tend to concentrate on the species level diversity. The main objective of a genebank, on the other hand, is to conserve genetic diversity of plants of present or potential use for man. The main utilization includes here plant breeding, for which availability of infraspecific variation is essential. Focusing on the *in situ* conservation, one of the problems is how to assess the existing infraspecific variation among the candidates chosen for *in situ* conservation - the genetic diversity across the whole geographical and ecological range of the area for which the genebank has the conservation and utilization responsibility. For certain species, where diversity extends over more or less the whole area, a system of reserves might be the realistic way to preserve the diversity of the species.

However, information on infraspecific genetic diversity, in existing protected areas, is often very limited and specific studies within and between populations for a few species using a variety of well-established methods, will be needed to assess this parameter.

Documentations of different environments in which species grow, give indications that variation may exist. Further ecogeographical studies of selected sites for *in situ* are important tools in assessing variability within a species. The data that will emerge from ecogeographical surveys and information on habitats from common flora inventories regarding mandate species for the Genebank will be a very important contribution in the effort to screen the genetic diversity of populations.

4. Discussion

The Convention on Biological Diversity (CBD) is, as the name indicates, aimed at conserving the Earths biological diversity. It is therefore also natural that the emphasis is on the ecosystem and species level of that diversity, and consequently on *in situ* conservation. The conservation of genetic resources, i.e. the genetic diversity of cultivated plants, which is in number of species small but in economic and human wellfare aspects very important, therefore needs to be clarified and possibly guarded, to receive proper attention. A sign of this need could well be the fact that in some nations the implementation of the CBD has been more or less monopolized by the interests of environment to the almost exclusion of the interests of agriculture and forestry. Since agriculture and forestry are also main factors of ecosystem influence, this could lead astray.

Internationally, FAO and its Commission of plant genetic resources, as well as International Board for Plant Genetic Resources and European Cooperative Programme for Plant Genetic Resources have long experience of work with PGR. It seems essential that such organizations get a seat and a saying in any new organization, national, regional or international, handling the implementation of CBD.

In many respects the CBD is, for different reasons, a vague document. From the side of PGR sustainable conservation and use many aspects need to be clarified, and one of these is the role of *in situ* conservation in PGR conservation, and reversed. Since the tasks involved have a large area overlapping with those of the general nature conservation and conservation of biodiversity as a whole, it seems clear that a collaboration has to be established and clear roles worked out, to avoid duplication of efforts. It seems also clear, that the infraspecific variability, the diversity below the species level, introduces a factor into such collaboration which is rather new to nature conservation but has for long been an essential element in PGR conservation.

Another factor to be considered is the demand for more or less immediate availability, for breeding and research purposes, of PGR, which has been totally lacking from the concept of nature conservation. If anything, there has been a tendency towards exclusion of both availability and use.

Examples like this should suffice to indicate that there is a need for clear establishment of roles, which in its turn requires a clear terminology, to avoid confusion. A few examples could demonstrate this.

Firstly, the definition of the CBD on *in-situ* conservation reads "..... and, **in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties**." (bold by the author).

This definition is obviously based on location, and not on mode of conservation. Under this definition, on-farm-management becomes a part of *in situ* conservation. If this is accepted, will it then be possible to place also farmers fields under protection by laws regulating nature conservation in general?

Secondly, the definition in CBD on country of origin reads: "Country of origin of genetic resources means the country which possesses those genetic resources in *in-situ* conditions." Since in most of Europe the landraces and older varieties at this point in time are maintained almost exclusively *ex situ*, should this then mean that Nordic landraces of eg. barley, will have as country of origin Syria or Ethiopia or whatever place that people came from that invaded Europe after the ice receded?

Finally and in conclusion, biodiversity conservation for different reasons will have to concentrate on the ecosystem and species level and work with the entire spectrum of organisms, and PGR conservation on the infraspecific level with a very limited number of species. Further, biodiversity conservation has *in situ* conservation as main instrument, PGR conservation has the *ex situ*. Consequently, the complementary and extending role of PGR conservation seems obvious. In the process of establishing roles of existing institutions - and NGOs - it is also essential that this and the following cooperation, is based on a common interpretetion of the Convention on Biodiversity and a use of common terminology.

New Approaches to Evaluation of Genetical Structure of Plant Populations for in situ and ex situ Conservation of Plant Genetic Resources

V. A. DRAGAVTSEV[1]

It is shown that besides the mechanism of differential activity of genes, which is induced, on the one hand, by the law of ontogenesis, while on the other hand, by environmental stresses, there exists the mechanisms of redetermination of genetical formulae of quantitative characters in different environments [1, 2]. On the basis of this mechanisms we created a new ecogenetical model of organization of quantitative characters [3, 4]. Using this ecogenetical model, it is possible to explain and predict the behaviour of many important genetical parameters of populations in different environments against the background of different limiting factors. From the standpoint of the ecogenetical model, the theory of polygenetic inheritance, developed by K. Mather [5], is a weak model without scientific prediction of changes in genetical parameters. Our model shows that now there are no good methods for genetic analysis of quantitative characters. It is impossible to have a stable "passport" of genetical structure of any quantitative character for any environment.

We have withdrawn from studying the genetics of quantitative characters. Now we study the genetical organization of the following six genetical-physiological systems:

1. Genes of attraction (attr)
2. Genes of micro-distribution of attractive plastic substances (mic)
3. Genes of adaptivity (cold, drought, frost, salt resistance) (ad)
4. Genes of "feed paying" (i.e. efficiency of using nitrogen, phosphorus, etc.) (ef)
5. Genes of tolerance to density in phytocenosis (tol)
6. Genes of variability of parts of ontogenesis (ont)

Together with A. Djakov we carefully studied the reasons of the success of best breeders, such as V.Pustovoit, P. Lukjanenko and others [6]. Each of them used one from six genetical systems for radical improvement of species.

We found the phenomenon of orthogonality in the effects of genes and effects of environmental factors in determining the coordinated of characters. With the help of this phenomenon, it is possible to delimitate very quickly the contribution of genes and environmental contribution to the level of a quantitative character. For example, see Fig. 1.

On the background of this approach we developed the new methods of creating core collections of self-pollinated crops. For example, in the Institute's collection we have about 40,000 samples of bread wheat. The core collection of genes of attraction (Fig. 1) should have about 400 samples, while the best genotypes - about 50 samples, which would make the working collection for plant breeders. A working collection for six genetical systems should be about 300 to 40 samples.

These methods are very interesting for analysis of natural populations. The focuses with maximum

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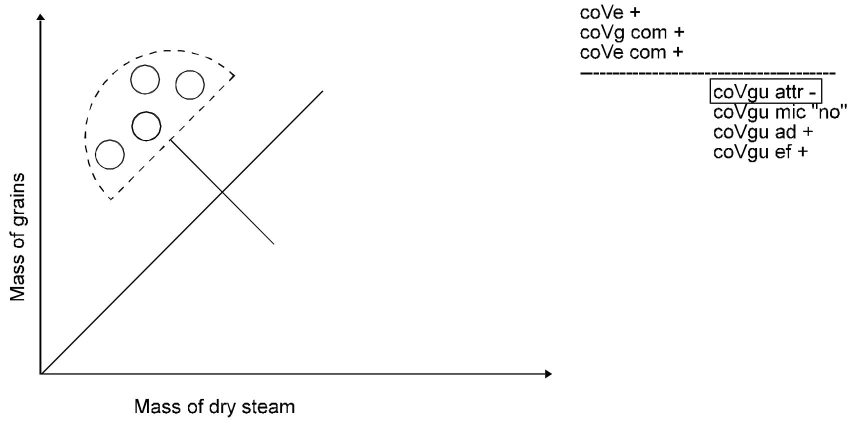
genetical variances for six genetic systems must be genetical reserves.

Self-pollinated plants have neither inter-varietal variance, nor dominant variance (d_D^2), nor overdominant variance (d_{OD}^2), nor variance of heterozygous epistasis. Homozygous epistasis variance is present, but it is included in parent-offspring co-variance, being the part of additive variance (d_A^2), because for wheat, barley and other self-pollinated crops $d_g^2 = d_a^2$ and $r_g = r_A$. Theoretical back

ground for creating a core collection of self-pollinated crops is quite clear now, and quick methods of identifying each of the six genetic polygenic systems seem a good way for organization in situ and ex situ conservation of plant genetic resources.

Fig. 1 Express identification of attractive genes



coVe - noise of environmental variability
coVg com - noise of genotypical competition
coVe com - noise of environmental competition

Fig. 2 Express identification of genes affecting micro-distribution of plastics (for sunflower)

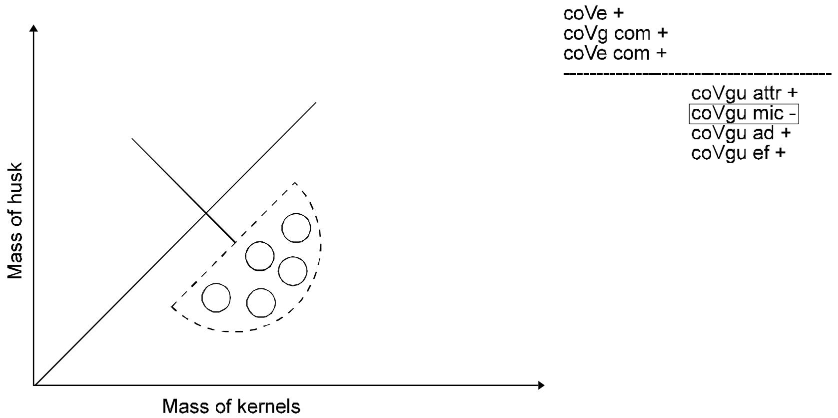
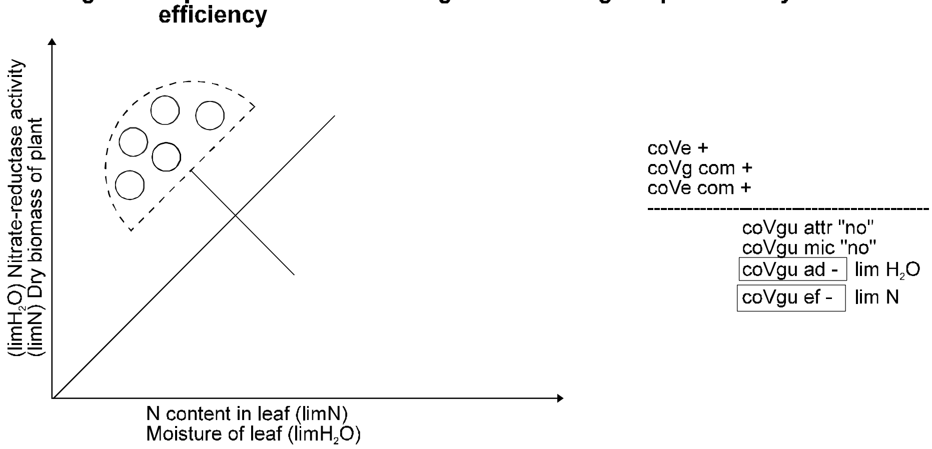


Fig. 3 Express identification of genes affecting adaption ability and efficiency



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Vegetable Crops Genetic Resources Conservation and Utilization

T. KOTLINSKA[1]

Introduction

Conservation of germplasm of vegetable crops is carried out from 1982 and it is a part of the National Plant Genetic Resources Conservation Programme, coordinated by the PBAI at Radzików.

From 1986-1990 was realized and financed within CPBP 05.04. entitled" Conservation, evaluation and documentation of crop plants for breeding and genetic research" under direction of prof. S. Góra, National Deparment of Plant Genetic Resources,PBAI, Radzików.

Modification of the principles of research financing caused, that "Conservation of genetic resources of vegetable crops is included to the basic activity of the Research Institute of Vegetable Crops at Skierniewice. From 1991 the Plant Genetic Resources Lab. of that institute carries responsibility of that programme, which is supported by Ministry of Agriculture.

The main objectives of programme are to collect, preserve in a viable state the plant genetic resources endangered by extinction and to stimulate its utilization.

This activity covers all aspects of the germplasm collection and preservation: as passport information, documentation, characterization, evaluation, distribution and also organization of collecting missions, maintaining of collections, multiplication, supply of germplasm to plant breeders and other research workers, exchange of materials and informations, cooperation with simmilar institution in Poland and abroad etc.

The most important task is to collect and protect; as many landraces, ecotypes, old native cultivars of vegetable crops, which can be found all over the country. Special attention is paid to collecting ecotypes and landraces, which for many years hare not been cultivated on acommercial scale, but still exist in small private farms. The specific structure of Polish agriculture and keeping a tradition alive by old peoples caused, that was possible to save many old native landraces are representing genetic diversity in dynamic equilibrium with the local environment. Sometimes the landraces originated from the time before the second war (pumpkin, shallots, bean, tomato, cabbage).

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The tasks of vegetables genetic resources conservation programme

Successive collecting of existing germplasm in natural environment, it is the only way for their preservation for using now and in future. Postponement of such works even for one year, make great endangered for these materials and decrease chance for their salvage.

In gene bank, the follwing materials were collected:
- native, old cultivars, landraces of vegetable crops, local populations, ecotypes, wild relatives and wild species.
- obsolete cultivars from national register.
- breeding lines, cultivars, wild species polish and foreign source of resistance to patogens, stress conditions and other characters.
- components of polish bred hybrids (self - incompatible lines, male-sterile etc.).
- cultivars and lines, which are testing pattern complex for pathogens races identification.
- standard cultivars recomended by Centre for Plant Cultivars Testing (COBORU), as a check in register trials.

The collected materials are stored in seed form in Central Gene Bank storage at Radzików, and vegetatively propagated accessions are maintained in field collections.

The current number of accessions is 2345 from 51 species of cultivated vegetable crops, 100 wild relatives and wild species and also 453 vegetatively propagated accessions are maintained in the field collections. 1451 seed samples hare been deposited in long term storage.(table 1).

Within the programme Plant Genetic Resources Lab. is holding collections, which are localized in various institutions (table 2). Here are the following collections:

1. The collection of genus Allium covers:
- Collection of Allium cepa (onion) and A.cepa var. aggregatum (shallot, potato-onion) - 167 accessions and consists of old, obsolete, advanced cultivars, landraces from Poland and other countries.
- The field collection of Allium sativum (garlic) - 233 accessions. Among materials are 133 polish "types" coming from 95 localities in Poland, 40 accessions collected in Kirgiz, Turkmen, Uzbek, Tadzhik, Kazakh, 28 from Syberia and also from Moldavia, Russia, Lithuania, Romania, Czechoslovakia, The Netherlands, Greece, USA, Japan. Some of accessions are duplicates of long day garlic collection in Olomouc, Czechoslovakia.
- The field collection of other edible Allium and wild species of Allium - 270 accessions collected mostly in centre of origin in Central Asia, Syberia.

All vegetatively propagated accessions, above mentioned collections, are reproduced every year in the field, to maintain them alive and to obtain sufficient experimental materials (for electrophoresis of isozymes, chemical composition et.c.). Accessions are evaluated during three growing season, to provide breeders and other scientists the informations necessary for them to utilize material.

2. The collection of genotypes of Phaseolus sp. covers:
- Collection of different forms of Phaseolus vulgaris and Phaseolus coccineus - 1O5 accessions mostly polish landraces collected during explorations in many regions of Poland.
- Collection of Phaseolus vulgaris (Snap bean) - 242 accessions of Polish and foreign cultivars.

Table 1: Status of vegetables genetic resources skierniewice, 1993.

Species	Number of accessions	Species	Number of accessions
Asparagus	51	Orach	1
Bean	374	Parsley	20
Broad bean	8	Parsnip	1
Broccoli	8	Pea	10
Brussels sprouts	19	Pepper	24
Carrot	51	Pumpkin	5
Cauliflower	92	Radish	28
Celery	4	Red beet	10
Chickory	5	Red cabbage	6
Chinense cabbage	7	Rhubarb	1
Chive	4	Rutabaga	1
Cucumber	66	Savoy cabbage	13
Curly cale	2	Salt green	3
Dill	9	Scorzonera	2
Eggplant	1	Shallot	23
Garlic	233	Sorrel	1
Husk tomato	3	Spinach	14
Kohlorabi	7	Stem lettuce	5
Lathyrus	89	Swedish turnip	1
Leek	7	Tomato	402
Lentil	50	Turnip	15
Lettuce	163	Watermelon	2
Maize	9	Winter radish	3
Melon	12	White cabbage	57
Mustard	9		
Onion	144		

Atriplex hortensis	1
Brassica campestris	15
Brassica napus var. rapifera	1
Cichorium intybus	1
Daucus sp.	1
Lactuca seriola	15
Lactuca saligna	2
Lactuca virosa	10
Lycopersicon esculentum	5
Lycopersicon hirsutum	6
Lycopersicon pimpinelifolium	3
Allium sp.	270

Table 2: List of institutions involved in "ex situ" conservation of vegetable crops in poland

Institution	Crop collection
Plant Genetic Resources Laboratory of Research Institute of Vegetable Crops, Skierniewice	vegetables, Allium cepa, A. cepa var. aggregatum, wild species of Allium
Agricultural University, SGGW, Warsaw	Cucumis sativus, Cucumis melo, Cucurbita maxima, Cucurbita pepo,
PlantiCo. Horticultural Breeding and Seed Production - Ltd. Szymanów	Phaseolus vulgaris, Phaseolus coccineus, Allium cepa, Daucus sp.
Agricultural University Pozna_ - Baranowo	Phaseolus vulgaris - snap bean
POLAN - Horticultural Breeding and Seed Production Kraków - Krzczonów	Allium sativum
Agricuitural University Pozna_ - Marcelin	Asparagus officinalis
Plant Breeding Laboratory of Research Institute of Vegetable Crops Skierniewice - Regu_y	Lycopersicon - determinate type
Horticultural Breeding Company Warsaw - Ulrichów	Lycopersicon - indeterminate type
PlantiCo Horticultural Breeding and Seed Production - Ltd. Zielonki	Brassica campestris, Brassica - (cabbage, cauliflower, broccoli, chinense)
PlantiCo - Horticultural Breeding and Seed Production - Ltd. Paw_owice Sochaczewskie	Lactuca sp.

3. Asparagus officinalis field collection covers
- 50 accessions and contains Polish local populations collected from the oldest asparagus plantations in Poland and foreign cultivars.

4. The Lycopersicon collection covers:
- Collection of indeterminate type of tomatoes - 96 accessions.
- Collection of determinate type of tomatoes - 120 accessions. Among materials are old, obsolete cultivars, landraces, breeding lines and wild species from Poland, Russia and other countries. Collected accessions has been evaluated during three years trials for 47 morphological characters of plant, fruit and some biological traits as well as screening the collection for resistance to Phytophtora infestans and chemical composition.

5. The collection some of Brassica sp. contains different lines, cultivars of cauliflower, cabbage, chinense cabbage, Brassica campestris as a source of resistance to diseases - 40 accessions.

6. The collection of Cucurbits - 110 accessions and includes Cucurbita maxima (winter squash), Cucurbita pepo (summer squash), Cucumis melo (melon), Cucumis sativus (cucumber). The materials contain mostly old polish, russian cultivars and landraces.

7. The collection of Lactuca sp. - 45 accessions and covers polish landraces, old cultivars of different forms of lettuce and wild species.

All collected accessions are documented with regard to passport data, and 40% of those accessions have been evaluated on morphological, economic and other characters according to IBPGR recommendation, to needs of the breeders. lnformation related to the materials is stored in computerized database.

Full evaluation is done for few species (garlic, onion, tomatoes, beans). Evaluation is carrying out in special field trials during three growning seasons.

During evaluation attach oneself importance not on yielding, but to valorization of morphological characters, occurance of determined genes and also on characters, which are especially valuable in given materials (resistance to diseases, to stress conditions, source of sterility et.c.). Such informations can be very helpful at the beginning of new breeding programme. Characterization, multiplication, evaluation and some regeneration is carried out in close collaboration with breeding organizations, agricultural universities and individual breeders.

Germplasm collecting and collaboration with different institutions

Source of new accessions are private producers, Polish and foreign scientific institutes and collecting missions organized both in Poland and abroad. 3-4 short are organized every year time exploration missions are organized year, which provides us with rare and valuable material, from different regions of Poland.

The Territory of Poland is successive penetrated, on a base of earlier prepared exploration plans. The route of expeditions lead through the old Polish centres of vegetables cultivation, where we suspect to find interesting us germplasm.

Genetic resources are collected:
- in allotment gardens.

Such gardens exist in each town in Poland. The workers - amateur cultivate in these gardens very old cultivars and landraces of many vegetables and other plants for longtime. So, these gardens are often source of interesting us materials.

- in small farms in villages

The most valuable materials origin from small primitive farms. According to polish tradition around the houses ought to be small home garden for own needs. In these gardens, mostly by old farmers, are grown old local cultivars the same for years from force of habit, for pleasure. Sometimes the tradition of their cultivation is going from generation to generation. The old farmers willingly partake of their seeds or plants with us and in addition we obtain a lot of informations about traditional cultivation, usability of different plants as food, medicine or resistance against pests and insects e.t.c.Such informations can be used in ecological programmes. Therefore, first of all we must collect as soon as possibie the germplasm in mentioned farms. In a few years, when old farmers will die, this rich source of genetic resources will be irretrievable.

Besides, close contacts have been made with certain non-governmental organizations such as: Allotment Garden Association, Polish Horticulture Society, Polish Botanical Society, National Fundation of Environment Protection, Advisory Agriculture Centre and also with private producers. These institutions play very important role in popularization of germplasm conservation and the possibilities of their utilization. Different specialists belong to these organizations provide us many valuable informations about history of plants, ecogeographical survey of species distribution et.c.

Owing to good cooperations with foreign institutions and specialists (IBPGR/FAO, VIR, other gene banks et.c.) we have possibilities to participate in international scientific missions (Syberia, Central Asia, Israel), in conference, trainings and also helps to exchange materials and informations.

The curator of vegetable crops collection is a member of Allium Working Group within IBPGR and data on our collections are included into European Data Base

Genetic resources utilization

The conservation of plant germplasm is the best guarantee that in future, breeders and other scientists, will have working material available to them.

Interest in gene bank materials has been increasing lately, mostly from breeders, agricultural universities, other universities, research institutes, botanical gardens, seed and breeding companies, experimental breeding stations, and also private producers. Gene bank collection is the main base of initial material and suggestions for research work useful for practical breeding. Besides, the materials from gene bank are examined by breeders and the results of the examination are included to the data base in the gene bank. Breeders are interested in utilizing germplasm wild and cultivated, which offers great potential value for breeding. The plant breeders look to plant germlasm as a source of high cold or drought tolerance, more effective photosynthesis in lower temperature, tolerant to air or soil pollution, resistant to pathogens et.c. Collected accessions can be used to rebuildsuch the quality characters as taste, flavour, and other nutrient compounds which are lost sometimes during of intensive breeding works.

The accessions maintained in field collection are used by students of agricultural universities or agricultural schools to prepare thesis or for didactic aims. The results of these studies also enlarge data base of given accessions in gene bank.

In 1993 474 samples of 17 species of vegetable crops and 19 wild species, were distributed in Poland. 57 samples of 26 species of vegetable crops where sent abroad. From Poland we received 205 samples of 11 species and from other countries we recived 62 samples of 5 species. During 3 short explorations in Poland have been gathered 95 accessions of 21 species.

The present economic situation in Poland cause more difficulties in our activity. Up to now we are successful in gathering only a small part of germplasm existing in natural environment. Progress depends on the financial situation in the future. Therefore, we are looking for collaboration with organizations, which understand the importance of genetic resources conservation and are able to help in our efforts.

In situ and *ex situ* conservation of endangered species in Poland

Puchalski J.T., Burska A., Rybczynski J.J.[1]

Both in Poland and all over the world the number of endangered species, of which some have already become extinct is increasing. In Poland, the greatest threat of extinction faces the flora of water habitats, peatbogs and marshes. Also meadow species, particularly those growing in damp and wet soils are endangred (Michalik, 1988). Highly alarming is the extinction of species in the whole areas of their occurrence, which is a common phenomenon especially in the case of endemic species restricted to limited or dispersed areas or represented by small and rare populations.

The survival of many biotops of great natural value and the restitution of endangered and threatend with extinction species have been undoubtedly the result of conservation efforts. Nature conservation is realized through the protection of species and biotops in national parks, biosphere reserves, nature reserves, scenic parks and in the areas of protected landscape.

Species conservation, based on the pertinent law regulations, allows the continuity of species to be preserved. The protection covers, among others, rare and/or endemic species, species whose range of distribution have borderlines in Poland, and those threatened with extinction due to the degradation of their habitats. 212 plant species, including 5 tree species. 20 species of bushes, shrubs and creepers, 15 ferns, 151 species of
herbaceus plnts and 21 fungi, are under the full protection of law in Poland. Partial legal protection covers 28 medicinal and industrial plant species (Regulation of Minister of Forestry and Wood Industry of 30 April, 1993).

Plant species which occur rarely and require specific habitat conditions and frequently, are known to botanists only, have been placed on the list of endangered species.

Only some threatened species are protected by law; not all protected plants are endangered by extinction. "The red list of Polish endangered vascular plants" (Zarzycki et al., 1992) contains 418 species, which makes about 19 per cent of Polish flora. Among them are 40 already extinct species, the occurrence of which has not been observed on their known sites. Another 40 species are threatened by extinction and 412 species vulnerable, if the factors causing extinction are not eliminated. Besides, 146 rare species which have limited geographical range or are widely dispersed in vast areas can became extinct if their habitats are futher destroyed. There are 36 plant species whose numbers of sites or populations have been decerasing which form a separate category, where the imminence of danger is yet to be determined.

There is a growing number of algae (256), slime (88), macrofungi (1013), lichens (602), liverworts (50) and mosses (136), sensitive to changes in the environment. If one considers the

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enormous variety of forms, the evolutionary diversification of the above mentioned plant groups, and fragmentary and in complete knowledge of those plants in some areas, one ran presume that some of these species either have not survived or will became extinct before they are identified and classified (Zarzycki et al., 1992).

National parks and nature reserves, particularly biosphere reserves, are the best means of ensuring genetic diversity and preserving ecological processes and systems which are the basis of life.

In Poland, national parks are created in sufficiently large areas meet the criteria defined by General Assembly of the International Union of Nature Preservation (New Delhi, 1969 and Banff, 1972), on the basis of Council of Ministers regulations. To date, there have been founded 19 national parks of 243.679 ha, which makes 0.78% of Poland's total area. The smallest is the Ojcow National Park of 1.595 ha and the largest is Biebrza National Park of 59.223 ha. The Polish national parks represent main geographical regions. However, most of them are situated in the southern mountainous part of Poland, characterized by nature and landscape of great value. The statutory tasks of the parks are carried out through full or partial protection. Full protection covers, on the average, 24% of the parks acreage. The percentage differs for individual parks, from 2% in the Wielkopolska NP to 97% in the Bialowieza NP, which makes the latter one of the most precious protected area of our continent (Sokolowski et al., 1993). Outstanding in its primeval forest nature and abundance of flora and fauna, the Bialowieza NP has been defined as part of the World's Natural Heritage within the framework of the Convention on Protection of World Natural and Cultural Heritage (Okolow, 1993).

317 plant communities (including 20 endemic) have been given protection in the national parks. In the parks flora there occur numerous endemic species, among others *Erysimum wahlenbergii*, *Cochlearia tatrae*, *Poa nobilis*, some species of the *Alchemilla* genus from Tatra Mts, *Saxifraga moschata* subsp. *basaltica*, *Campanula corcontica* (Karkonosze), *Alchemilla babiogorensis* (The Babia Gora NP), *Taraxacum pieninicum, Erysimum pieninicum* (The Pieniny NP). Besides in the national parks 180 plant species grow under legal protection, among them 155 species under full protection by law (Denisiuk, 1992).

Biosphere reserves, being areas not bounded by regional and state boundaries, have special position in the conservation of the natural environment. Their aim is to preserve the variety of plants and animals in theirs natural ecosystems, to protect genetic diversity of species, and to provide the field for ecological and environmental research, of which the results will have crucial importance as points of reference in the case long-term changes of the whole biosphere.

Because of their international significance, biosphere reserves are approved by UNESCO. Among the seven reserves in existence in Poland only Lake Luknajno is not a national park. The biosphere reserves covering The Babia Gora NP, the Bialowieza NP, The Slovian NP and Lake Luknajno have been created in order to protect unique, endangered natural heritage. Each of them is an example of incomparable specific ecosystem or landscape. In 1992 a resolution of the Bureau of International Coordinative Council of the Man and Biosphere Project called into being three bilateral biosphere reserves in the area between the Polish and Ukrainian, and the Slovak and Czech borders - the East Carpathians (which is soon to become the first three-state International Biosphere Reserve), the Tatry and the Karkonosze, On the Polish side, the first reserve includes the Bieszczady NP and two scenic parks: the Cisna-Wetlina SP and the San River Valley SP. The second reserve includes the Tatry NP, and the third reserve - the Karkonosze NP. The plans include to enlagre the biosphere reserve network by the Biebrza River Valley, the Wigry NPN, the Drawno NPN, the Tucholskie Forest, the Odra River Valley, the Kampinos NP and the Orawa peat marshes (Celinski, Denisiuk, 1993).

The nature reserves cover areas of up to, 500 ha, and protect one or more ecosystems, which have been only slightly degraded by man. In 1992 there were 1.035 nature reserves in Poland, in which the dominating ecosystems are forests and meadows, water and peat bogs.

Scenic parks (82 in 1992) aim at the conservation, popularization and dissemination of natural, historical or cultural values under the conditions of economic management.

The areas of protected landscape, characteristic of a given region, (forests, river valleys, seaside, lakelands), play a significant role in tourism, due to their natural value. In 1992 there were 251 areas of protected landscape in Poland. They represent various types ecosystems, and their management should ensure relative ecological balance on the natural systems.

So far, the in situ conservation is the most frequent, the most officient cheapest means of counteracting the degradation of flora. However, only simultaneous *in situ* and *ex situ* conservation will preserve valuable elemnts of our flora.

Ex situ conservation done in botanical garden aims at preserving species under garden conditions and consequently, by learning their biology and propagation methods, at reintroduction the species into natural habitat.

Steadily lengthening "red lists" of endangered plants have led to the incerased intensity of botanical gardens work on active conservation of the listed species. Besides the research on two rare species of the Polish flora - *Corydalis pumila* and *Gagea spathacea* - Botanical Garden of the Polish Academy of Sciences in Powsin does observation of endangered plant species of deciduous forest habitats that belong to the Polish lowlands flora. The plants gathered in the Garden have documented origin form natural habitats, which will make possible their reintroduction in the case of their extinction in nature. Other Polish botanical gardens under take similar tasks, with proper consideration given to local conditions. Among others, the Botanical Garden of Warsaw University is concerned with the flora of north-eastern Poland, the BG of the Poznan University does work on flora of north-western Poland (mainly xerophytes), one of the interests of the BG of the Maria Sklodowska-Curie University in Lublin is the flora of the Lublin region and southern Poland; Department of Physiography and Arboretum in Bolestraszyce near Przemysl covers the plants of south-eastern Poland. The Botanical Garden of Wroclaw University conducts research on aquatic and swamp plants and on orchids, mainly of the Lower Silesia region. A positive examples of active ex situ conservation of endangered plant species is the preservation of the endemic species *Cochlearia polonica* (extinc in natural habitat) in the Botanical Garden of the Polish Academy of Sciences in Powsin, or acquiring the knowledge of biology and cultivation methods of the endangered *Trapa natans* in the Bolestraszyce Arboretum.

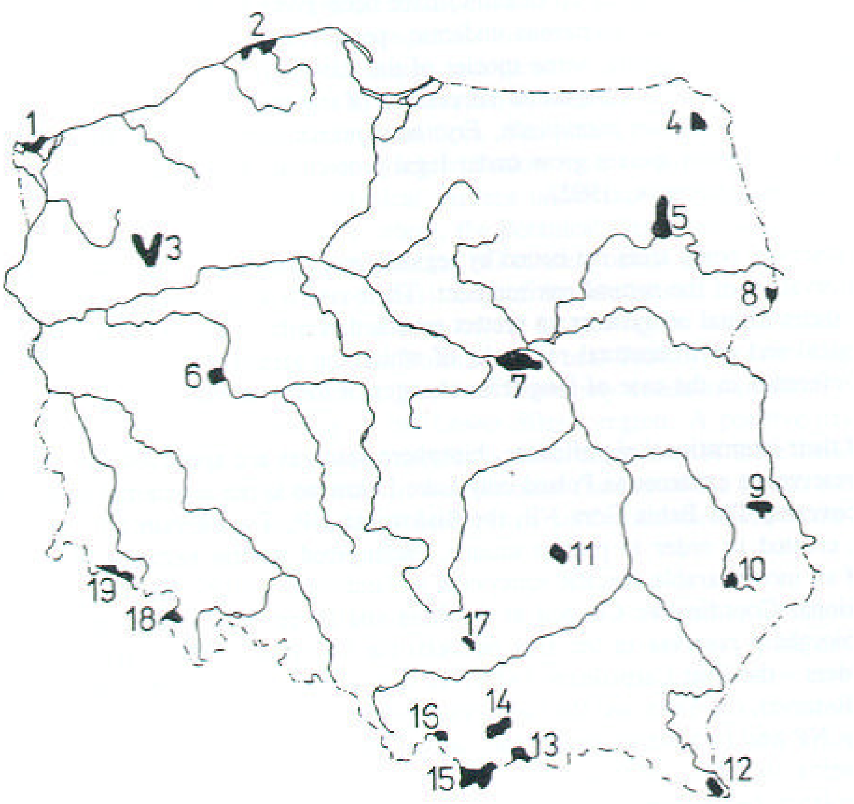
In vitro propagation and preservation of endangered plant species are two other methods of active conservation of the world genetic resources. In Poland the research is carried on the development of the regeneration systems of the protected species, which is the basis of *in vitro* storage for a long-term period. The Botanical Garden in Wroclaw has developed methods of vegetative propagation of plants of the *Droseraceae* and *Orchidaceae* families (Kukulczanka et al., 1984, 1989).

For several years now the Botanical Garden of the Polish Academy of Sciences in Powsin has been doing experiments on *in vitro* culture of *Lilium martagon* (Rybczynski and Gomolinska, 1989) and ferns with simultaneous application of cryopreservation methods by using LN (liquid nitrogen).

A seed bank is traditionally used for storing seeds of agricultural and horticultural plants trees and bushes at temperatures between +l0°C and -20°C. While the seeds are stored under those conditions, certain deterioration processes take place, which eventually influence the viability of the seed material. The scientific and research potential of the Botanical Garden in Powsin helps to develop methods of seed preservation in ultra-low temperatures of liquid nitrogen, i.e. -192°C. At present, there are being preserved in LN the seeds of some protected, endangered and extinct Polish native species which are on the red list of endangered vascular plant species. The research was focused on the introduction of several species of the following families: *Caryophyllaceae, Cruciferae, Compositae*, *Gentianaceae, Labiatae, Liliaceae, Linaceae, Poaceae, Polentoniaceae, Rutaceae* and *Scrophulariaceae*.

Tab. 1: Area of National Parks in Poland (ha)

No.	Name of the Park	Area
1.	Biebrzanski	59.223
2.	Kampinowski	35.699
3.	Bieszczedzki	27.064
4.	Tatrzanski	21.164
5.	Slowianski	18.789
6.	Wigierski	14.956
7.	Drawienski	8.725
8.	Roztoczanski	7.905
9.	Gorczanski	6.494
10.	Gor Stolowych	6.280
11.	Swietokrzyski	5.910
12.	Karkonoski	5.562
13.	Bialowieski	5.348
14.	Wielkopolski	5.095
15.	Wolinski	5.001
16.	Poleski	4.907
17.	Pieninski	2.231
18.	Babiogorski	1.734
19.	Ojcowski	1.592
	T O T A L (ha)	243.679



1. The Wolin NP
2. The Slowin NP
3. The Drawa NP
4. The Wigry NP
5. The Biebrza NP
6. The Wielkopolska NP
7. The Kampinos NP
8. The Bialowieza NP
9. The Polesie NP
10. The Roztocze NP
11. The Swietokrzyski NP
12. The Bieszczady NP
13. The Pieniny NP
14. The Gorce NP
15. The Tatry NP
16. The Babia Gora NP
17. The Ojcow NP
18. The Stolowe Gory NP
19. The Karkonosze NP

Fig. 1: Distribution of the National Parks in Poland

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Perspectives for *in situ* conservation programs in Chestnut: Genetic Variation of *Castanea satica* Mill. in Europe

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It is a common opinion now that nature conservation, including *in situ* reserves, should concentrate on the species level diversity and should be applied not only to species whose gene pool is already highly reduced but also to widespread and largely used species for which a rather high degree of genetic diversity is still available.

Chestnut can represent an example of a widely spread endangered species. In fact, it is widely distributed and it is an element of the forest ecosystems in temperate areas. On the other hand it has been and still is under strong selection pressure due to: a) intensive cultivation for fruit and timber production; b) parasitic attacks which are the cause of rather widespread diseases like blight and ink diseases. Therefore conservation programs, following an appropriate assessment of the amount of genetic diversity along the distribution range of the species, are needed.

Data on studies carried out on the genetic structure of European chestnut (*Castanea sativa* Mill.) are reported.

The aims of these studies were:

- to contribute to the knowledge of the origin and evolution of the species;
- to evaluate the present genetic resources which could be used in programs aiming at the preservation and the exploitation of resources;
- to contribute to find new criteria which will indicate the most suitable strategies on management of chestnut.

Samples were collected from three major zones, representing relevant steps in the evolution and the spread of sweet chestnut in Europe:

1) Turkey, the supposed centre of origin of the species;
2) Italy, where chestnut, after disappearance during the last glaciation, was then found during Neolitic and later during Roman period;
3) France, representing the latest phase of the expansion, close to the northern limit of the taxon.

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Winter buds were used and analyzed for 14 isozyme loci. Allelic frequencies were used to evaluate the level of genetic variability and differentiation within and between populations. The results of these analyses can be summarized as follows:

Castanea sativa is characterized by a very high degree of genetic differentiation across its range in Europe and in Turkey.

The genetic variability and differentiation within area decreases in east-west direction. This seems to support the general contention that Turkey is the area closest to centre of origin of the species, and has maintained the highest level of gene diversity. Genetic variability probably dropped during the expansion of the range due to genetic drift and because of relatively limited gene flow also due to human influence.

High degree of genetic, morphological and physiological differentiation was observed between population from two areas of Turkey: Black Sea coast and Aegean coast. The level of differentiation is so high that it is not possible to exclude some speciation phenomenon which, on the other hand, has been also reported in other plant and animal species. Black Sea coast is in fact characterized by a large number of endemic species.

Finally, from a closer inspection on Turkish populations, a possible introgression area, between the two genetically distinct forms of *Castanea sativa* was detected in the North-Western part of Turkey.

The finding of this possible introgression area or hybrid zone, if confirmed, could be of great theoretical and practical interest.

These areas offer a valuable experimental material for studies of characters and processes involved in divergence and speciation and for the safeguard and development of genetic resources.

In fact new genotypes are created from the crossing and subsequent interactions of similar but distinct genomes. The resulting progeny may show: phenotypic characteristics unlike either of the parents; eenhanced physiological stability; selective advantage in novel habitats; capacity to exploit resources unused by either parents.

Moreover, introgression can result in a transfer of genetic information across the usual species boundaries. This may contribute to the maintenance of larger quantities of genetic variation; more rapid response to selection.

For all these reasons, the identification and conservation of hybridization and introgression areas as well as centres of origin are of great interest for forest species and particulary for chestnut.

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Report of Working Groups:

J. CHERFAS, F. BEGEMANN AND R.D. SMITH

On-farm conservation and its relations to ex-situ conservation

Rapporteur J. CHERFAS

The participants spent considerable time discussing various interpretations of the phrase "on-farm". After an exchange of views, it was agreed to extend the use of "farm" to cover fields and gardens too. The use of the term "in-situ" was felt not always to be entirely appropriate, for example in the case of assembled orchards of fruit trees. In the end, participants agreed that people and their activities are an essential part of on-farm conservation, and that one defining characteristic might be that in on-farm conservation plant genetic resources are at least open to the continuing evolutionary influence of selective forces.

Three possible aspects or levels of on-farm conservation and its relationships with ex-situ (genebank) conservation were identified:

1 Specific conservation of plant genetic resources, for example to assist a genebank with regeneration.
2 The conservation of plant genetic resources through their use as part of a wider effort to conserve the social and cultural identity of a region and its agriculture.
3 Work with farmers to increase the diversity of plant genetic resources being grown, through programmes such as farmer innovation.

All three can contribute to the conservation of plant genetic resources in different ways. But all three, it was felt, shared a common factor, which was their potential for increasing public awareness of the value of plant genetic resources.

The group identified several factors that might influence on farm conservation in positive and negative directions. For example, genebanks could pay farmers to grow specific crops, such as large populations of obligate outbreeders. On the other hand, genebanks might never be able to match the returns available to farmers from other crops or even set aside. Farmers might also be trained to make preliminary characterisations.

The group suggested that there was much to be learned about direct collaboration between genebanks and growers, particularly from the experience of colleagues in Hungary and elsewhere.

Working within existing agricultural societies there is an important place for a diversity of plant (and animal) genetic resources. Products typical of a region can enhance the value of conserving diversity to farmers and the use of regionally adapted varieties can help to maintain traditional forms of culture.

The group suggested further exploration of ways of encouraging diversity in agriculture, for example in Biosphere Reserves, and in pursuing the marketing of authentic regional specialities. Tourism, too, and Living Farm museums offer significant opportunities for the conservation of plant genetic resources while at the same time making an important contribution to heightened

public awareness. The group also stressed the need for genebanks to document aspects of usage and cultivation in addition to phenology and provenance.
Participants discussed examples from around the world, particularly less-developed countries, of collaborations between genebanks, breeders and farmers, to use existing plant genetic resources to create new varieties shaped by the needs of the farmers. While there was much debate on the nature and value systems of different modes of agriculture, and the need for land reform, the group was generally reluctant to enter into this kind of on-farm use of plant genetic resources.

During group discussions several questions for further consideration were raised. Many might usefully form the subjects of future meetings and of efforts to gather and collate material. A sample of these topics would include:

- Can farmers regenerate genebank stocks efficiently?
- Can amateurs be trained to carry out assessments and characterisation?
- What mechanisms exist to encourage consumers to use variety identifiers, especially in the promotion of regional specialities?
- How can genebanks improve their documentation of traditional patterns of use and cultivation?
- What mechanisms exist within nationally designated reserves to encourage the conservation and utilisation of a greater diversity of plant genetic resources?
- Can the use of regionally adapted varieties be linked to traditional methods of farming?
- Can genebanks play a part in mitigating the negative impact of the introduction of genetically uniform crops and varieties?
- Can genebanks work with farmers to increase the yields of traditional landraces grown in traditional systems?
- What opportunities exist for increasing public awareness of the issues around plant genetic resources through the use of shows and exhibitions, local fields days, open days at genebanks, living museums, historic houses and gardens, botanic gardens, and the like?

In the final analysis, the group agreed that, at least within the European Union, the biggest single barrier to enhanced on-farm conservation was legal; existing plant variety legislation makes it almost impossible for the farmer to derive any economic benefit from the conservation of plant genetic resources. A change in this legislation would have a great impact, even if it did not promote an increased diversity of plant genetic resources on the farm, but merely permitted it instead of preventing it.

As a first step, the group urges the European Parliament to use whatever mechanisms it can to assess the impact of existing legislation on the conservation and utilisation of plant genetic resources, and to consider additional systems if appropriate.

Report of Working Group on:

Complementary contribution of Nature Conservation (i.e. Biosphere Reserves) and Genebanks in conservation of plant genetic resources

Rapporteur: F. BEGEMANN

The group discussed numerous aspects that influence collaboration between genebanks and institutions engaged in nature conservation. Areas of common interest were identified and participants agreed that conservation in the wider sense would also imply the necessity to monitor diversity at various levels and to utilize plant genetic resources as a means to continuing conservation.

The need to improve the cost efficiency of on-going activities lead to a detailed discussion on collaborative research work and opportunities that will evolve from combined communication systems. Participants welcomed the offer made by a representative of the German Committee of the Man and Biosphere Programme (MAB) to use the existing instrument of biosphere reserves for conservation and management of plant genetic resources.

The group agreed on a list of concrete activities at a national level to be executed as soon as possible:

1 As a first step, the participants of the symposium will clarify existing instruments in the area of nature conservation that would be useful for conservation and management of plant genetic resources in their respective countries; biosphere reserves or other categories of protected landscape were mentioned.

2 The participants of the symposium will develop a list of ecotypes and areas worthwhile for protection; diversity of wild progenitors and wild relatives of crop plants to be of particular importance.

3 Representatives of the genebanks will draft lists of species to be considered for monitoring systems that already exist in protected areas; in addition, lists of descriptors of different species for the monitoring will be developed.

4 It was agreed to develop a list of crops that a re suitable for on-farm or in-situ conservation in protected areas (i.e. biosphere reserves).

5 It was emphasized that a communication system between genebanks (in a wider sense) and the national MAB-secretariats and other relevant authorities is needed and should be established as soon as possible. Participants obtained addresses of their respective national MAB-secretariats. The lists to be developed (see 2, 3 and 4) will be communicated to the relevant national authorities and the MAB-secretariats in particular.

6 To support European cooperation it was agreed to send the lists (see 2,3 and 4) to the ECP/GR-Coordinator who will forward the lists to the European MAB-secretariat in Poland.

7 The following research needs were mentioned with respect to opportunities arising from the in-situ / ex-situ collaboration:
   - Evaluation of genetic variance of polymorphisms and molecular variance;
   - Crop evolution studies;
   - Species identification;
   - Identification of marginal populations;
   - Establishment of core collections;
   - Comparison of genetic resources under in-situ and ex-situ conservation practices.

Report of Working Group on:

Complementary contribution of Botanic Gardens, Genebanks and other institutions involved in ex-situ conservation of wider plant genetic resources

Rapporteur: R. SMITH

A positive governmental response to the implementation of the Biological Diversity Convention will involve the integration of all institutional resources involved in ex situ conservation. Whilst there have been recent positive initiatives in the various interest groups this integration has been slowed by a lack of information exchange between them.

Information exchange

The first step toward improved integration will involve greater information exchange between the botanic gardens, genebanks and other institutions involved in ex situ conservation of plant genetic resources.

This exchange will need to cover information on:

- plant holdings at accession level and involving geographic origins and genetic history
- availability of material for exchange
- information about ex situ conservation activities, e.g. technics been applied
- systematics

Evaluation of material at genetic level

There is a need for evaluating the genetic constitution of the material to asses the variability held and for planning future actions.

Local responsibilities

In the ex situ conservation of plant genetic resources botanic gardens and other research institutes are likely to expand their current interest in preserving local native and wild flora.

Required future actions

Development of national action plans should pay special attention to the integration of the various plant genetic resources activities. The monitoring of subsequent progress in the execution of the plans should allow the success and efficiency of this integration to be seen.

- networking (putting people from the different interest groups together, allow database accession, etc.)
- data exchange between botanic gardens and other PGR activities (database links)

Whilst national efforts will form the backbone of any international activity there will remain a need for the improved integration of the various umbrella organizations which represent the different interest groups within plant genetic resources.

Botanic gardens are particulary well-suited to developing the different protocols necessary for the maintainance of collections of perennials and clonaly propagated plants as living material.

Resolution
(formulated by all participants)

An ´International Symposium on Plant Genetic Resources in Europe´ was held at the Institute for Plant Genetics and Crop Plant Research (IPK) in Gatersleben, Germany, for three days from 6 to 8 December 1993. The Symposium was jointly organised by IPK, the British Council, Köln and the Information Centre for Genetic Resources (IGR), Bonn.

Some 60 participants from the formal and informal sector of fourteen countries discussed plant genetic resources activities in Europe and focussed on the relationship between in situ and ex situ conservation. In three working groups, possibilities of collaboration among genebanks and (1) nature conservation / biosphere reserves, (2) botanic gardens and other ex situ conservation institutions and (3) on farm conservation were investigated. At the end, the participants formulated the following resolution:

Resolution

The Symposium emphasizes the importance of the future use of plant genetic resources (PGR) for human welfare and culture

- recognizing the fact that PGR are an essential element of biodiversity and that their preservation requires a more integrated approach;
- recognizing the increasing threat to PGR and their further erosion, especially because the evolution of PGR no longer continues on farm in many parts of the world;
- recognizing the importance of longterm storage as well as the maintenance of evolving populations in either natural habitats or on farm;
- recognizing the need of PGR for crop germplasm enhancement.

The participants of the Symposium

1. recommend that PGR, according to their importance to humanity, should rank high on the political priority list, which should be expressed, e.g. in improved coordination between relevant ministries and their specialized agencies;
2. recommend everyone concerned with PGR to promote greater public awareness (through media, education, etc.) of the importance of PGR;
3. recommend that mutual understanding and cooperation between all those involved (formal/informal sectors, national/international, north/south/east/west Europe) are promoted;
4. recommend that terminology and concepts are clarified, such as *in situ* and on farm conservation;
5. urge authorities to reconsider laws and regulations that albeit unintentionally reduce diversity.
6. in particular, urge authorities to ensure that seed trade regulations take into account the needs of small scale, traditional and amateur growers and permit them to conserve and utilize PGR;

7. affirm their willingness to cooperate with other groups involved in biodiversity conservation, in particular by transferring knowledge i.e. in the fields of evaluation of diversity, seed technology, information handling, plant breeding, etc.:
8. urge authorities and appropriate institutions to encourage and support sustainable/traditional farming systems as a way of maintaining and increasing the conservation and utilization of biodiversity in agriculture throughout Europe;
9. stress the need for research activities in existing national genebanks and networks aiming at better utilization of PGR, along with the increased support for cooperation and joint activities for national European genebanks, e.g., through the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR).

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