

**FINNISH NATIONAL PLANT GENETIC
RESOURCES PROGRAMME FOR
AGRICULTURE AND FORESTRY**

CONTENTS

PART I: The Plant Genetic Resources Programme

- 1. Preparation of the Programme**
- 2. Main Principles and Objectives**
- 3. General Foundations for the Programme**
- 4. Detailed Objectives and Measures**
 - 4.1. Legislation and International Agreements on Genetic Resources**
 - 4.2. Conservation of Plant Genetic Resources**
 - 4.3. Sustainable Use of Plant Genetic Resources**
 - 4.4. Research, Information, Education and Training,
and Advisory Services Regarding Plant Genetic Resources**
- 5. Proposal of the Working Group for a Model for the
Implementation of the Plant Genetic Resources Programme**
- 6. Funding**
- Appendix 1**

PART II: Background Survey

- 1. Background**
- 2. Legislation and International Agreements Relating to Genetic Resources**
 - 2.1. The Convention on Biological Diversity**
 - 2.2. International Undertaking Agreement, IU**
 - 2.3. The Plant Genetic Resources Programme,
Global Plan of Action, GPA**
 - 2.4. The TRIPS Agreement**
 - 2.5. The UPOV Convention and Legislation
Concerning Plant Breeders' Rights**
 - 2.6. Patenting of Genetic Resources**
 - 2.7. Legislation on Genetically Modified Plant Genetic
Resources for Agriculture**
 - **Directive 98/81/EC on the Contained Use
of Genetically Modified Organisms**
 - **Community Directive 90/220/EEC,
the So-Called 'Free Use' of GMOs**
 - **The Regulation on Novel Foods and
Novel Food Ingredients EC 258/97**
 - **Finnish Gene Technology Act (377/1995)
and Decree (821/1995)**
 - **The Cartagena Protocol on Biosafety to the
Convention on Biological Diversity**
 - 2.8. Legislation on Seed and Propagating Material**

- Seed
- Propagation Material for Fruit, Berry, Vegetable, and Ornamental Plants
- Forest Reproductive Material

2.9. Measures to Conserve Biological Diversity in Agriculture

2.10. Nature Conservation Act

3. Ownership of Plant Genetic Resources

4. Conservation of Plant Genetic Resources

4.1. Methods of Conservation

1. Agriculture
2. Forestry

4.2. Plant Genetic Resources Collections in Finland

1. Agriculture
2. Forestry

4.3. Nordic Cooperation for the Conservation of Genetic Resources

- The Nordic Gene Bank, NGB
- Nordic Strategy on Genetic Resources

4.4. International Institutions and Organisations

- International Institutions of Agricultural Research (Consultative Group on International Agricultural Research, CGIAR)
- European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR)
- The Vavilov Institute, VIR

5. Utilisation of Plant Genetic Resources in Finland

5.1. Agriculture

1. Agri-Environmental Support
2. General Indicators for Sustainable Utilisation of Renewable Natural Resources
3. Plant Breeding
4. Seed Trade

5.2. Forestry

1. Forests and the Principles of their Utilisation
2. General Characteristics of Forestry and Forest Industry
3. Conservation of Diversity in Forests
4. Forest Tree Breeding
5. Production and Use of Forest Reproductive Material

6. Research and Education on Plant Genetic Resources in Finland

7. Associations and Other Organisations

8. Literature

Appendices

PART I
THE PLANT GENETIC RESOURCES PROGRAMME

1. Preparation of the Programme

Finnish agriculture and forestry, as well as food production and forest industries that are dependent on them, are based on the sustainable use of renewable natural resources. The conservation and sustainable use of plant genetic resources, as well as issues regarding their ownership and the sharing of benefits from them, have become some of the key issues in the negotiation of international agreements in the 1990s.

The objectives of the Convention on Biological Diversity (CBD) are to conserve the diversity of global ecosystems, plants and animals (organisms), as well as their genetic resources, to promote the sustainable use of natural resources, and to ensure fair and equitable sharing of the benefits arising from the utilisation of biological resources. In addition to wild species of organisms, the concept of biodiversity also encompasses varieties of arable crops and livestock breeds. In adopting the Convention on Biological Diversity, Finland committed itself to promoting the conservation and sustainable use of biodiversity as part of all societal activities.

Since 1994, negotiations have been under way within the FAO Commission for Genetic Resources on an International Undertaking (IU) agreement concerning the genetic resources for agriculture. A Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (GPA) was signed by 150 member states in Leipzig in 1996, including all Nordic countries. The GPA emphasises the importance of national genetic resources programmes, particularly in the promotion of the conservation and sustainable use of agricultural plants.

Resolution 2 of the First Ministerial Conference on the Protection of Forests in Europe, held in 1990 in Strasbourg, obligates the signatory countries to safeguard the preservation of the genetic resources of their forests. This led to the creation of the European Forest Genetic Resources Programme (EUFORGEN), which was ratified by the Second Ministerial Conference held in Helsinki in 1993.

The Finnish Ministry of Agriculture and Forestry appointed a working group for the preparation of a Finnish National Plant Genetic Resources Programme, related to the implementation of the CBD and the GPA. The working group was appointed for the period 1 March 1998 – 31 December 2000. The group continued the work of the first Committee for Plant Genetic Resources appointed in 1995. The group's period of office was later extended to the end of April 2001.

The Ministry appointed Agricultural Counsellor Mirja Suurnäkki as chairman of the working group and Senior Research Scientist Leena Hömmö as its secretary. The appointed members of the group were Senior Inspector Marjatta Kemppainen-Mäkelä and Senior Advisor Hannu Kukkonen from the Ministry of Agriculture and Forestry, and the invited members were Breeder Reino Aikasalo and Breeder Leena Pietilä from Boreal Plant Breeding Ltd.; Professor Aarne Kurppa and Researcher Tarja Hietaranta from the Agricultural Research Centre of Finland (since 1 March 2001, the MTT Agrifood Research Finland); Professor P.M.A. Tigerstedt from the University of Helsinki; Docent Kari Laine from the University of Oulu; Professor Veikko Koski from the Finnish Forest Research Institute; Agricultural Advisor Kaisa Karttunen from the Ministry of Foreign Affairs (replaced by Agricultural Advisor Eero Horstia from 2000); Senior Advisor Anneli Sund from the Ministry of the Environment; Researcher Leena Pietilä from the Plant Production Inspection Centre; Director Juha Ruippo from Central Union of Agricultural Producers and Forest Owners (MTK); Director Kaarlo Kinnunen from the Association of Rural Advisory Centers, SLF; Executive Director Pekka Metsola from the Central Organisation for Finnish Horticulture; Researcher Annmaj Rönning from

the Turku Provincial Museum (also representing the Nordic Cultural Landscape Society); Chairman Markku Rämö from Maatiainen ry; Tapio Poutala (now Lahti) from Kesko Oy; Product Director Timo Uusi-Rauva from Nieminen S.G. Oy; and Director Arto Vuori from the Plant Variety Rights Office.

The Finnish Advisory Board to the Nordic Gene Bank (NGB) was included in the working group as a sub-division.

The Finnish National Plant Genetic Resources Programme for Agriculture and Forestry (Part I) prepared by the working group is based on an extensive background survey (Part II), which addressed in detail the various issues involved in the conservation and sustainable use of plant genetic resources. These include international and national legislation on genetic resources, agreements and organisations, ownership of genetic resources, their conservation and utilisation, as well as research and education concerning genetic resources.

The National Plant Genetic Resources Programme for Agriculture and Forestry outlines the main principles, objectives, and proposals for measures regarding the conservation and sustainable use of genetic resources for agriculture, horticulture, and forestry.

The working group decided to limit the Programme presented herein to cover the plant genetic resources for agriculture, horticulture, and forestry. Consequently, the Programme does not cover herbs, medicinal, ornamental, or landscape plants insofar as they are not included within the mandate of the Nordic Gene Bank. These categories of plants can be most appropriately managed by the Advisory Board for Plant Genetic Resources, the appointment of which is proposed in the present programme, as they are adopted into the mandate of the NGB.

It is the contention of the working group that the Nordic Gene Bank (NGB) should be utilised more efficiently than at present for the coordination, planning, and implementation of work for the conservation of national plant genetic resources. The working group recommends that responsibility for the implementation of the Finnish National Plant Genetic Resources Programme for Agriculture and Forestry be increased for MTT Agrifood Research Finland, and an additional person workyear should be established there for this purpose. The corresponding responsible organisation regarding forest genetic resources is the Finnish Forest Research Institute (Metla).

Having completed its work, the working group submits the National Plant Genetic Resources Programme for Finnish Agriculture and Forestry to the Ministry of Agriculture and Forestry.

Helsinki, on the 9th day of May, 2001

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2. Main Principles and Objectives

The plant genetic resources for agriculture and forestry constitute the basis for agriculture, horticulture, and forestry, as well as food security and forest industries based thereon.

These genetic resources shall be protected, maintained, and utilised in a sustainable manner to safeguard the conservation of genetic diversity, also for future generations.

Research and plant breeding based on and utilising the genetic variability of plants are activities that produce plant varieties and strains suited to conditions in this country for the needs of agriculture and forestry, also in the future.

International agreements, Nordic cooperation on gene banks and genetic resources, as well as national measures, shall all be utilised to safeguard the conservation and sustainable use of genetic resources for agriculture and forestry, on the one hand, and the access to genetic resources for the needs of plant breeding and research, on the other.

Resolution of open questions relating to the conservation and sustainable use of plant genetic resources calls for interdisciplinary research.

Cooperation between administrative sectors shall be utilised to ensure sufficient coverage of measures – educational, advisory and informational services included – aimed at the conservation and sustainable utilisation of genetic resources.

3. General Foundations for the Programme

The conservation and sustainable use of genetic resources for agriculture, horticulture, and forestry is agreed upon in international agreements (CBD, IU, GPA). In Finland, the body responsible for the conservation and sustainable use of these resources is the Ministry of Agriculture and Forestry.

The objective of the Ministry of Agriculture and Forestry is to safeguard the economic growth of the nation and its rural areas in such a way as to ensure that the utilisation of the renewable natural resources under its mandate is sustainable in the long term. This objective can only be achieved if the principle of sustainable use of renewable natural resources is established as the governing principle in the utilisation of natural resources and in the development of new methods for their use. Moreover, decisions regarding the use of these resources must be based on up-to-date and generally accepted information on the status and utilisation of natural resources.

The Strategy for the Sustainable Use of Renewable Natural Resources of the Ministry of Agriculture and Forestry (1997) lists nine objectives that seek to ensure the sustainable use of renewable natural resources. The objective regarding the conservation of the genetic diversity of species presents a list of proposed measures for the conservation of the genetic resources of agricultural plants, livestock, and forests, as follows: "The necessary national programmes and strategies will be prepared for the conservation of the diversity of the genetic resources of crops and livestock, also by increasing the investments made in Nordic gene bank operations" and "A sufficient number of gene reserve forests will be established and sufficient genetic diversity maintained in reforestation material".

The guidelines included in the objectives of the Natural Resources Strategy also propose the establishment of a permanent system for monitoring changes in the biological diversity of agricultural environments.

The Finnish National Plant Genetic Resources Programme implements the Ministry's operative principles and the Natural Resources Strategy, as well as the objectives contained therein, by ensuring that the conservation and sustainable use of plant genetic resources for agriculture, horticulture, and forestry take into consideration the needs of present and future generations.

Measures proposed in the National Plant Genetic Resources Programme shall be primarily carried out by the competent authorities of the various administrative sectors. Indeed, the successful implementation of the Programme calls for close cooperation between several administrative sectors.

It is the recommendation of the working group that the Ministry of Agriculture and Forestry adopt a proactive role in determining the appropriate division of labour between the administrative sectors for the implementation of the National Plant Genetic Resources Programme.

4. Detailed Objectives and Measures

4.1. Legislation and International Agreements on Genetic Resources

Background

Issues regarding the ownership and use of plant genetic resources for agriculture are negotiated in the context of the Convention on Biological Diversity and the International Undertaking on Plant Genetic Resources. The objective of these agreements is to safeguard the conservation and sustainable use of genetic resources in a way that ensures that benefits from the utilisation of the resources accrue also to the countries of origin of the resources in question. The ownership of genetic resources is regulated by the international TRIPS Agreement, and, in the case of plant varieties, in legislation concerning plant breeders' rights. Genetic resources can, in some cases, also be patented.

In the FAO's programme, forest genetic resources are included under the concept of 'agriculture', which means they are included in the FAO's numerous regional programmes, especially in the tropics and developing countries. Under Resolution 2 of the First Ministerial Conference on the Protection of Forests in Europe, held in Strasbourg in 1990, the European Forest Genetic Resources Programme (EUFORGEN) was established to safeguard the conservation and sustainable use of forest genetic resources in Europe. Implementation of the programme began in 1994. The second phase of the programme covers the period from 2000-2004. A total of 28 European countries participate in the programme. The contribution of Finland both in the initiation and implementation of the programme has been considerable.

National and Community legislation relating to plant genetic resources for agriculture and forestry are discussed in the background survey (Part II, Chapter 3).

Objectives

Legislation on plant genetic resources shall support the conservation and sustainable utilisation of genetic resources. New varieties are protected under plant breeders' rights, nevertheless in such a way that genetic resources remain accessible to breeders and to research into genetic resources as freely as possible.

The protection and sustainable utilisation of forest genetic resources is covered by international agreements.

Measures

- National preparation of international agreements will be participated in to ensure the conservation and sustainable use of plant genetic resources. These agreements include notably the Convention on Biological Diversity and the International Undertaking agreement.
- The Nordic strategy for genetic resources will be implemented.

- The preparation of international and national legislation on the ownership of plant genetic resources will be participated in.
- Within available resources, research into the effects of legislation on the conservation and sustainable use of genetic resources will be supported.

4.2. Conservation of Plant Genetic Resources

Background

Along with other Nordic countries, Finland has used the Nordic Gene Bank (NGB) for the conservation of the plant genetic resources for agriculture since the establishment of the bank in 1979. Currently, the NGB's mandate covers only agricultural and horticultural species. Work on the collection and conservation of these plant categories has been under way for more than 20 years, and most collection projects have been completed. There has been discussion about extending the NGB's mandate to cover also herbs as well as medicinal, ornamental, and landscape plants.

For the purpose of conserving the plant genetic resources for agriculture, it is vital that, during the support period of 2000-2006, special support contracts within the Finnish system of agri-environmental support can be used to encourage the cultivation of native plant species. The purpose of special support for the cultivation of native plants is to promote the conservation of the genetic material of hardy landraces and old cultivars adapted to the northern conditions in Finland.

The proposal of the Committee for Forest Tree Breeding for a National Forest Tree Breeding Programme for 1976-1985 included special measures for the conservation of forest genetic resources. However, activity on this issue first came to the fore in 1992, when implementation of the Resolutions of the First Ministerial Conference on the Protection of Forests in Europe began.

The principal method in the conservation of forest genetic resources is to reserve representative samples of natural populations as gene reserve forests. The exception is hardwood trees; in their case, the principal method of conservation is the establishment of special clone banks. Because trees in different parts of the country have adapted to different climatic conditions, conservation is consequently decentralised into different parts of the country. The Finnish Forest Research Institute is responsible for the planning of the conservation of forest genetic resources, as well as for drawing up guidelines for practical work. Gene reserve forests have been established on the lands of different forest owner groups, predominantly on state land, however. Nature conservation areas and clone banks established primarily for the purpose of breeding forest trees also play a role in the conservation of forest genetic resources.

Objectives

The objective of the National Plant Genetic Resources Programme is to safeguard the long-term conservation and sustainable utilisation of the genetic resources of agricultural plants, forest trees, and horticultural plants in Finland. As the mandate of the Nordic Gene Bank is extended to cover also herbs, medicinal, ornamental, and landscape plants, it will also become necessary for the Plant Genetic Resources Programme to cover these plant categories as well. The extent of genetic

material to be conserved will be investigated utilising researched knowledge, and methods for the conservation of the material will be developed to enhance the efficient use of resources.

The primary facility for storing plant genetic resources for agriculture will be the Nordic Gene Bank, which coordinates storage activities in the Nordic countries, and serves as the expert authority on practical issues involving storage. Nationally valuable *in situ* and *ex situ* collections of plant genetic resources will be inventoried, using the expertise of the NGB where necessary. These valuable collections will be stored either as seed samples at the NGB, or in national *in situ* collections to be determined separately, such as those maintained by MTT Agrifood Research Finland. MTT Agrifood Research Finland will serve as the primary organisation for the storage of vegetatively conserved horticultural species. The research station in Jomala in Åland also maintains provincial collections as far as possible. The Finnish plant categories stored in the NGB are presented in Table 1 of Appendix 1.

By 2005, a geographically comprehensive network of gene reserve forests will be established, as well as necessary collections for the conservation of hardwood trees and other tree species less common in forestry.

Measures

- The responsibility of MTT Agrifood Research Finland will be increased for the conservation of nationally valuable genetic resources for agriculture.
- The storage of the plant genetic resources for agriculture will be centralised in the Nordic Gene Bank. Operations of the NGB will be developed through active participation in the Board of the NGB.
- Work by various associations and other organisations for the promotion of the conservation and sustainable use of plant genetic resources for agriculture will be supported within available resources.
- Measures promoting the conservation and sustainable use of the plant genetic resources for agriculture will be maintained and developed through the system of agri-environmental support.
- New gene reserve forests will be established as outlined in Table 2 in Appendix 1, and new collections of hardwood trees as detailed in Table 3 of the same Appendix. In addition to these, collections for the conservation of genetic material of aspen, black alder, Siberian larch and juniper will be established. The management and maintenance of gene reserve forests and the collections will be ensured.
- The Advisory Board for Plant Genetic Resources to be established will study opportunities for extending the mandate of the Nordic Gene Bank to cover also herbal, medicinal, ornamental, and landscape plants, as well as the national measures for the organisation of the protection, maintenance, and sustainable use of these plant categories.

4.3. Sustainable Use of Plant Genetic Resources

Background

Commercial agriculture is practised in Finland in more northern conditions than anywhere else in the world. Crops cultivated in Finland are adapted to the long, cold winter, and to the short growing season with long hours of daylight. It is the conservation and sustainable use of such genetic resources for agriculture adapted to these conditions that constitutes the foundation of successful agriculture now and in the future.

Domestic species of forest trees grow in Finland on the northernmost limit of their distribution area. Provenance tests have shown that exotic tree species and provenances transferred to Finland from abroad do not generally thrive here. As long-lived plant species, forest trees must endure the great temperature fluctuations of the current Finnish climate. Furthermore, the anticipated climate change will demand an even greater capacity for adaptation in the future.

Conservation of the genetic material of wild forest trees is an absolute requirement for the continued practice of forest management in this country.

The maintenance of sufficient genetic diversity in the breeding of forest trees and in the production of genetically improved reforestation material have been secured through the establishment of long-term programmes and legislation concerning the production and trade in forest reproductive material.

Objectives

Plant genetic resources for agriculture adapted to the Finnish climate will be utilised sustainably so as to secure the availability of sufficient genetic variation also in the future.

Plant breeding will be utilised to produce varieties adapted to Finnish conditions that are reliable, more productive, and of a higher quality.

The conservation of the natural genetic variability of forest trees, as well as the maintenance of sufficient diversity in breeding populations and artificially regenerated forests, will be secured.

Measures

- Breeding of varieties adapted to Finnish conditions will be maintained, and, when necessary (with funds from the National Emergency Supply Fund), breeding will be supported of commercially non-profitable field crops that are nevertheless necessary to secure a national seed supply.
- The maintenance and cultivation of landraces and varieties, as well as old cultivars, will be promoted as part of the system of agri-environmental support.
- The development of indicators for measuring the sustainable use of genetic resources will be participated in, both nationally and internationally.

- Within available resources, research into the diverse utilisation of plant genetic resources for agriculture will be promoted, as well as the transfer of research results into practice.
- Long-term programmes for forest tree breeding and seed supply, as well as legislation regulating the production of genetically improved reforestation material, will be kept up to date.

4.4. Research, Information, Education and Training, and Advisory Services Regarding Plant Genetic Resources

Background

Plant genetic resources are part of the biological diversity of nature. Objectives for research and education in the field of plant genetic resources are laid down in the Finnish National Action Plan for Biodiversity. However, education and research on the conservation and sustainable use of plant genetic resources is currently very fragmentary in Finland .

Objectives

Research and education on plant genetic resources will be used to ensure sufficient expertise in all sectors of the conservation and sustainable use of plant genetic resources. University-level education on plant genetic resources will be provided in all faculties of the biosciences in Finland, as well as in the Faculty of Agriculture and Forestry at the University of Helsinki. Some of the research and training will take place on the Nordic and EU levels.

Advisory and information services will be utilised to increase the knowledge and understanding of the public the significance of plant genetic resources for the successful practice of agriculture and forestry now and in the future.

Measures

- Efforts will be made to enhance the efficiency of research, education, and advisory services on the protection, conservation, and sustainable use of plant genetic resources in Finland.
- Efforts will be made to ensure that research on the plant genetic resources for agriculture, forestry, and horticulture is sufficiently covered in current and future research programmes on genetic resources.
- The expertise of the Nordic Gene Bank will be utilised in research and education on the conservation of genetic resources (for example, through participation in Nordic researcher workshops).
- Within available resources, research will be supported on the conservation and sustainable utilisation, as well as diversity, of plant genetic resources.
- Links will be established on the MTT Agrifood Research Finland website to the websites of major organisations in the field of conservation and sustainable use of the genetic resources for agriculture and forestry.

- Associations and other organisations will, within their resources, provide practical advisory services on issues involving the utilisation of plant genetic resources.

5. Proposal of the Working Group for a Model for the Implementation of the Plant Genetic Resources Programme

Current Status

Finland

The conservation and sustainable use of plant genetic resources in Finland have been addressed by a broad-based plant genetic resources working group appointed by the Ministry of Agriculture and Forestry.

On 30 November 1999, the Parliamentary Agricultural and Forestry Committee required (HE 58/1999 vp) that a "unit for the biological diversity of field crops and horticultural plants" be established within MTT Agrifood Research Finland, charged with the conservation of the genetic diversity of field crops, including also species and varieties of plants that are economically non-profitable at any given moment.

In its response, the Ministry of Agriculture and Forestry stated that the proposal would be addressed in conjunction with the Plant Genetic Resources Programme then under preparation.

Since the mid-1970s, the general principles for the conservation of forest genetic resources have been included in the long-term breeding programmes for forest trees. The implementation of the programmes is carried out jointly by several organisations.

The main responsibility for the conservation of forest genetic resources is carried by the Finnish Forest Research Institute, which is charged with all forest tree breeding operations conducted with state funding. The Institute is responsible for the overall planning of the conservation of forest genetic resources, the establishment of the network of gene reserve forests in cooperation with forest owners, and the establishment of clone banks and breeding populations. The Forest Research Institute also participates in international and Nordic cooperation in this field.

Nordic Cooperation

The Nordic Council of Ministers decided in its summer meeting in 2000 to appoint a Nordic Council of Gene Resources to act as an advisory body to the Civil Servants Committee and the Council of Ministers in matters pertaining to the genetic resources of plants, livestock, and forests. The Council of Gene Resources has two representatives from each Nordic country, with one from the sector of agriculture and forestry, the other from the environmental sector. The Nordic Council of Gene Resources works in close cooperation with the Boards of the Nordic gene banks (NGB, NGH) and the Forest Genetic Resources Network (Nordiskt skogsbruks frö- och plantråd (NSFP) and Samnordisk skogsforskning (SNS)).

Proposal

The working group proposes that an Advisory Board for Plant Genetic Resources for Agriculture and Forestry be established to implement the National Plant Genetic Resources Programme, and to coordinate the conservation and sustainable use of genetic resources for agriculture, forestry, and food production in Finland.

The duties of the Advisory Board shall be:

- To address Nordic and international matters involving plant genetic resources.
- To act as an inter-ministry cooperation body in matters pertaining to plant genetic resources.
- To prepare positions for the Finnish government in matters processed by the Nordic Council of Gene Resources.
- To make decisions previously made by the Finnish Advisory Board to the Nordic Gene Bank.
- To prepare matters pertaining to the National Plant Genetic Resources Programme, and to monitor and develop the Programme further.
- To participate in the preparation of necessary legislation.

The Ministry of Agriculture and Forestry shall appoint the Advisory Board for Plant Genetic Resources for four-year periods of office at a time. The chairman of the Board shall be a representative of the Ministry of Agriculture and Forestry, and its secretary a person to be hired full-time at MTT Agrifood Research Finland. The Advisory Board shall have representation from all competent authorities dealing with matters in the field of plant genetic resources, as well as experts from at least MTT Agrifood Research Finland, the Finnish Forest Research Institute, the Finnish Environment Institute, and Boreal Plant Breeding Ltd. The Board may also hear other experts and organisations when necessary.

Furthermore, the working group proposes that the Advisory Board for Plant Genetic Resources replace the Finnish Advisory Board to the Nordic Gene Bank, which shall be terminated.

6. Funding

To launch the National Plant Genetic Resources Programme on the proposed scale, the working group proposes that an additional sum of FIM 500,000 (about EUR 84,000) be added to the budget of MTT Agrifood Research Finland for the purposes of hiring a secretary for the working group for plant genetic resources for agriculture and forestry, for managing collections, and for other tasks involving the conservation of genetic resources, such as the organisation and implementation of new collection projects.

The cost of the conservation of forest genetic resources from 2001-2005 will be an average of FIM 800,000 (about EUR 130,000) per year, about half of which will be spent on breeding populations covered in the long-term forest tree breeding programme. The conservation of forest genetic resources will be funded from the operative budget of the Finnish Forest Research Institute.

It is the view of the working group that the Nordic Gene Bank should be developed further and be used for the performance of important tasks in the programme. Such tasks are, for example, the analysis and storage of nationally valuable special collections.

The working group proposes that, starting in 2002, a sum of FIM 50,000 per year (about EUR 8,400) be allocated in the state budget for projects conducted by the Nordic Gene Bank.

The working group considers that the needs of the National Plant Genetic Resources Programme should also be taken into consideration when determining research allocations in agriculture and forestry, as well as in the financial management of MTT Agrifood Research Finland and the Finnish Forest Research Institute.

Appendix 1. Collections of Genetic Resources for Agriculture and Forestry. Current Status and Future Needs

Table 1. Finnish accessions currently stored in the Nordic Gene Bank

Plant Group	Varieties and Strains, Total
Cereals	240
Potatoes	9
Cultivated grasses	219
Other, e.g. oil-seed plants	66
Fruit trees	616
Berries	491
Vegetables	51

Table 2. Number and area of gene reserve forests at the beginning of 2001 and objectives for the end of 2002.

Species	Status		Objective		Need for New Forests	
	1 January 2001		31 December 2002			
Pine	23	5108 ha	24	5200 ha	1	100 ha
Spruce	8	1541 ha	12	2000 ha	4	400 ha
Birches	4	422 ha	8	750 ha	4	300 ha
Lime	2	19 ha	5	40 ha	3	20 ha
Maple + lime	2	15 ha	2	15 ha	-	-
Ash	1	30 ha	1	30 ha	-	-
Oak			4	10 ha	4	10 ha

Table 3. Conservation collections of hardwood trees at start of 2001 and goals by the year 2005

Species	Status 1 Jan. 2001		Goal for 31 Dec. 2005	
	Stands	Trees/ Families	Stands	Trees/ Families
Maple	42	268	50	290
Ash	29	152	20	170
Lime	91	506	70	400
Oak	25	163	20	170
Scotch elm	38	220	40	250
European white elm	19	125	30	150

PART II
BACKGROUND SURVEY

1. Background

The invention of agriculture some 10,000 years ago was one of the major turning points in the history of mankind. Prior to this, people gathered plants for food, medicine, and for many other purposes.

Before the development of modern plant breeding, crops were bred by selecting high-yield varieties for propagation in the next generation. The criteria used in the selection included the size of the part of the plant that was utilised, as well as its good taste, one of the results of which was a gradual decrease in the plants' chemical resistance against diseases and pests, when selective breeding removed bitter repellents. As a result of such breeding, new genes and gene combinations gradually became more common in crops.

Modern plant breeding aims at developing new varieties that are either more productive or of higher quality. Breeding makes use of either existing or artificially produced genetic variation. In earlier times, new gene combinations were generally produced by crossing different strains of plants. Currently, new biotechnological methods, such as gene transfers, have made possible the use of a more extensive genetic material in the breeding of new varieties.

After careful selection, a new variety may be launched on the market, when its cultivation characteristics have been ascertained in official variety trials, and when it satisfies the criteria for new varieties imposed by the International Union for the Protection of New Varieties of Plants (UPOV). The new variety must be distinct from existing varieties, genetically stable, and sufficiently uniform. The last of these is important with respect to the identification of varieties and their quality characteristics, for example.

Traditional agriculture was based on the cultivation of landraces that had, over considerable time, adapted to local climate and soil conditions. Even today, landraces of several of the major crops, potato, barley, oat, wheat, and rye, as well as of many horticultural species have been discovered in Finland. After ascertaining their origin and identity, these landraces are stored in the Nordic Gene Bank (NGB) whenever possible. Landraces are generally cultivated in quite small areas, and as they become adapted to a particular environment, they often develop into genetically quite distinct varieties. Another typical feature of landraces is their within-strain variation. When a landrace strain contains variation with respect to stress tolerance genes, for example, its productivity potential is greater when environmental conditions change. The genetic variation of crops was at its greatest in the late 19th century. Since then, variation that had developed over thousands of years has crucially decreased in the space of less than a hundred years (Rousi 1997).

Modern agriculture is often based on the cultivation of but a few productive, high-quality varieties. The breeding of these varieties was originally based on the selection and crossing of the best landraces. As a result of continuous, intensive selection and the increased commercial value of bred varieties, landraces are no longer cultivated or bred. This has led to genetic uniformity and decreased variation in almost all crops.

With its new cultivation methods, modern agriculture has modified the entire agricultural ecosystem as well, so that many wild species or wild relatives of crops have either disappeared or are threatened in such ecosystems.

Large-scale forest management only began some 50 years ago. Forest tree species have gradually partly been developed into a kind of "crops". Seeding and planting of trees opened up new opportunities for forest improvement as well. In Finland, tree breeding got its start about 50 years ago, when the Forest Breeding Foundation was established. Activities relating to forest genetic resources have in the last ten years intensified in Finland because of the Convention on Biological Diversity (CBD) and the threat of global climate change.

The 1960s saw an international awakening of concern over the erosion of the genetic resources of crops, and, in 1965, the UN Food and Agriculture Organisation (FAO) appointed a seed and plant genetic resources service for the promotion of the conservation of crop genetic resources. The international technical conferences of the FAO, the Commission on Plant Genetic Resources (CPGR), and programmes aiming at the conservation of genetic resources, offered an international forum for discussion on genetic resources. In 1971, a new organisation was founded, the Consultative Group on International Agriculture Research (CGIAR). The CGIAR centres are charged with safeguarding sustainable agriculture and food security in developing countries in particular, using, *inter alia*, transfer of technology, training, and pre-breeding of genetic resources.

The genetic erosion of crops was on the agenda of the FAO international technical conferences in 1968 and 1972, and in 1974 the International Board for Plant Genetic Resources (IBPGR) was founded by the CGIAR. The IBPGR was charged with collecting in gene banks as much genetic variation of crops as possible. The IBPGR has been quite successful. However, developing countries in which these genetic resources were collected were often quite poorly prepared for the storage of genetic resources. They did not possess the necessary gene bank systems, and the collected genetic resources were consequently stored in either the CGIAR centres, or deposited in the gene banks of industrialised countries on the basis of bilateral agreements.

In addition to international gene banks, national or regional gene banks have been established in about a hundred countries around the world.

In 1979, the Nordic countries founded a joint Nordic Gene Bank (Nordiska Genbanken, NGB) located in Southern Sweden. The NGB stores samples of field crops and horticultural species from all Nordic countries. Currently, the NGB has about 30,000 seed accessions and about 3,000 clone accessions. Many of the latter accessions are fruits and berries, and they are stored in the Nordic countries by research institutions, for example.

After the adoption of the Convention on Biological Diversity, the FAO Commission on Plant Genetic Resources began in 1994 work on the amendment of the International Undertaking (IU) agreement to align it with the spirit of the CBD. The new agreement was to be adopted by the FAO Conference in 1999. However, negotiations have proved to be difficult, and the utilisation of genetic resources has developed into a political dispute between developing countries and the industrial world. Developing countries consider that they have the right to receive monetary compensation for the commercialisation of their genetic resources. The industrialised countries, many of which are signatories to the CBD, seek to reach a multilateral agreement under which the exchange of genetic resources would be free and the sharing of benefits (also other than monetary compensations) would not be linked to individual transfers of genes.

2. Legislation and International Agreements Relating to Genetic Resources

2.1. The Convention on Biological Diversity

The Convention on Biological Diversity (CBD) was signed on 5 June 1992 at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, and it entered into force on 29 December 1993. The CBD is the single most important international binding agreement that seeks to preserve the diversity of biological resources and ensure their sustainable utilisation. Finland ratified the convention in 1994.

The objectives of the CBD are: "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding." (Article 1, Objectives).

The Convention aims to conserve the genetic material of species of flora and fauna, as well as the diversity of species and ecosystems. In addition to wild plants and animals, the Convention also covers the conservation of the diversity of crops and livestock, as well as the diversity of traditional landscapes resulting from human activity.

The Convention provides a new definition for the ownership of natural resources, genetic resources included. Article 15 of the Convention states the following regarding access to genetic resources: "Recognizing the sovereign rights of States over their natural resources, the authority to determine access to genetic resources rests with the national governments and is subject to national legislation."

While bestowing states sovereign rights over their natural resources, the Convention requires that states take into account the conservation and sustainable utilisation of nature in their activities.

Because it is a convention, responsibility for the implementation of the CBD rests on the signatory states. Article 6 of the Convention requires the Contracting Parties to "develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity" in the implementation of their contractual obligations.

The Finnish National Commission for Biological Diversity, with representation from ministries, major sectors of the economy, as well as research, interest, and environmental organisations, prepared, in 1996-1997, a unanimous proposal for a National Action Plan for Biodiversity for the years 1997-2005 (The Finnish Environment publication series 137). The plan details the development measures (1-124), mandates, and needs for resources for the protection, management, and sustainable use of biological diversity by the year 2005. The plan is based on the ministries' sectoral programmes and biodiversity reports.

Under the principle of 'sectoral responsibility', the Ministry of Agriculture and Forestry prepared a proposal for measures for its administrative sector entitled 'Renewable Natural Resources and

Biological Diversity' (Committee Report 1996:1), which presented a compilation of proposals for measures required by the CBD within the various mandates of the Ministry of Agriculture and Forestry. The proposal states: "The central objectives in the sustainable use of biological diversity are the conservation of the genetic diversity of species of plants and livestock in agriculture, and the management of the habitats of wild species dependent on the practice of agriculture". Additionally, the committee suggested that:

- Contributions be increased regarding the operation of Nordic gene banks for the storage of genetic material of landraces and local breeds of livestock, and
- A National Plant Genetic Resources Programme be prepared, and a strategy drawn up for the conservation of local and other rare breeds of livestock.

The proposal by the Ministry of Agriculture and Forestry for the Plant Genetic Resources Programme is taken into consideration in Action 61 of the National Action Plan: "Genetic diversity in plant breeding shall be secured by drawing up a National Plant Genetic Resources Programme, by securing the conservation of the genetic resources of landraces and old cultivars, and by participating actively in the maintenance of a Nordic gene bank for agricultural and horticultural plants."

In 1998, a working group was appointed to coordinate and monitor the implementation of the National Action Plan. The group's tasks were to monitor the state of biological diversity in Finland and to supervise the preparation of summary reports. Two groups of specialist consultants were appointed as well, to provide assistance to the monitoring group.

The first follow-up report on the National Action Plan was completed in spring 2000 (The Finnish Environment publication series 407). The report presents a summary of the implementation of the National Action Plan, focal areas as well as development objectives for the near future (Chapter 1), a detailed description of the realisation of core proposals for the development of the plan (124 proposals) (Chapter 2), and a review of the funding and other resources required for realisation of the focal areas of the plan (Chapter 3). In its general assessment, the monitoring group observes that the National Action Plan had commenced in the way intended in the preparatory phase, and that it can already be regarded as being in the forefront of such programmes internationally.

Problems in the implementation of the plan identified by the monitoring group were the vast scope of the plan and the lack of information on the key processes affecting biodiversity. According to the report, cooperation and coordination between and within sectors must be improved, and the processing of information (databases and information systems, for example) should be rendered more efficient. The monitoring group also observes that the implementation of the plan was examined on the national level, and that consequently the regional and local success of the plan could not be properly assessed.

The Convention on Biological Diversity seeks to secure the sovereign right of states to their genetic resources, and to facilitate access to genetic material and to the knowledge and technology required for its use. The aim is that the countries of origin of genetic material would receive compensation for the benefits from their commercial exploitation. The purpose of this is to motivate efforts by countries of origin, developing countries in particular, to protect biological diversity.

One of the objectives of the CBD is to ensure that the industrialised countries would also in the future be able to access genetic resources from the developing countries, to be used by the biotechnological industry, for example. On the other hand, the Contracting Parties to the

Convention are required to take action to enable the participation in biotechnological research of, in particular, the developing countries that submit genetic material, and the conducting of research in such countries. The Contracting Parties are also required to promote the fair and equitable access of the results and benefits of biotechnological research to all parties, developing countries in particular. The access to genetic resources is based on mutual agreement (Articles 15, 16(3) and 19(2).)

Several decisions taken by the Contracting Parties to the CBD (II/15, III/11, III/15, IV/8 and V/26) stipulate that access to the genetic resources for agriculture and the sharing of benefits therefrom shall be agreed upon in conjunction with the FAO International Undertaking agreement.

2.2. International Undertaking Agreement, IU

The Conference of the FAO held in 1983 made a decision to establish a permanent Commission on Genetic Resources (Resolution 9/83). The same meeting also approved the establishment of the International Undertaking on Plant Genetic Resources, IU (Resolution 8/83). The International Undertaking is the first comprehensive international agreement addressing the issue of the plant genetic resources for agriculture. The aim of the agreement is to secure the conservation, collection, and evaluation of the plant genetic resources for agriculture, as well as their accessibility especially for the purposes of plant breeding and research. The non-binding agreement has been signed by 113 countries. According to the fundamental idea of the IU, genetic resources constitute a common heritage of mankind, and access to them must not be restricted.

In 1995, the FAO Conference extended the mandate of the Commission on Genetic Resources to cover all components of biodiversity of relevance to food and agriculture (Resolution 3/95). The Commission was renamed the Commission on Genetic Resources for Food and Agriculture. Currently, a total of 160 countries and the European Union have joined the Commission.

In 1992, Agenda 21 (Chapter 14) recommended the reinforcement of the FAO's Global System on Plant Genetic Resources and its harmonisation with the CBD.

In adopting the CBD, the Contracting Parties also adopted Article 3 of the Final Act of the Nairobi Conference, according to which the FAO shall process, among other things:

- Access to plant genetic resources in *ex situ* collections collected prior to the CBD, and
- Issues related to Farmers' Rights.

In 1993, the FAO Conference adopted Resolution 7/93, according to which FAO shall provide the Commission on Genetic Resources with an opportunity for intergovernmental negotiations to:

- Harmonise the IU with the CBD,
- Establish multilateral rules for access to plant genetic resources, including *ex situ* collections not covered by the CBD, and
- The implementation of Farmers' Rights.

The Commission on Genetic Resources for Food and Agriculture launched negotiations for the revision of the IU in November 1994. The revised agreement was to be adopted by the FAO Conference in 1999. However, negotiations have proved to be more difficult than expected, and are still under way. Particularly difficult political questions include access to genetic resources, the

sharing of benefits arising from the commercial exploitation of genetic resources, and Farmers' Rights, although preliminary agreement on the latter point has been reached.

On the one hand, access to genetic resources is connected with national legislations on access, by which no less than some 50 countries are planning to regulate the transfer of their genetic resources for the use of other countries. On the other hand, access to genetic resources is regulated by mechanisms related to private ownership, such as patents and plant breeders' rights. Another issue that remains open is the legal status of the IU agreement in the context of the FAO and the CBD. For the European Union, it is important that the agreement be closely linked with both organisations.

2.3. The Plant Genetic Resources Programme, Global Plan of Action, GPA

In accordance with the CBD and Agenda 21, the FAO Commission on Genetic Resources passed a resolution on the drawing up of a Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (GPA). For this purpose, the countries involved (115 of them), as well as regions, drew up national reports, on the basis of which the FAO compiled a report to serve as the basis for the GPA: 'The State of the World's Plant Genetic Resources'.

According to the report, part of the plant genetic resources for agriculture either under cultivation or stored in gene banks is under the threat of disappearing. Measures are, therefore, needed to conserve these genetic resources and secure their sustainable use. The report recommends that national plant genetic resources programmes be drawn up, aiming at the conservation and sustainable use of these resources.

The Global Plan of Action, drawn up on the basis of the report on the status of plant genetic resources, and the related Leipzig Declaration were adopted at the FAO's fourth International Technical Conference for Plant Genetic Resources held in June 1996 in Leipzig. The programme has been adopted by 150 countries.

The objectives of the GPA are to:

- Secure the conservation of the plant genetic resources for agriculture that form the basis for global food security,
- Support the sustainable use of the genetic resources for agriculture and thereby to promote development and mitigate famine and poverty, especially in developing countries,
- Promote the fair and equitable sharing of benefits from the use of genetic resources for agriculture. At the same time, the need is recognised for also sharing equitably the benefits from the use of traditional knowledge, innovations, and practices regarding the conservation and sustainable use of plant genetic resources for agriculture,
- Provide assistance to countries and institutions charged with the conservation and use of plant genetic resources for agriculture to prioritise their operations, and
- Reinforce national, regional, and international programmes for the conservation and sustainable use of plant genetic resources for agriculture, training programmes and societal know-how included.

The GPA includes 20 activities organised into four main groups: 1. *in situ* conservation and development, 2. *ex situ* conservation, 3. utilisation of plant genetic resources, and 4. institutions and capacity building. The GPA will come under regular revision, and its purpose is to assist the FAO

Commission on Genetic Resources in the determination of the key areas of action for the conservation of genetic resources and their sustainable use.

In the Leipzig Declaration, the signatory countries make a commitment to take the GPA objectives into account in their national plant genetic resources programmes for agriculture.

The FAO, the European Community (EC), and several countries also suggested the inclusion of forest trees in the GPA, but these were ultimately excluded. However, the conservation of forest genetic resources is generally regarded as vital, and efforts continue to achieve an international programme for that purpose. However, the adoption and implementation of a global action plan apparently requires a long and arduous process of negotiation. Consequently, it is necessary that national and regional measures for the conservation of forest genetic resources be initiated as soon as possible, as has been done at the European level already.

2.4. The TRIPS Agreement

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) is one of the agreements adopted during the Uruguay Round of trade negotiations of the World Trade Organization (WTO) in 1994. The TRIPS Agreement entered into force in 1995 and binds all the member states of the WTO (on 9 November 2000, there were 139 member states in the organisation).

The purpose of the TRIPS Agreement is to protect invention-related rights of ownership in all WTO member states using various means, such as patents, copyrights, or trademarks. Thus, the member states ensure that products covered by rights of ownership are also protected within their own territory and that they can only be manufactured under licence.

The first point of Article 27 of the TRIPS Agreement states that "patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application."

From the perspective of plant genetic resources for agriculture, a particularly important point of the TRIPS Agreement is Article 27.3(b) according to which parties to the agreement may exclude from patentability "plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents or by an effective sui generis system or by any combination thereof. The provisions of this subparagraph shall be reviewed four years after the date of entry into force of the WTO Agreement."

This Article calls for member states to create adequate systems for the protection of ownership for plant varieties. In Finland, as in most industrial countries, this is addressed under legislation on plant breeders' rights.

The said Article obligates member states to allow patenting of micro-organisms in their legislation.

The provisions of the TRIPS Article 27.3(b) on the patentability of life and the protection of plant varieties were supposed to come under revision for the first time in 1999. However, the negotiations never led to a result that would have satisfied all parties. Work on the revision of the Article continues.

The World Intellectual Property Organisation (WIPO) has been used for resolving the uncertainties and disputes arising from the TRIPS Agreement. WIPO has also served as an expert organisation for investigating how the procedures developed in various countries for the protection of plant varieties satisfies the requirements of the TRIPS Agreement. Established in 1967, WIPO is an expert organisation on property rights, operating under the UN, with its headquarters in Geneva.

WIPO monitors 19 international agreements on property rights and has 175 members.

In recent years, WIPO has also taken an interest in issues related to the protection of the traditional knowledge of indigenous peoples regarding, for example, the utilisation of plant genetic resources. The WIPO General Assembly decided in autumn 2000 to appoint an Intergovernmental Committee to investigate the connections between genetic resources, traditional knowledge and folklore, and the protection of intellectual property. The Committee's first meeting was held in spring 2001.

2.5. The UPOV Convention and Legislation Concerning Plant Breeders' Rights

UPOV is an intergovernmental organisation for the protection of plant breeders' rights, with its headquarters in Geneva. UPOV's operations are based on the international UPOV Convention on the protection of new plant varieties, which has been revised several times since its signing on 2 December 1961. The UPOV Convention enables an efficient *sui generis* protected privilege in principle for all new plant varieties, forest trees included. The UPOV Convention has been adopted by 47 countries, including Finland.

Finland has since 1992 had in place an Act on Plant Breeders' Rights (789/1992, 238/1999), under which breeders have the right to receive compensation for the commercial utilisation of the varieties they have developed. The Finnish law corresponds in substance to similar legislation in other countries, as well as the provisions of the international agreement in this field, the UPOV Convention.

The European Community has in place the plant breeders' rights of the European Community, which provides an alternative form of protection of new plant varieties to the national plant breeders' rights legislations. EC plant breeders' rights legislation is not well suited to the protection of agricultural plant breeding in Finland, however. Finnish agricultural plants are not protected under the EC plant breeders' rights legislation.

The objectives of Finnish legislation on plant breeders' rights are to create preconditions for the funding of plant breeding in Finland, to safeguard access to foreign varieties, and to harmonise Finnish legislation pertaining to this area with corresponding legislation in other countries.

A plant breeder's right is a legally defined exclusive right for the use of a protected variety, granted upon registration of the variety to the breeder or their assignee, regardless of the method used to develop the variety. Variety protection means that anyone who produces for sale or trades in propagating material of the protected variety is required to obtain permission to do so from the owner of the protected privilege. In addition to the above-mentioned measures, plant breeders' rights also apply to processing, import, export, and storage of propagating material for the said purposes. The breeding of new varieties requires considerable investment and input of labour, the cost of which can be covered by the limited exclusive right granted to the breeder. Without legal protection of varieties, anyone would be able to exploit material developed by a breeder, and breeders would not receive compensation for their work.

Excluded from the scope of the breeder's exclusive right is the production and sale of plant material for the purposes of consumption. Farmers have the right to propagate seed of a protected variety on their farm for their own use, but are, with certain exceptions, obligated to pay a lowered royalty to the breeder for seed produced and used on the farm.

Plant breeders' rights are subject to the condition that the variety is clearly distinguishable from existing varieties on the basis of at least one characteristic, that the crop of the variety is sufficiently uniform, and that the essential characteristics of the variety are stable. Only new varieties can be protected. The variety must have an approved name. The name is registered at the same time that the legal right protecting the variety is granted.

The legal protection of a variety protected under plant breeders' rights applies to the genetic structure of the variety, by which the variety can be optimally utilised under certain environmental conditions. Thus, plant breeders' rights do not apply to any single specific genetic component of the variety as such.

Plant breeding is based on the utilisation of existing varieties and their genetic material. In order to increase the efficiency of plant breeding, it is necessary that the exclusive right be limited so as to allow free access to variety material for breeding purposes. Thus, the variety owner's permission is not required when using the protected variety for breeding new varieties. The term for this freedom of the breeders of new varieties is 'breeder's exemption'. Protected varieties can be used fairly easily, employing gene transfer, for example, to produce new varieties which deviate only slightly from the original variety. Such a new variety may be almost identical with the original variety in terms of its genetic and essential characteristics. However, it may differ sufficiently from the original to satisfy the requirement of distinct identity and possibly also other conditions for the granting of the breeder's right. The value of such a derived variety is based essentially on the characteristics of the original variety. In the UPOV Convention and national legislation on breeders' rights, this type of variety is termed an 'essentially derived variety'. The commercial exploitation of such derived varieties requires the permission from the owner of the protected original variety.

2.6. Patenting of Genetic Resources

The Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 regulates the legal protection of biotechnological inventions.

Under the Directive, inventions involving biological material can be patented providing they are new, innovative, reproducible, and suitable for industrial use. The practice of agriculture and forestry, for example, are regarded as satisfying the criterion of industrial use. Inventions involving plants and animals can be patented if the technical feasibility of the invention is not restricted to one plant variety or breed of animal. This allows, for example, the granting of patents to transgenic plants or animals, even if the target of the genetic transfer is a plant variety or breed of animal. Patents are not granted to biological methods for the breeding of plants or animals (that is, methods based solely on natural phenomena such as crossing and selection).

Under patents law, the isolation of a gene as such is not a patentable invention, but a discovery that does not fulfil the conditions for patenting. However, the identification, isolation, and demonstration of a new technical use for a gene may constitute a patentable invention.

The definition of the scope of patent protection includes the so-called 'farmer's exemption', which gives farmers the right to use, under certain conditions, the product of their harvest for further

multiplication or propagation on their own farms (cf. plant breeders' rights). With certain restrictions, farmers are also allowed to use patent-protected livestock for agricultural purposes, and to produce the offspring of such breeding stock to regenerate their livestock.

The Directive also contains provisions on the cross licencing of plant breeders' rights and patents. If the holders of a patent or a plant breeder's right have not succeeded in acquiring, by way of agreement, a permit for the utilisation of the biotechnological invention or patented variety, a court of law shall, under certain conditions, grant reciprocally a compulsory licence for the non-exclusive use of both the biotechnological invention protected by the patent and the variety protected by the breeder's right. However, the Directive does not limit the obligations of Member States under international conventions: the plant breeder's right can only be restricted if public good so demands. Commercial considerations and private interest are not regarded as sufficient grounds for granting a compulsory licence. Some of the formulations in the Directive are open to different interpretations, in which case the final practice will probably be formulated with precedents set in the courts.

In discussions on the legal protection of inventions, patent law has been considered as a *per se* necessary form of protection of biotechnological inventions in view of their development and marketing. However, too broad an application of the right would needlessly extend it too far into the future, in other words, provide protection for inventions not yet made, which would obstruct development of this field.

The amendments required by the Directive (98/44/EC) were implemented nationally in Finland by amending, on 30 June 2000, the Finnish Patents Act (550/1967) by an Act Amending the Patents Act (650/2000) and by amending the Act on Plant Breeders' Rights (789/1992) by an Act Amending the Act on Plant Breeders' Rights (651/2000).

2.7. Legislation on Genetically Modified Plant Genetic Resources for Agriculture

The use of genetic technology in agriculture and the food industry is tightly regulated throughout the European Union through Directives, Regulations, and national legislation.

Directive 98/81/EC on the Contained Use of Genetically Modified Organisms

The EC Directive on the contained use of genetically modified micro-organisms (90/219/EEC) was amended by Council Directive 98/81/EC on 26 October 1998. The Directive applies to the 'contained use' of genetically modified micro-organisms. This denotes, for example, the production, on an industrial scale, of enzymes, antibiotics, medicines, or chemicals utilising genetically modified microbes approved for the purpose and produced by monitored production plants.

The system for classifying the contained use of GMOs is based on assessment of the risks involved. The amended Directive made risk assessment more uniform by defining certain common principles as well as uniform procedures for the assessment. The four safety classifications adopted in the Directive allow the risks to be analysed case by case. The most stringent requirements and monitoring can be targeted, for the minimisation of risks, to those areas where real problems might be anticipated to occur.

Community Directive 90/220/EEC, the So-Called 'Free Use' of GMOs

Council Directive 90/220/EEC is a horizontal directive on the deliberate release into the environment of genetically modified organisms. The Commission is in the process of transferring decisions concerning GMOs into the sphere of sectoral legislation, but the Directive will in all probability also be applied in the future to cases not covered by sectoral legislation. Such cases may include research and development in the testing of genetically modified organisms.

The Directive applies to experimental research and development on GMOs, as well as to the marketing of products containing or composed of GMOs.

Genetically modified plants and animals, as well as animal fodder containing GMOs, may be released on the market under Directive 90/220/EEC. Genetically modified plants intended for cultivation must additionally pass the normal procedures of the seed sector for accepting varieties in the catalogue of varieties. Genetically modified products intended for human consumption come under the Regulation on Novel Foods. The procedure within the Community for accepting GMOs is extremely tight to ensure the safety of the products. Each new GMO is studied individually. Approval of the free use of GMOs is based on a scientific risk assessment. In accordance with the precautionary principle, testing is expanded step by step from the laboratory through greenhouses to testing in the field.

Applications to market genetically modified plants must include an assessment of the potential risks of the product to human health and the environment. Environment in this case denotes both the natural and cultivated environment.

The Directive 2001/18/EC of the European Parliament and of the Council on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC was adopted on 12 March 2001. The Directive entered into force upon its publication in the Official Journal on 17 April 2001. The Member States are required to enforce the laws, regulations, and administrative provisions required to implement the Directive by 17 October 2002.

The Regulation on Novel Foods and Novel Food Ingredients EC 258/97

The main responsibility for novel foodstuffs (including genetically modified foodstuffs or foodstuffs containing GMOs) falls on the food sector. The first sectoral instrument addressing genetically modified organisms in the EU was the Novel Foods Regulation (EC 258/97). As a Community Regulation, it is in force as such in all Member States. Among other things, the Regulation requires that factors giving rise to ethical concerns, as well as allergenicity and altered nutrient content, must always be indicated on the package, along with information stating that the product contains genetically modified material. Decisions regarding issues falling under the Novel Foods Regulation are made on the Community level.

Finnish Gene Technology Act (377/1995) and Decree (821/1995)

In Finland, the contained use and deliberate release into the environment of genetically modified organisms (GMOs) is regulated by the Gene Technology Act and Decree. The EU Directive on contained use only applies to micro-organisms, whereas the Finnish gene technology laws also regulate nationally the contained use of genetically modified plants and animals. The revision of the

EU Directive 90/219/EEC required corresponding revisions to be made in national legislation. The Finnish Act Amending the Gene Technology Act (490/2000) and the Decree Amending the Gene Technology Decree (491/2000) entered into force on 1 June 2000. The Act and the Decree have been supplemented with resolutions and decrees issued by the Ministry of Social Affairs and Health.

The objective of the Gene Technology Act is to promote the safe use and development of gene technology in an ethically sustainable way, and to prevent and mitigate any adverse effects the use of GMOs might have on human health, animals, property, or the environment. The Act applies to research on GMOs as well as to products containing (live) GMOs. The Act is applied to the use, production, import, sales, and other marketing of genetically modified organisms and products containing them. However, other provisions regarding the manufacture and marketing of products, public health care, occupational safety, animal and environmental protection are applied without prejudice to the Gene Technology Act. The technological modification of human genetic material does not come under the scope of the Gene Technology Act.

The Gene Technology Act and the resolutions of the Ministry of Social Affairs and Health taken under the Act are used to provide in more detail on organisms and technological methods of genetic modification as defined in the Act, as well as on the duties of the Gene Technology Board.

In Finland, the competent authority, both nationally and for the EU, for the utilisation of gene technology is the Gene Technology Board, operating under the Ministry of Social Affairs and Health. The Board is appointed, upon presentation of the Ministry of Social Affairs and Health, by the Council of State for a period of five years at a time. The Board consists of a chairman, vice chairman, and not more than five ordinary members. The vice chairman and ordinary members each have a personal deputy. The Board shall have representatives from at least the Ministry of Trade and Industry, the Ministry of Agriculture and Forestry, the Ministry of Social Affairs and Health, and the Ministry of the Environment. Additionally, the Board shall also contain ethical expertise. The Board has a full-time general secretary.

The Cartagena Protocol on Biosafety to the Convention on Biological Diversity

The first protocol to the Convention on Biological Diversity was the Cartagena Protocol on Biosafety, adopted on 29 January 2000 in Montreal. The protocol was signed by 68 parties to the CBD at the Fifth Conference of the Parties held in Nairobi from 15-26 May 2000. The purpose of the Protocol on Biosafety is to regulate the transboundary movement of any living modified organism resulting from modern biotechnology (LMO¹). Under the Protocol, the export of LMOs intended for intentional introduction into the environment is subject to an advance informed agreement procedure. The purpose of the procedure is to safeguard the right of the country of import to decide on the import of LMOs into its territory. The Protocol requires that the country of

¹ "Living modified organism" means any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology.

"Living organism" means any biological entity capable of transferring or replicating genetic material, including sterile organisms, viruses and viroids.

"Modern biotechnology" means the application of:

- a) *In vitro* nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles, or
- b) Fusion of cells beyond the taxonomic family that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection;

(Cartagena Protocol on Biosafety: Article 3, definitions)

import be supplied with adequate information concerning the effects on the protection and sustainable use of biological diversity of the LMOs intended for import, also taking into account the effects on human health. Decision-making is based on scientific risk assessment.

The procedure for approving the import of LMOs differs depending on whether the LMOs are intended for direct introduction into the environment, such as sowing seed, or seed for processing, such as raw material for fodder. Under the precautionary principle in the Protocol, conditions may be imposed on the use of any LMO, or its import be prohibited, even if full scientific proof of the magnitude of environmental risks were not available.

2.8. Legislation on Seed and Propagating Material

Seed

EU Legislation

In the European Union, the marketing of the seed of agricultural plants is regulated under several Directives. On 14 December 1998, the Council adopted the Directive (98/95/EC) amending certain Directives on the marketing of seeds and on the common catalogue of varieties of agricultural plant species. The Directive regulates, among other things, the marketing of the seed of landraces and their varieties, as well as genetically modified varieties.

According to the Directive, it is "essential to ensure that plant genetic resources are conserved; a legal basis to that end should be introduced to permit, within the framework of legislation on the seed trade, the conservation, by use *in situ*, of varieties threatened with genetic erosion."

The Directive also lays down provisions on the acceptance of landraces and varieties on the common catalogue of varieties and their marketing. The Directive allows "specific conditions [to] be established (...) to take account of developments in relation to the conservation *in situ* and the sustainable use of plant genetic resources through growing and marketing of seed of landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion."

According to the Directive, "landraces and varieties shall be accepted in accordance with the provisions of this Directive. The procedure for official acceptance shall take into account specific quality characteristics and requirements. In particular the results of unofficial tests and knowledge gained from practical experience during cultivation, reproduction and use and the detailed descriptions of the varieties and their relevant denominations, as notified to the Member State concerned, shall be taken into account and, if sufficient, shall result in exemption from the requirement of official examination. Upon acceptance of such a landrace or variety, it shall be indicated as a 'conservation variety' in the common catalogue."

Seed may be marketed for the purposes of *in situ* conservation and sustainable use of their genetic material, including seed mixtures of species associated with specific natural and semi-natural habitats and which are threatened by genetic erosion. The seed must be of a known provenance approved by the appropriate authority in each Member State for marketing the seed in defined areas. Authorities may also impose appropriate quantitative restrictions on this.

The Directive lays down provisions regarding the characteristics and marking of genetically modified seeds. Under the seed Directive, genetically modified varieties may be produced and marketed only on the condition that all appropriate measures have been taken to avoid adverse effects on human health and the environment. Moreover, the use of gene technology must be indicated with appropriate labelling. The environmental risk assessment to be conducted in this respect shall be carried out as stipulated in the provisions of Directive 70/457/EEC.

Regarding the approval of genetically modified varieties developed for human consumption on the common catalogue of varieties, it is required that the foods or food ingredients be already approved under the Novel Foods Regulation. A genetically modified variety may be accepted in the national catalogue of varieties regardless of whether it is accepted in the EU common catalogue or not.

The use of genetic modification must always be indicated clearly in all catalogues of varieties and sales catalogues. Moreover, in the case of seed of a variety which has been genetically modified, any label or document, official or otherwise, which is affixed to or accompanies the seed lot shall, under the provisions of this Directive, clearly indicate that the variety has been genetically modified.

Finnish Seed Trade Act (728/2000)

Provisions of the Directive 98/95/EC concerning landraces and varieties, as well as gene technology, are implemented in Finland in the Seed Trade Act (728/2000) and Decree, adopted on 1 November 2000.

Under the Seed Trade Act, only certified seed may be marketed in Finland. In exception to this principle, uncertified seed of landraces may be marketed for the purposes of conserving genetic diversity.

Under the Seed Trade Act, a catalogue of varieties is maintained on crop varieties used in agriculture. Varieties are accepted in the catalogue if they are distinct, stable, and sufficiently uniform, and if they have sufficient value in cultivation and use. In the case of genetically modified varieties, the acceptance of the variety on the catalogue is subject to the condition that it satisfies the provisions in Article 8 of the Act, or other conditions issued under the said article. Decisions of acceptance are made by the Plant Variety Board, referred to in Article 9 of Act on Plant Breeder's Rights (789/1992). The Board publishes an annual catalogue of the varieties accepted by it.

Once a variety is accepted in the catalogue, the acceptance remains valid until the end of the tenth calendar year following the year of acceptance. Acceptance can also be renewed.

Under the Seed Trade Act, the acceptance of genetically modified varieties will in the future also be carried out by the Gene Technology Board. Genetically modified seed may only be produced and marketed if all appropriate research and other measures have been taken to discover and avoid adverse effects on human health and the environment. The performance of such research and other measures, as well as procedures for acceptance, will be laid down in decrees issued by the Ministry of Agriculture and Forestry in so far as the matter does not fall under the Gene Technology Act.

Decrees

Decrees of the Ministry of Agriculture and Forestry regulate, in a very detailed manner, the marketing of cereal seed (109/2000), grass and fodder plant seed (110/2000), seed of oil and fibre plants (111/2000), seed potatoes (112/2000), vegetable seed (113/2000), and beet seed (114/2000).

The production, acceptance, and marketing of seed of the landrace varieties of cereals and forage and fodder grasses are regulated in Decree 117/2000 of the Ministry of Agriculture and Forestry. The Decree contains provisions on, for example, inspections, markings, and mixtures of seed, as well as the requirements for cultivations for the conservation of such plants.

The Decree covers the following cereals, cultivated grasses, and fodder species:

A. Cereals:

Oat	<i>Avena sativa</i> L.
Barley	<i>Hordeum vulgare</i> L.
Rye	<i>Secale cereale</i> L.
Wheat	<i>Triticum aestivum</i> L.

B. Cultivated grasses and fodder plants:

Red clover	<i>Trifolium pratense</i> L.
White clover	<i>T. repens</i> L.
Alsike clover	<i>T. hybridum</i> L.
Timothy	<i>Phleum pratense</i> L.
Meadow fescue	<i>Festuca pratensis</i> Huds.
Smooth-stalked meadow grass	<i>Poa pratensis</i> L.
Orchard grass	<i>Dactylis glomerata</i> L.
Red fescue	<i>Festuca rubra</i> L.
Turnip	<i>Brassica rapa</i> L. subs. <i>rapa</i>
Swede	<i>B. napus</i> L. var. <i>napobrassica</i> (L.) Rchb.
Faba bean	<i>Vicia faba</i> L. (partim.)
Field pea	<i>Pisum sativum</i> L. (partim.)

Landrace varieties are defined in the Decree as such strains that have been cultivated on the farm or in the area for an extended period of time, and which, at least in most part, are of a provenance other than old, scientifically bred cultivars.

However, only seed of landrace varieties referred to in Decree 647/2000 of the Ministry of Agriculture and Forestry may be accepted for marketing in Finland.

The cultivator of a landrace variety may market accepted seed of the variety in question only from a cultivated area not exceeding the size stipulated in Decree 117/2000 of the Ministry of Agriculture and Forestry.

The population of a landrace cultivation must be of a recognisable variety, and its characteristics must conform to the variety specification and the field inspection conducted as per Decree 647/2000 of the Ministry of Agriculture and Forestry. The population may not contain harmful amounts of varieties that were not documented during testing. Endangered or rare associate species documented during the inspection may not be removed during the growing season. No common wild oat may be found in these cultivations.

Propagation Material for Fruit, Berry, Vegetable, and Ornamental Plants

EU Legislation

The EU Council has adopted three Directives concerning the marketing of propagating material and plants of horticultural plant species. These are: Directive 92/34/EEC on the marketing of fruit plant propagating material and fruit plants intended for fruit production; Directive 92/33/EEC on the marketing of vegetable propagating and planting material, other than seed; and Directive 98/56/EC on the marketing of propagating material of ornamental plants. The Directives lay down provisions regarding quality and health to promote the free movement of propagating material and plants in the internal market.

Finnish Nursery Plant Material Act (1205/1994; last amended by 727/2000)

The production, marketing, and import of plants and propagating material for horticulture is regulated by the Finnish Nursery Plant Material Act (1205/1994, last amended by 727/2000). The Act has been harmonised with Community legislation.

The Act applies to plants and other propagating material of fruits and berries, as well as ornamental and vegetable plants, but not to onion sets or seed of vegetable plants.

The objective of the Act is to ensure that plant material marketed in Finland and exported to the Common Market satisfies the requirements of the Act regarding quality and health. Under the Act, the Ministry of Agriculture and Forestry may impose conditions and requirements regarding the genetic and external qualities, as well as the protection of the health of plant material intended for the market.

Forest Reproductive Material

EU Legislation

Trade within the European Union in forest reproductive material is regulated by two Council Directives: Directive 66/404/EEC lays down provisions on the provenance of marketed material and the information supplied thereof, and Directive 71/161/EEC on the quality of seed and seedlings. The Directives were revised in 1999, leading to the adoption of the Council Directive 1999/105/EC on the marketing of forest reproductive material. The Directive entered into force on 15 January 2000, and all Member States are required to harmonise their national legislation accordingly from the beginning of 2003. The harmonisation of Finnish national legislation is currently under way.

Act on Trade in Forest Reproductive Material (684/1979, last amended with 1210/1994)

Marketing, import and export of reforestation material is in Finland regulated under the Act on Trade in Forest Reproductive Material (684/1979). With respect to provisions on import and export, the Act has been harmonised with EU legislation since the beginning of 1995.

The Act applies to seed, seedlings, cuttings, and other propagating material of forest tree species. The Act seeks to ensure that seed and seedlings used in silviculture satisfy the quality requirements set for them, and that the buyer of such material receives adequate and correct information in order to be able to select suitable material for the site in question. Under the Act, decisions regarding quality requirements and classification of the provenance of forest reproductive material are made by the Ministry of Agriculture and Forestry.

2.9. Measures to Conserve Biological Diversity in Agriculture

Measures required by the Convention on Biological Diversity are implemented in the European Union in its Common Agricultural Policy (CAP) with the following Regulations:

- Council Regulation 1467/94 on the conservation, characterisation, collection and utilisation of genetic resources in agriculture
- Council Regulation (EEC) 2078/92 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside, repealed on 17 May 1999 by Council Regulation 1257/1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF) and amending and repealing certain Regulations

Council Regulation (EC) 1467/94 on the conservation, characterisation, collection, and utilisation of genetic resources in agriculture was adopted on 20 June 1994. It was agreed that the Regulation would be implemented using five-year action programmes. The first five-year programme was adopted on 21 November 1994, and the budget was set at 20 million ECUs.

The Regulation aims at the harmonisation and promotion, on the Community level, of work undertaken in the Member States on the conservation, characterisation, collection, and utilisation of genetic resources in agriculture and forestry in order to attain the objectives of the Common Agricultural Policy and to support and complement measures undertaken in the Member States, in accordance with the principle of subsidiarity, in so far as these measures seem currently inadequate.

The Regulation confirms the duties of the Commission and the Member States for the attainment of the abovementioned objectives. It sets out, for the first time, provisions regarding a Community action programme for the conservation, characterisation, collection, and utilisation of genetic resources in agriculture.

Regulation (EC) 1467/94 and the associated action programme have constituted an extremely important instrument in the implementation by the Member States of international agreements and programmes regarding the sustainable use of genetic resources for agriculture. The Regulation and the action programme are a demonstration of the active efforts of the European Union and its Member States for the management of genetic resources for agriculture, and their willingness to honour the obligations set out in the Convention on Biological Diversity and the GPA.

The last round of applications for the action programme was in summer 1998. A total of 24 projects have been funded during the programme.

Member States have pressured the Commission to prepare and initiate another five-year action programme as soon as possible.

Council Regulation 1257/1999 provides Member States with an opportunity to support the conservation and promotion of important natural values and of sustainable agriculture conforming to environmental requirements. Agri-environmental programmes based on the Regulation allow the utilisation of agricultural land to be supported whilst taking into consideration the conservation and enhancement of the environment, landscape and its natural characteristics, natural resources, soil and genetic diversity. Under the Regulation, support can be paid, for example, for the cultivation of endangered crops adapted to local conditions.

In Finland, the Regulation is implemented by the Act on the Financing of Rural Industries (329/1999), Article 11 of which lays down provisions on environmental support, for example.

Payments for basic and additional measures under the agri-environmental support system are regulated by Decree 646/2000 of the Ministry of Agriculture and Forestry, and special support by Decree 647/2000 of the Ministry.

With respect to the conservation of biological diversity, special support for the management of traditional biotopes, the enhancement of biological diversity, landscape management and development, and the husbandry of local breeds and cultivation of native plant species are of particular importance.

2.10. Nature Conservation Act

The Finnish Nature Conservation Act (1096/1996, amended with Acts 144/1999 and 371/1999) and the Nature Conservation Decree (160/1997) are used to implement EU Council Directives 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (the so-called Habitat Directive), and 79/409/EEC on the conservation of wild birds (the so-called Bird Directive), except in the case of animal species mentioned in Article 5 of the Finnish Hunting Act.

The objectives of the Nature Conservation Act are:

- 1) Conservation of biological diversity;
- 2) Preservation of natural scenery and landscape values;
- 3) Support of the sustainable use of natural resources and ecosystems;
- 4) Promotion of public awareness of and interest in nature; and
- 5) Promotion of research on nature.

Under the Act, nature conservation must aim at attaining and maintaining a suitable level of protection for biotopes and wild species.

- The level of protection of a biotope is suitable, when its natural distribution range and total area are sufficient to secure its preservation and the structure and functionality of its ecosystem in the long term, and when the level of protection of its characteristic species is suitable.
- The level of protection of a species is suitable, when the species is able, in the long term, to remain viable in its natural habitat.

In addition to the protection of nature preserves and biotopes, the Nature Conservation Act contains provisions on, for example, the Natura 2000 network and the protection of species, as well as restricting the spread of exotic species.

The Nature Conservation Act seeks to take into consideration the obligations of the Convention on Biological Diversity, primarily in the protection of wild nature. It applies to plant genetic resources for agriculture in so far as methods of cultivation threaten the survival of plant or animal species in agricultural ecosystems.

The Nature Conservation Decree lays down more detailed provisions regarding, for example, the monitoring of wild species and biotopes, and the protection of species. The appendices to the Decree contain lists of protected and threatened species.

3. Ownership of Plant Genetic Resources

Under the Convention on Biological Diversity, all states have sovereign rights over their genetic resources, and consequently the authority to determine access to and use of those resources. Access to genetic resources as well as to the knowledge and practices of indigenous and local communities related to their use, and the sharing of the benefits therefrom, are provided for in Articles 1, 8(j), 15, 16, and 19 of the Convention.

Although the CBD confers on states the right to decide on the utilisation of their genetic resources, it also requires that states promote access to genetic resources for purposes of their environmentally sustainable use, and prohibits states from restricting access to genetic resources contrary to the spirit of the Convention.

According to Article 15(1) of the CBD, "the authority to determine access to genetic resources rests with the national governments and is subject to national legislation." Currently, states differ considerably with respect to the extent to which they have implemented the opportunity to regulate access to their genetic resources by legislation offered by this Article.

The number of countries developing their national legislation and policies regarding access to their genetic resources is constantly growing. Currently, national legislation is under development in almost 50 countries, primarily in developing countries, but also in such countries as Australia and the USA.

However, national legislations on access differ considerably, for example, with respect to their coverage. Some provide the option, regarding the genetic resources for agriculture, for deciding on the access to these resources within the multilateral system to be developed under the International Undertaking agreement. The strictest national legislations apply to all genetic resources, as well as their derivatives (such as molecules isolated from genetic material).

No specific legislation regulating access to genetic resources has been laid down in the EU countries. However, these have differing practices concerning, for example, the collection and export of genetic resources from the wild, or *in situ* conserved genetic resources for agriculture.

The gene banks in the EU countries are, however, in the process of adopting material transfer agreements (MTAs), under which conditions may be imposed on organisations receiving genetic resources, such as regarding the sharing of benefits from the utilisation of the resources with the country of origin.

The Nordic countries have not restricted access to genetic resources for agriculture by legislation. Material collected in the Nordic Gene Bank may be ordered freely by, for example, plant breeders and researchers. However, the NGB, too, is currently considering adopting MTAs.

In Finland, the only legislation addressing the ownership of genetic resources for agriculture is the Act on Plant Breeders' Rights (789/1992, 238/1999), and to some extent the Patents Act (550/1967, amended by the Act Amending the Patents Act 650/2000). The marketing of genetic resources is addressed by the provisions of the Seed Trade Act (728/2000) and Decree.

Finland has no specific legislation regarding access to genetic resources. The Finnish Right of Public Access (Everyman's Right) however grants the right to collect certain natural products (the most important of these are mentioned in Article 14 of the Penal Code 769/1990), including cones, nuts, wild berries, mushrooms, and flowers, as well as wild herbs in areas where public access is allowed. The right is not restricted solely to Finnish citizens (cf. Act on Restricting the Collection of Wild Produce in Certain Cases, 332/1955).

However, the collection of plants is nevertheless restricted in nature conservation areas, and the collection of certain rare plants is also restricted under the Nature Conservation Decree (160/1997). In some parts of Lapland, the gathering of cloudberries by other than the local population can be prohibited.

The export of genetic resources is not governed by specific laws, either. It is regulated by normal rules and regulations governing the quarantine, health, etc. of plant material.

4. Conservation of Plant Genetic Resources

4.1. Methods of Conservation

1. Agriculture

The conservation of plant genetic resources for agriculture can be divided into three types:

- In *ex situ* conservation, genetic resources are conserved outside their original habitats, for example, as seeds or *in vitro* cultures in gene banks, or in arboretums or botanical gardens,
- *In situ* conservation means the conservation of ecosystems and wild habitats and the preservation of the populations of species inhabiting them. In the case of crops, *in situ* conservation means the conservation of genetic resources under conditions in which the characteristics of the varieties have developed, and

- *On farm* conservation is conservation and management of genetic resources on farms. *On farm* conservation also takes into account the conservation of wild species dependent on agriculture.

Plant genetic resources for agriculture are traditionally conserved primarily *ex situ* in gene banks, clone collections, or botanical gardens. In recent years, *in situ* and *on farm* conservation have attracted increasing attention, however, because these forms of conservation allow evolutionary changes to take place in the populations.

An extensive survey was conducted in Finland from 1997-1999 on opportunities for *on farm* conservation of landraces and varieties (Plant Production Inspection Centre publications B1 Seed Production 1/99). The project led to a proposal for the organisation in Finland of variety trials, registration, and *on farm* conservation of landraces and old cultivars of cereals and cultivated grasses. The conditions for granting special agri-environmental support are mainly based on the proposals made in this survey.

2. Forestry

The objective of the conservation of forest genetic resources is to preserve the genetic variability of species and local populations far into the future, thus securing their viability and capacity for adaptation also in changing conditions. Changing conditions include such factors as long-term climate changes and the effects of forest management. Forest tree breeding can be used to transfer into reforestation material new, as yet unknown characteristics, which may affect such factors as resistance or the quality of the wood. The essential thing is that the conservation of genetic diversity means primarily the preservation of normal, that is, common, alternatives.

Forest trees differ from other crops in several important respects.

- 1) Extensive and viable wild populations are still in existence.
- 2) They have a very long life-span.
- 3) They are strongly cross-pollinating.
- 4) Individual variation within populations is extensive.

In situ conservation consists of collecting representative samples of wild populations into living genetic reserves, which in this case also includes naturally generated production forests. This method has several advantages:

- 1) No real initial investments are necessary, nor other measures for establishment, because the forests already exist.
- 2) The conservation of the material does not depend on the faultless functioning of technical equipment.
- 3) The maintenance and regeneration of the material does not require frequently repeated measures.

In situ conservation is not possible or appropriate in the case of rare tree species, or when the populations only consist of small enclaves, or when the habitat is threatened. In such cases, either some *ex situ* method must be used, such as clonal archives, transfer planting, or a seed bank.

In Situ Conservation

Protected Areas and Habitats

The purpose of national parks, nature reserves, and other wooded conservation areas is to conserve and preserve part of the original forest nature, and to offer habitats for species that do not flourish in production forests. The emphasis in forest protection is on species in old-growth forests, because it is precisely such habitats that have declined in commercial forests.

The areas and methods of management of protected areas differ widely. Nature reserves are maintained in a completely virgin state, whereas protected herb-rich forests, for example, should be actively managed by favouring hardwood trees. In addition to other conservation purposes, these areas also aid the conservation of forest genetic resources. Their advantage is that they are protected by law, and are permanent. Most such areas are owned by the state. In addition to designated conservation areas, habitats important for forest trees are protected under the Forest Act (1093/1996, Article 10), the Nature Conservation Act (1096/1996, Article 29), and the Programme for the Conservation of Herb-Rich Forests.

Conservation areas feature two important restrictions with respect to the conservation of genetic resources. Firstly, their coverage and location are not fully commensurate with the needs for the conservation of genetic resources. Secondly, statutory restrictions regarding forest management prevent regeneration and management work, and restrict the utilisation of genetic resources.

Gene Reserve Forests

Gene reserve forests are an intermediate form of forest, developed specifically for the conservation of genetic resources, that lies somewhere between protected forests and normal production forests. A gene reserve forest is a representative sample of the local wild population. Many studies have shown that in forest trees, most of the genetic variation within a certain area takes place between individual trees. Therefore, one large stand can embrace the entire genetic diversity of an extended area. Because of differences in climate, there are differences in the genetic factors affecting the capacity for adaptation. The basic requirement for gene reserve forests is that all stands of the species in question are naturally generated, that is, of local provenance. The entire area does not have to be a monoculture, however, nor does it have to consist solely of old-growth forest.

In the case of wind-pollinated main species (spruce, pine, silver and downy birch), the gene reserve forest should be at least a hundred hectares in area. To secure adequate pollination within the stand, the area must be several hundred metres in diameter. Continuity is secured in gene reserve forests by maintaining several age classes. The forest is allowed to regenerate naturally whenever possible. Thinning and regeneration felling can be performed normally. When artificial regeneration is needed, the seed must come from the same forest. Furthermore, seed is collected from those gene reserve forests which could not be replaced with stands in the same area if, for some reason, the original stands were to be destroyed.

Stands of birch and spruce large enough to be used as gene reserve forests are rare in southern Finland on state land and on the lands of forest companies. For this reason, suitable mixed forests of spruce and birch have been selected as shared gene reserve forests for two or three species. The original stand may even be smaller than 100 hectares, provided it can be extended later by artificial regeneration.

Requirements concerning gene reserve forests for hardwood trees and other rarer species are different. These tree species have never existed in Finland in large uniform stands, but rather in small enclaves, strips, and mixed stands.

In addition to roundwood production, gene reserve forests are also used for other purposes other than the conservation of genetic resources. Seed can be collected from them, to be used, for example, to represent the wild population of the area in provenance trials, and as control lots in experimental breeding plantations. Fairly large managed wild populations are well suited for many other research purposes as well.

The active management of gene reserve forests does not alter the genetic composition of the stands. In standard forest management, non-viable individuals are removed in thinning. In the course of the development of the forest, they would not have been able to develop into parents of a new generation, because the seeds are produced by the dominant individuals. Trees that lose in competition and, therefore, do not propagate have no significance for the conservation of genetic resources.

***Ex situ* conservation**

The range of *ex situ* conservation methods is wide. In the case of many field crops, *ex situ* conservation means in the first instance a gene bank, but there are other methods as well. Although the seeds of most forest tree species remain viable even for several decades under correct storage conditions, the trees themselves are 'live gene banks' with an even longer life span. Current solutions for the conservation of forest genetic resources are clone collections containing breeding and research material, and provenance trials.

Table 1 presents primary and supplementary methods for genetic resources conservation for different tree species. The conservation of the genetic resources of grey alder, aspen, rowan, and Siberian larch does not call for intensive special measures.

Table 1. Methods of conservation, by tree species.

Species	Method			
	Conservation areas	Gene reserve forests	Collections	Breeding populations
Pine	μ	λ	μ	μ
Spruce	μ	λ	μ	μ
Juniper	λ		μ	
Silver birch	μ	λ	μ	μ
Downy birch	μ	λ		
Black alder	λ		μ	
Grey alder	μ		μ	
Aspen	μ		μ	μ
Rowan	μ		μ	
Lime	μ	μ	λ	
European ash	μ	μ	λ	
Oak	μ	μ	λ	
Maple	μ	μ	λ	
Scotch elm	μ		λ	
European white elm	μ		λ	
Siberian larch			μ	

λ Primary method

μ Supplementary method

Many tree species have exceptional varieties in the wild, such as golden Norway spruce (*Picea abies f aurea*) and curly birch (*Petula pendula var carelica*). Such varieties are rare, and except for curly birch, they are important as ornamental trees only. However, as manifestations of genetic diversity, they have a value as such, and have, therefore, been collected into collections of special varieties and sample plots.

The most important *ex situ* forms of conservation for forest tree species in the future will be breeding populations and collections. A breeding population consists of selected trees from a specified zone, and

the number of individuals is from a few dozen to a few hundred trees. Breeding populations are used to maintain genetic variability, which forms the basis for the production of breeding material at any given time. Such populations do not contain the entire range of variation of the original wild populations. Breeding populations constitute the most important content of a separate long-term forest breeding programme.

Collections are special plantations where individuals (clone collections), progeny (family collections), or provenances (provenance collections) of one or more species are collected. The distinct identity of the conserved lots is an absolute requirement, although such collections do not have to be planted according to experimental procedures.

The conservation of cells in liquid nitrogen (cryopreservation) is a technically simple and fairly low-cost method. Cryopreservation allows the conservation of threatened individuals or populations when viable seed cannot be obtained from them. Especially in the case of hardwood trees, good seed harvests are rare. However, this method can only be applied if the micropropagation method of the species in question is mastered. This readiness exists at the moment only for birch, and cryopreservation is, therefore, not in extensive use as yet.

4.2. Plant Genetic Resources Collections in Finland

1. Agriculture

Finland has sought to store genetic resources for agriculture, especially those propagated from seed, in the Nordic Gene Bank. Since the founding of the NGB, several collection projects have been organised in Finland with a view to collecting landraces, in particular, and their varieties from different plant categories for storage with the NGB, although populations of wild plants have also been collected, especially grasses. The latest collection project was organised in 1998-1999. The collection submitted to the NGB contained 209 samples collected from Finland, including the following species: timothy (*Phleum pratense*), red clover (*Trifolium pratense*), white clover (*T. repens*), alsike clover (*T. hybridum*), meadow foxtail (*Alopecurus pratensis*), orchard grass (*Dactylis glomerata*), reed canary grass (*Phalaris arundinacea*), meadow fescue (*Festuca pratensis*), red fescue (*F. rubra*), bluegrasses (*Poa* spp.), rye (*Secale cereale*), sweet vernal grasses (*Anthoxanthum* spp.), oat (*Avena sativa*), Bromegrasses (*Bromus* spp.), reed grasses (*Calamagrostis* spp.), barley (*Hordeum vulgare*), bentgrasses (*Agrostis* spp.).

In 1999, the Board of the NGB decided that plants preserved as clones, fruits and berries in particular, would thence be covered by the mandate of the Bank, and that the NGB would undertake the coordination of the storage of such species. Because the maintenance of clone collections is expensive, and since they should be preserved in conditions as closely resembling their original conditions as possible, it was agreed that the Nordic countries will undertake the maintenance of such collections themselves.

In Finland, these collections of fruit trees and berries are located at MTT Agrifood Research Finland's Institute of Horticulture in Piikkiö, the research station in Häme, the research station at Jomala in Åland, and at the University of Helsinki. In addition to collections of fruit trees and berries, MTT Agrifood Research Finland also maintains in Piikkiö collections of rhubarb, potato

onion, and chives. The chive collection originates from a collection of wild strains, launched in 2000, and will be extended in the future. The potato onion collection is maintained at the MTT Agrifood Research Finland research station in Lapland. Horticultural plants collected in the NGB are listed in Table 2.

Table 2. Nordic Gene Bank collections of horticultural plants in Finland.

Species	MTT Agrifood Research Finland, Jomala research station	University of Helsinki
<u>Fruits and berries:</u>		
Apple (collected) ("old collection")	<i>Malus domestica</i>	126
Pear	<i>Pyrus communis</i>	13
	<i>Prunus</i> spp.	73
Sour cherry	<i>Prunus cerasus</i>	78
Damson	<i>Prunus domestica</i> subsp. <i>insitia</i>	74
Blackcurrant	<i>Ribes nigrum</i>	16
Red and white currant group	<i>Ribes rubrum</i>	20
Eur. gooseberry	<i>Ribes uva-crispa</i>	22
Other gooseberries	<i>Ribes</i> spp.	16
Raspberry	<i>Rubus idaeus</i>	5
	<i>Rubus</i> spp.	c. 80
Sea buckthorn	<i>Hippophae rhamnoides</i>	28
Roses	<i>Rosa</i> spp.	11
<u>Vegetables:</u>		
Rhubarb	<i>Rheum rhaponticum</i>	34
Potato onion	<i>Allium cepa</i> var. <i>solaninum</i>	10
Chives	<i>Allium schoenoprasum</i> var. <i>schoenoprasum</i>	7

Collections Intended for Research and Teaching Purposes

In addition to gene bank collections, collections of plant genetic resources intended mainly for research and education purposes are also maintained in Finland at research institutions and universities. The maintenance of, or the material contained in, these collections is not monitored systematically or coordinated. Some of the collections were established for research projects, and the collected and evaluated material has in many cases disappeared after the conclusion of the project in question.

MTT Agrifood Research Finland

The KESKAS Project (Alanko & Tegel, 1989, Juhanoja *et al.* 1998)

In order to improve the quality of plant material used in landscaping activities, three projects were launched in Finland in the 1980s for collecting and registering hardy, healthy and beautiful ornamental shrubs for propagation. The work began in Lapland as the so-called Kalotti project, which later developed into a development project for nursery production in Lapland. The development project for landscaping plants in northern Finland was responsible for the work in the province of Oulu, and the KESKAS project for that in other parts of the country. The joint name POHKAS is currently in use for the projects in northern Finland.

The KESKAS project began at the University of Helsinki in 1984 with a search for and registration of strains of ornamental plants. The project produced over 700 promising strains of shrub and trees. Much of this material is of variable provenance and contains a great deal of genetic variation. The utility and characteristics of the strains were studied in comparative field tests, so-called clone selection trials, conducted at the research centre of MTT Agrifood Research Finland. Testing was launched on five test sites in 1988. The species tested are presented in Appendix 2.

The tests conducted by MTT Agrifood Research Finland aimed to assess the ornamental value of the different varieties, their winter-hardiness, health, and growth habits, and to find the best varieties for propagation. Furthermore, the tests aimed to ascertain the varietal purity of available material, and to check and unify nomenclature and rename hybrids. One of the purposes was also to produce a symbol for Finnish plant material.

The FinE Trademark

The purpose of the FinE trademark is to indicate plant material that satisfies certain quality criteria. The FinE trademark has been in use since 1997, and can be granted to plants that are tested in Finland, are of a high-quality genetic material, healthy, easy to propagate, and suited to conditions in Finland. The trademark was developed jointly by Taimistoviljelijät Ry (Finnish Nursery Stock Association) and MTT Agrifood Research Finland, which owns the trademark.

The precondition for acquiring the trademark is comparative testing carried out in Finland, or long-term experience of the species and its characteristics in one or more locations. Ornamental plants that have been granted the FinE trademark to date are all selected on the basis of the KESKAS clone selection trials or long-term practical experience. In addition to the selection trials, the success of the varieties have been monitored and selection performed in botanical gardens and at Arboretum Mustila, for example. The right to use the FinE trademark can also be granted to varieties of fruits and berries that are the result of breeding done in Finland, tested, hardy cultivars, or varieties which have been studied abroad and are demonstrably suited to Finnish conditions. Berry-bearing plants must always be produced by certified nursery stock growers. The FinE species are listed in Appendix 3.

The Institute of Horticulture in Piikkiö also maintains collections of strawberries intended for use by horticultural plant breeders (currently there are about 160 varieties in the collections, almost exclusively of foreign provenance) and a small collection of bush blueberries. The MTT Agrifood Research Finland research station in Ruukki also has a small collection of sea buckthorn.

In addition to collections of horticultural plants, the research centre of MTT Agrifood Research Finland also has collections of species originally collected for various projects. These collections are mainly intended for research purposes, and include collections of buckwheat, spelt, tansy, quinoa, dyer's woad, canary grass (in 1993, 83 populations of canary grass were collected from various parts of the country and planted for breeding at Jokioinen. In summer 2000, samples of these populations were collected in the Nordic Gene Bank), St. John's-wort, cumin, wild tobacco, narrow leaf lupin, European yellow lupin, sea kale, #öljyunikko#, borago, evening primrose, falseflax, spurge, fibre hemp, chicory, Jerusalem artichoke, and amaranth. The research station in Häme also maintains a population of landrace rye from Myttäälä. MTT Agrifood Research Finland maintains on its research station in Lapland a population of 20 potato onion strains for the NGB. One of them is of Estonian provenance, the rest are Finnish strains. Some of the same material is also maintained in Piikkiö.

Collections of herbal and medicinal plants are maintained in Mikkeli in conjunction with an ecological study conducted by MTT Agrifood Research Finland.

Seed of wild medicinal plants have been collected from Scandinavia and Europe, and are cultivated in Mikkeli. The growth, winter-hardiness, productivity and their amount of effective substances are monitored constantly and the best strains are selected for further propagation and cultivation.

Botanical Gardens

The universities in Helsinki, Turku, Oulu, and Kuopio have botanical gardens, whose collections also include plant genetic resources for agriculture. The collections have generally been established for research and educational purposes. Some of the collections are temporary and are maintained only for the duration of the relevant study.

Species cultivated in the test field at the Oulu University botanical gardens include blueberry (from 18 countries, total of 47 provenances), lingonberry (10 countries, 45 provenances), crowberry (14 countries, 29 provenances), cloudberry (mainly from Finland, about 120 provenances), cranberry (17 provenances), gooseberry (from northern Ostrobothnia and Kainuu, about 50 strains). Additionally, the gardens contain several provenances of rowan and bird cherry. The material has been propagated from seed or cuttings, or by micropropagation, depending on the species.

The Plant Production Inspection Centre

The Finnish Plant Production Inspection Centre's Seed Testing Department in Loimaa stores samples of certain landraces and their varieties, as well as old cultivars of barley, oat, wheat, timothy, alsike and red clover, and pea for the purposes of identification and registration of landrace species. The seed samples can also be accessed for research purposes.

Boreal Plant Breeding Ltd.

Plant breeders need extensive material to provide sufficient genetic variation for the breeding of new varieties. Consequently, breeders have extensive collections of varieties and line material of the varieties developed by them. These collections are only intended for private breeding purposes,

however, and they are maintained only as long as they remain useful. Material of special importance for breeders is generally stored in the Nordic Gene Bank for possible later use.

Boreal Plant Breeding Ltd. has currently breeder collections of at least barley, oat, spring and winter wheat, rye, triticale, potato, pea, rapeseed, flax, and several cultivated grasses (www.borealpb.com).

Other Collections:

The Central Organisation for Finnish Horticulture maintains at their website (www.puutarhaliitto.fi in Finnish only) a fairly extensive list of sites for horticultural tourism in Finland. These sites generally offer visitors an opportunity to visit open collections of horticultural plants. Some outdoor museums also maintain collections of plant genetic resources. No systematic register of the species in these collections is maintained. Information about the collections and on the supply of seeds and plant material of species and varieties of old cultivars is available from Hyötykasviyhdistys (Association of Useful Plants, website at www.hyotykasviyhdistys.fi, in Finnish only) and Maatiainen r.y. (www.maatiainen.fi. Website under construction).

2. Forestry

Current Gene Reserve Forests

The number and area, as well as division by type of owner, of gene reserve forests in Finland is presented in Tables 3 and 4.

Table 3. Number and area of gene reserve forests in Finland at beginning of 2001.

Species	Status	
	1 January 2001	
Pine	23	5108 ha
Spruce	8	1541 ha
Birch	4	422 ha
Lime	2	19 ha
Maple + lime	2	15 ha
European ash	1	30 ha

Owners of gene reserve forests make their forests available to the conservation genetic resources free of charge. However, they still retain full right of ownership to the forests. The owners are committed to maintain the forests as gene reserve forests, that is, to always regenerate the area either naturally or with reproductive material collected from the same stand. All normal forest management works, felling and regeneration are carried out by the owners themselves. If the forest is regenerated artificially, the

owners are compensated for the extra cost incurred from complying with the special requirements for gene reserve forests.

Table 4. Distribution of gene reserve forests by type of owner.

Owner	Nr. of forests	Area
Finnish Forest and Park Service	15	3032 ha
Finnish Forest Research Institute	13	2030 ha
Forest industry	10	1805 ha
Private	2	268 ha
Total	40	7135 ha

Breeding Populations

Plans have been made to establish breeding populations for pine, spruce, silver and downy birch, and oak. The number of trees per population will be between 200 and 300, of which 50 will constitute a so-called core population. Breeding populations are established in zones, with a total of about 15 zones planned. A detailed plan for the establishment of breeding populations is included in the revised long-term forest breeding programme.

Collections

The number of registered collections of forest tree species is 157, with a total of 8,370 families. Old collections were established for the purposes of research and cross breeding, and consequently they do not as such fully serve the conservation of genetic diversity. New clonal archives to be established of the main species will focus on the conservation of special varieties, and will largely consist of regeneration of existing material.

The current status of collections of hardwood trees is presented in Table 5. With the exception of oak and Scotch elm, the figures for the current status include trees already planted in the collections, as well as seedlings and grafts still being bred in nurseries. Current figures for stands and individuals/families that exceed in part the original objectives are explained by the fact that allowances are made for damage during and after planting.

Table 5. Collections of hardwood trees.

Species	Status, beginning of 2001	
	Stands	Individuals/ Families
Maple	42	268
European ash	29	152
Lime	91	506
Oak	25	163
Scotch elm	38	220
European white elm	19	125

Arboretums

Arboretums have over the decades produced a great deal of information on the adaptation of exotic tree species to Finland. This information has been used to focus the selection of seed of exotic trees on species and provenances that have proved to be durable in their country of origin. Arboretums are also important for the preservation of forest tree species that are not part of the natural range of species in Finland. The most extensive arboretums in Finland, and with the most representative selection of species, are the arboretums of Mustila and Punkaharju.

4.3. Nordic Cooperation for the Conservation of Genetic Resources

The Nordic Gene Bank, NGB

The Nordic countries engage in close cooperation for the conservation of plant genetic resources for agriculture. The most visible form of this cooperation is the Nordic Gene Bank (NGB) operating under the Nordic Council of Ministers. The NGB was founded in 1979, and is located in Alnarp, Sweden.

The mission of the NGB is to store and document the genetic variation of crops and horticultural species found in the Nordic countries that are important for agriculture. In recent years, there has been discussion on extending the mandate of the NGB to also cover herbal, medicinal, ornamental, and landscape plants. The NGB is obligated to make its collections accessible to plant breeders and researchers, so as to enable them to be utilised in the best possible way.

The NGB is assisted by six working groups dedicated to its mandate species:

1. Cereals
2. Fruit and berries,
3. Potatoes,
4. Forage crops,
5. Vegetables,
6. Root crops, oil-seed plants, and pulses.

The working groups generally have members from each Nordic country. The groups are charged with making recommendations regarding the maintenance of the collections falling under their mandate.

Nordic genetic material is deemed to comprise wild plants (with certain conditions), landraces and varieties, varieties produced by modern plant breeding methods, and other collections of material established for research. The NGB is responsible for the *ex situ* storage of this material.

The NGB has three kinds of *ex situ* collections:

1. **Active collection**, where samples are stored in alufoil plastic bags. These are the samples that are sent to breeders, and for conducting analyses, such as germination tests.
2. **Base collection**, where seeds are stored in glass bottles in freezers to maintain their ability to germinate as long as possible. Bottles are opened only when the sample's ability to germinate has decreased so far that the collection has to be regenerated.
3. Seeds in the **special collection** are stored in glass ampoules kept in an old coal mine on Svalbard, Norway, where the temperature remains at a constant -3 - -4 C.

The collections at Alnarp contain about 27,000 seed accessions, of which 8,500 are bred varieties, old landraces, or wild relatives of cultivated crops. The rest of the samples are special collections from research projects. Most of the collections at the NGB are well documented, although the quality varies from species to species.

Of the samples stored at the NGB, 510 are of Finnish provenance (Appendix 1). Of these, 240 are samples of cereals, 219 of grasses, and 75 of smaller plant groups.

Although *in situ* collections come under the mandate of the NGB, their maintenance is the responsibility of each Nordic country. In Finland, these *in situ* collections are maintained at the MTT Agrifood Research Finland's research stations in Piikkiö and Pälkäne, the University of Helsinki, and at Jomala research station in Åland (material from the Åland Islands). The collections include fruits, berries (Table 4), and ornamental plants (Appendix 2).

Information about the NGB collections is stored in databases, and is accessible on the Internet. The NGB also supplies species-specific catalogues. One of the tasks of the NGB is dissemination of information on plant genetic resources and their conservation.

The NGB collections were gathered primarily prior to the entering into force of the CBD, and samples as well as related information are freely accessible. However, the NGB is considering adopting a material transfer agreement like other gene banks. The MTA would be used to issue regulations on the use of the material, such as patenting.

One of the tasks of the NGB is to support plant breeding activities. Accordingly, the NGB supports projects and surveys that aim at enhancing Nordic cooperation and better utilisation of plant genetic resources. Supported projects include breeding as well as research projects that promote the competitiveness of Nordic plant breeding.

The Nordic Council of Ministers funds the NGB by about 10 million Danish crowns a year. Of this, some 1.8 million crowns are allocated to supporting the activities of the NGB working groups, and about 2 million for project funding. The NGB is in the process of aligning project funding with the objectives of the bank, so that priority would be given to projects that most clearly are in line with

the strategy of the NGB. One purpose of project funding is to enhance cooperation between the NGB and universities and research institutions by providing funding for joint research projects, as well as post-graduate studies, in order to secure a high degree of expertise in plant genetic resources also in the future.

The NGB also engages in international operations, working in close cooperation with many other gene banks. The NGB also represents the Nordic countries in networks belonging to the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR). About one million Danish crowns are spent annually on Baltic cooperation, to assist the Baltic states in the establishment and maintenance of their own gene banks. The NGB has also participated in the project for saving the collections of the Vavilov Institute.

Expertise on plant genetic resources at the NGB has been utilised in EU projects as well. The NGB participates in several projects under the action programme launched under the EU Directive 1467/94 on the conservation, characterisation, collection, and utilisation of genetic resources in agriculture.

In 1989, the NGB launched a project to establish a similar regional gene bank in the African SADC countries. The project will cover 20 years and involve 11 African states. Information on the project, as well as on the NGB in general, is available on the Internet at the NGB Website at www.ngb.se.

Nordic Strategy on Genetic Resources

Organised Nordic cooperation in the field of genetic resources was launched in 1979, when the Nordic Gene Bank was founded under the Nordic Council of Ministers. The NGB is located in Alnarp, southern Sweden, in conjunction with the Swedish University of Agricultural Sciences (SLU). A corresponding gene bank for livestock genetic resources (NGH) was established in 1984. It is located at the Agricultural University of Norway.

A joint Nordic action programme was prepared for 1994-1997, entitled '*Samarbeid om genetiske ressurser – nordisk handlingsprogram 1994-1997*', based on the existing cooperation on the genetic resources of plants, animals, and forests. The programme also covered education and training, as well as information activities.

Among the concrete measures in the action programme were researcher training, the establishment of two Nordic lectureships (one in plant, the other in animal genetic resources sector), and the enhancement and development of the operation of gene banks. A Strategy Group was appointed to monitor the programme, and was charged with monitoring and developing Nordic cooperation on genetic resources.

In its meeting held on 25 June 1998, the Nordic Council of Ministers requested the Strategy Group to assess the implementation of the action programme. The group submitted its report to the Nordic Civil Servants Committee for Agriculture and Forestry (Nordiska Ämbetsmannakommittén för jord- och skogsbruksfrågor, NÄJS) on 9 April 1999. According to the report, Nordic cooperation on genetic resources is both useful and successful. Nordic cooperation has in fact served as a model for initiatives to establish similar regional cooperation in other parts of the world.

On the basis of the report of the Strategy Group, the Council of Ministers decided on 22 June 1999 to appoint a working group to prepare a strategy for Nordic cooperation in genetic resources for the years 2001-2004. The working group submitted its report, '*Förslag till strategi för hållbart bevarande av genetiska resurser i Norden 2001-2004*' to the Council of Ministers at the Council's summer meeting held 13-17 August 2000.

According to the vision for Nordic strategy for genetic resources, "The Nordic countries will seek to fulfil their duty towards future generations and the international community in a way that the genetic diversity important for Nordic agriculture and forestry, as well as our cultural heritage, are conserved and used sustainably. Nordic resources for the conservation of genetic resources will be used to intensify and deepen cooperation between different sectors of genetic resources (plants, animals, forest trees)."

The objectives of the strategy are to:

- Reinforce and develop the conservation of genetic resources important for agriculture, forestry, future food security, and cultural heritage,
- Secure the access to and sustainable use of genetic diversity,
- Develop principles for joint Nordic administration of genetic resources in a way that takes into consideration the provisions of the Convention on Biological Diversity on the sharing of benefits,
- Improve the knowledge of those participating in the work on genetic resources, as well as of the public, concerning the necessity for the conservation and sustainable utilisation of genetic resources,
- Promote cooperation between those participating in the work on genetic resources both within individual countries and on the Nordic level, in order to optimise expertise and the use of financial resources, and
- Further develop cooperation in the adjacent areas, the EU, and other international cooperation.

According to the Strategy Group, cooperation on genetic resources applies primarily to plant and animal genetic resources for agriculture and forestry, although cooperation can, when necessary, be extended to cover other organisms as well. One especially important issue in the group's view is to deepen inter-sectoral cooperation in order to raise Nordic expertise on genetic resources to a level that can be utilised in both Nordic and international discourse and cooperation on genetic resources. This objective will be attained by improving information services in all areas.

In order to develop cooperation for the conservation of forest genetic resources, the Strategy Group proposes the establishment of a Nordic cooperation network. The Nordic Forest Seed and Plant Commission (NSFP), necessary additional resources for whose operations have been allocated, will have an important role in the preparation and practical implementation of a development plan for cooperation.

Nordic interest in the conservation and sustainable use of genetic resources places also demands on education, which must be used to maintain the high level of expertise. In this regard, hopes are high for the utilisation of the Nordic Forestry, Veterinary and Agricultural University (NOVA) in Nordic education. Gene banks, too, must serve as centres of expertise in their respective sectors, providing their know-how for the use of universities and projects, for example.

In keeping with the proposal of the working group, the Nordic Council of Ministers appointed, in March 2001, a Nordic Council of Gene Resources which convened for the first time on 28 March

2001. The purpose of the Council of Gene Resources is to act as an expert advisory body to the Civil Servants Committee and the Council of Ministers on issues involving policy on genetic resources. Such issues include the ownership of genetic resources, the sharing of benefits, education and research, gene technology, development aid, and ethical questions.

The Nordic Council of Gene Resources has two members from each Nordic country, with one representing agriculture and forestry, the other the environmental sector. All sectors of genetic resources are represented on the Council.

4.4. International Institutions and Organisations

International Institutions of Agricultural Research (Consultative Group on International Agricultural Research, CGIAR)

The CGIAR network was founded in 1971 by leading international agricultural research centres. Currently the cooperation covers 16 research centres. Funding for the operating costs of CGIAR comes from both the public and private sectors. CGIAR's annual budget of is about 330 million US dollars, and the funding of the various institutions is the largest single development cooperation project within the field of agricultural research. The funding of the CGIAR research centres constitutes 4-5 per cent of all agricultural research conducted either in or for developing countries. In 2000, Finland spent eight million marks (about EUR 1.3 million) on funding for institutions operating under CGIAR. CGIAR currently has 43 member states. In addition, other organisations and communities may join the organisation. One of these is the EU Commission.

The mission of CGIAR is to use science and new technologies for increasing food security, mitigating poverty, and protecting the environment, especially in developing countries.

The gene banks operating under CGIAR have about 600,000 seed samples of over 3,000 plant species. This corresponds to nearly 40 per cent of all genetic resources stored in gene banks in the world. Because the material in these collections has been inventoried, they are perhaps the world's most valuable gene bank materials. Inventoried material can be easily accessed by both plant breeders and researchers.

Most of the genetic resources stored at the CGIAR institutions are collected from developing countries prior to the entering into force of the CBD. Right of ownership to these collections is currently under negotiation in connection of both the IU and the CBD. The established policy of the CGIAR institutions is that material in their collections cannot be protected under systems of ownership rights. However, CGIAR is currently considering changing its policy, because it is apparent that the new varieties produced in the CGIAR institutions should be protected against pressures for ownership from the industrialised countries.

A new organisation, International Plant Genetic Resources Institute, IPGRI, was established under CGIAR in 1991, which provides the coordinating secretariat to the European Cooperative Programme for Crop Genetic Resources Networks, ECP/GR.

European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR)

The ECP/GR programme, originally called The European Cooperative Programme for Conservation and Exchange of Crop Genetic Resources, was founded as a UNDP/FAO project in 1980.

Currently 32 countries are members of ECP/GR. Representatives of the member states (one/state) decide on the Programme's operations in a Steering Committee, which convenes every 2-3 years. The latest meeting of the Steering Committee was from 29 June to 5 July 1998. The meeting adopted the report of Phase V, and decided on the launching, direction of operations, and budget of the next phase (Phase VI, 1999-2003).

At a European meeting on Plant Genetic Resources held in 1995 in Nitra, Slovakia, the European countries recommended that the ECP/GR programme will be the primary instrument for the implementation of the GPA in Europe. For this reason, efforts are now being made for the development of the programme and for the improvement of its operating conditions in order that these obligations might be satisfied. Since Finland has accepted this objective in Nitra, as well as the GPA, it is also committed to the continuation of the programme.

Resolution 2 of the Ministerial Conference on the Protection of Forests in Europe, held in Strasbourg in 1990, obligates the signatory countries to secure the conservation of the genetic resources in their own forests. This was the basis on which the European Forest Genetic Resources Programme (EUFORGEN) was created, which was adopted at the Second Ministerial Conference in Helsinki in 1993.

The Vavilov Institute, VIR

The N-I. Vavilov All-Russian Research Institute of Plant Industry (VIR) was founded in 1894. The entire history of the institute revolves around Academician N.I. Vavilov. The collections of the Vavilov Institute are based on Vavilov's theory on the 'centres of origin' of agricultural crops and on general knowledge of genetics.

The plant genetic resources collections at the VIR are considered some of the oldest in the world, and the most valuable gene bank for agriculture. The collections contain a total of 330,941 samples of agricultural species from all over the world. Vavilov himself collected and documented much of the collection.

The collections at VIR are extremely important for the conservation of genetic resources in Finland and other Nordic countries, because they contain an extremely valuable collection of the genetic resources of our agricultural crops. For this reason, the Nordic Gene Bank participated in a project for the assessment of the resources and measures required to preserve the VIR collections.

The Vavilov Institute has experienced severe financial difficulties in recent years, and means to solve the problems have been sought under the leadership of IPGRI. The Nordic Gene Bank has also participated in the efforts to determine how to save these valuable collections.

5. Utilisation of Plant Genetic Resources in Finland

5.1. Agriculture

Finnish agriculture is predominantly based on family farming, which is characterised by the predominance of small farms and their great number. In 1998, the number of active farms in Finland was 88,070. Of these, 46 percent had crop production as their main production line, on 32 percent the main line was dairy production.

Agricultural land (cultivated fields and gardens) constitutes a total of about 8 percent of the land area of the country, some 2.5 million hectares. In 2000, about 2.2 million hectares were under cultivation. The division of agricultural land by crop is presented in Table 6.

In 2000, the average yield of the main crops was as follows: spring wheat 3,570 kg/ha, winter wheat 3,700 kg/ha, rye 2,430 kg/ha, barley 3,550 kg/ha, and oat 3,540 kg/ha. Because of the climate, the average yield is clearly less than in most other EU countries. The total production of bread cereals was 646 million kilos, fodder cereal 3,449 million kilos, and other cereals 8 million kilos. The total cereal harvest in 2000 was 2,882 million kilos. In 1999, the average market price of cereals varied in Finland from FIM 675/tn for oats to FIM 845/tn for rye. (Viljavaaka 2000:11).

Table 6. Utilisation of fields and other agricultural land. Greenhouse cultivation not included. (Monthly Review of Agricultural Statistics 11/2000)

Crop	Arable area (1000ha)
Winter wheat	40.0
Spring wheat	109.5
Rye	44.6
Barley	559.0
Oats	400.0
Mixed cereals	16.7
Other cereals	3.0
Cereals total	1,172.8
Hay	157.6
Silage	372.3
Green fodder	23.1
Pasture	116.4
Seed production	9.8
Cultivated grasses, total (1)	679.2
Potatoes	32.3
Sugar beets	32.1
Peas	5.2
Oil-seed plants	52.5
Horticultural plants (2)	13.9
Other plants	9.5
Area under arable crops, total	1,997.5
Set-aside	181.6
Arable area with set-aside, total	2,179.1
Permanent grassland and meadows (3)	25.9
Perennial horticultural plants (4)	3.5
Home-use cultivations	0.9
Agricultural land in use, total	2,209.4

(1) Grasslands less than 5 years of age

(2) Vegetables, strawberry, and ornamental plants in the open

(3) Incl. grasslands at least 5 years of age. Wild meadows and pastures in use, as well as woodland pastures

(4) Apples, berries and nurseries in the open

Some 20,000 people work permanently in horticulture in Finland. There are almost 10,000 horticultural farms in Finland. In addition to cultivation, horticulture also provides employment for other associated professions.

Horticultural production covers vegetables grown in the open, fruits, cultivated berries and plants, cut flowers and foliage plants, vegetables and ornamental plants grown in greenhouses, and nursery products. In 1999, some 18,380 hectares were under outdoor cultivation, and 491 under greenhouse cultivation.

The diversity of habitats on the farm dictates the extent of total species diversity, as well as the conditions for species to survive and maintain their genetic diversity. To conserve farmland diversity, activities should be avoided that render the environment and the landscape more uniform.

Regional diversity is enhanced by the preservation of different farm types and agricultural production modes.

Like that of other ecosystems, the diversity of agricultural environments is measured on three levels: genetic, species and ecosystems. These levels are all strongly interdependent. In agriculture, we need to examine the interaction and relationships between crops and livestock and production environments on the one hand, and wild organisms and environments on the other.

The diversity of both production organisms and wild organisms has eroded in recent decades, and some species have become threatened. Factors contributing to the decrease in the diversity of crops include increased efficiency of production, and, especially, the proliferation of monocultures, whereas, in the case of wild species, the basic cause for the decline in their diversity is the decrease in the number of suitable habitats.

Agriculture and horticulture are an important aspect of biological diversity in Finland, because they cultivate over 3,000 species and varieties of plant, and some dozens of breeds and species of livestock. Furthermore, some 500-600 wild species are known to benefit from agricultural habitats. The typically small field size in Finland increases the amount of border zones that are important for biodiversity. Moreover, because of animal husbandry, a great number of fields are maintained as pastures, which offer suitable habitats for many organisms benefiting from agriculture.

Some of the wild species benefiting from agriculture have not adjusted to the changes that have taken place therein. Species dependent on woodland pastures, meadows, and ditch edges, in particular, have declined.

In 2000, a survey was conducted to estimate the extent of endangered species in Finland. The survey covered nearly 19,000 of the almost 43,000 species in the country (Lumonet www.vyh.fi/luosuo/lumo/lumonet). Data gathered on 15,000 species were sufficient to assess the threat to their survival, and a total of 1,505 species were classified as threatened. Threatened species are divided into five categories: critically endangered 249 species, endangered 452, and vulnerable 804 species. 186 species were deemed extinct, and 1,060 as near-threatened.

Of the threatened plants, 180 are vascular plants, 142 are cryptogams, and 347 species are fungi (including lichen). Of the threatened animals, 50 species are vertebrates and 759 invertebrates.

Of the threatened species, 28% live in traditional rural habitats. In a survey conducted in the early 1990s, the corresponding figure was 21%. Of extinct species, no less than 39.2% lived in traditional rural habitats, and it is such species that are most rapidly becoming threatened in Finland. The greatest reason for this is that open areas are becoming overgrown. According to the survey, two of the vascular plants were extinct, 70 endangered, and 36 species near-threatened.

The preparation of the Ministry of Agriculture and Forestry's Strategy for Sustainable Utilisation of Natural Resources began in 1993, and the first report on the sustainable use of natural resources was published in 1995 (Ministry of Agriculture and Forestry publications 4/1995). The same year saw the completion of a proposal for measures for the maintenance, management, and restoration, in conjunction with agriculture and animal husbandry, of the biological diversity and landscape values of habitats formed by agriculture, such as traditional rural habitats and other agricultural environments (Ministry of Agriculture and Forestry committee report 4/1995). As part of the National Action Plan for Biodiversity 1997-2005, prepared under the auspices of the Ministry of the Environment, the Ministry of Agriculture and Forestry prepared, in keeping with the principle of

'sectoral responsibility', a comprehensive programme for the sustainable use of the biological diversity of renewable natural resources (Ministry of Agriculture and Forestry committee report 1/1996).

The Ministry of Agriculture and Forestry's Natural Resources Strategy was completed in 1997, as were the Guidelines for the Sustainable Use of Renewable Natural Resources (Ministry of Agriculture and Forestry publications 2/1997) with a separate, supporting survey on the status, use, and development of renewable natural resources (Ministry of Agriculture and Forestry publications 1/1997).

Under the Natural Resources Strategy, the utilisation of natural resources is sustainable, if their use takes into account the preservation of biological diversity, and if the use of the resources does not essentially decrease the quality of the environment.

The scenario for 2010 in the Natural Resources Strategy states that "Natural resources will be utilised within the limits of their productive capacity, the operations will be economically profitable and in harmony with the interests of different livelihoods, biological diversity will be maintained, the multiple utilitarian and recreational use of nature will be possible, and the load on the environment from these activities will be under control. Rural areas and village communities will thrive."

Nine objectives were listed in the Strategy for its implementation, of which Objective 2 contains the preservation of the genetic diversity of species: "Forest ecosystems, agricultural environments, and water ecosystems will offer diverse habitats for organisms and contain within their natural prerequisites a large number of species, and the genetic diversity of species will be preserved." Main lines of action for the attainment of the objective are listed, one of which is "the preparation of national programmes and strategies for the conservation of the diversity of the genetic resources of crops and livestock." Under the objective, contributions to the operations of the Nordic Gene Bank should also be increased.

1. Agri-Environmental Support

After Finland's accession to the European Union in 1995, an agri-environmental programme for 1995-1999 was adopted, funded in part by the EU. Although commitment to the programme was voluntary, about 90% of active farms committed themselves to it during the first programming period. Similarly, 91% of active farms made a commitment to the system for agri-environmental support for 2000-2006. In 2000, 96% of fields under cultivation came under the scope of basic measures in the agri-environmental support system. With such figures, Finland is, along with Austria, a leading country in the EU.

From 1995-1999, about FIM 1,690 million (about EUR 284 million) were allocated for agri-environmental support annually. Between 2000 and 2006, it is estimated that the average amount will be FIM 1,440 million (about EUR 242 million) per annum.

Environmental support has had a significant impact on Finnish agriculture and the national economy. In the Horizontal Rural Development Programme (2000), it was estimated that the value of benefits to society from the agri-environmental programme for 1995-1999 was, at the current

rate, FIM 11.6-17.6 billion (EUR 1,9-2,9 billion), depending on the period of validity and the reduction in the nutrient load.

The agri-environmental support system for 2000-2006 continues the actions initiated in the agri-environmental programme for 1995-1999. Under the system, farmers commit to implementing basic and additional environmental support measures for five-year periods. Contracts for special support can be made for five or ten years, depending on the type of contract.

One of the options of additional environmental measures for farmers is the conservation of biological diversity on their farm, the purpose of which is to increase the farmer's knowledge of the wild plant and animal species on their farm, their habitats, and opportunities for management. Biological and landscape diversity are promoted by establishing arable land for game and/or fields for landscape and diversity conservation for five-year periods.

Farmers who select this option are required to participate in training in the *on farm* management and maintenance of biological diversity. They are also required to draw up a general plan for their farm, listing the important sites of diversity and their management.

Contracts for special support within the agri-environmental support system cover:

- Organic production
- Management of traditional biotopes
- Promotion of other biological diversity
- Cultivation of native plant species

Organic Production

In 2000 the arable area under organic production or conversion into this was 6.7% of all land under cultivation in Finland, or 147,423 hectares, of which 30,188 hectares in transition. The area of land under organic production as per special support contracts is expected to grow to 240,000 hectares during 2000-2006.

Organic production is a form of agricultural production which is regulated by the EU Council Directive (EEC) 2092/91. In organic production, the nutrient supply of plants is managed primarily by carefully planned crop rotation, by the cultivation of legumes, and by utilising nutrients contained in farmyard manure and other organic material. The use of synthetic pesticides is prohibited in organic production.

It is recommended that landraces and local breeds be used in organic production. In practice, however, their use is not much more common in organic production than in standard production.

It can be expected that crop rotation, mixed crop cultivation, variable selection of crops, grazing, and avoidance of the use of chemical pesticides will increase the diversity of both flora and fauna on the farm. Measures promoting soil fertility will probably increase the diversity of micro-organisms in the soil. Organic cultivation can also be used to enhance biological diversity by building up a network of ecological corridors of protection areas, transition zones between fields and forests, and virgin areas. Such a network is conducive to the conservation of many threatened

species of flora and fauna, and to the promotion of the migration of such species from one area to the next.

The use of gene transfer technology is prohibited in organic plant production.

Management of Traditional Biotopes

Traditional biotopes are agricultural environments of exceptional biological diversity that are the result of traditional methods of agriculture, particularly mowing and grazing. Special support for the management and restoration of traditional biotopes aims at the conservation and enhancement of biological diversity in agricultural environments through the maintenance of the diversity of flora and fauna in these biotopes, as well as of the cultural heritage and landscape values associated with traditional agriculture.

The objective is to ensure that the biotopes are properly managed, and to bring as many of the nationally and regionally valuable traditional biotopes within the scope of management. The management of locally valuable biotopes and other, restorable sites in the vicinity of valuable biotopes is also important.

About 2,160 contracts for the management of traditional biotopes were concluded under the agri-environmental programme for 1995-1999, and they cover over 15,700 hectares. About one fifth of the contracts are made for areas classified as valuable.

Other Activities for the Enhancement of Biological Diversity

Special environmental support can also be granted to other measures for the enhancement of biological diversity. The objective is to ensure the maintenance of biodiversity associated with agricultural production through the conservation and management of the species, ecosystems and biotopes typical to agricultural environments, as well as their diversity. The management of the habitats of threatened species and other sites important for the conservation of diversity in agricultural environments merits special attention.

Other objectives are the enhancement of the number of animals and plants typical to agricultural environments, favourable conditions for game, and the enhancement of the number and quality of natural features.

Support contracts for the promotion of biodiversity give precedence to agricultural natural features classified as nationally valuable as well as those belonging to the Natura network, and also sites which have previously been covered by similar contracts. Under the agri-environmental programme for 1995-1999, the support covered about 1,520 hectares.

Cultivation of Native Plant Species

It is important for the conservation of plant genetic resources for agriculture that the cultivation of native plant species and varieties can also be supported during the support period of 2000-2006. Already in the agri-environmental programme for 1995-1999, Finland proposed the inclusion of a support system for landraces, but the Commission did not accept the proposal, because it was not satisfied with the criteria determining the degree to which the proposed varieties are threatened, and the system for their registration. In the European Union, support for the cultivation of native plants is only present in Austria (the catalogue includes about 100 landrace varieties and local strains) and Sweden (cultivation of strains of landrace beans).

A landrace project launched in 1997 conducted a survey on endangered landraces and old cultivars of cereals and grasses in Finland, and also assessed how the study, registration, and *on farm* conservation of these varieties should be organised. (Publications of the Plant Production Inspection Centre, B1 Seed Production 1/99).

The system for supporting the cultivation of native plants promotes the *on farm* conservation of cereals and cultivated grasses adapted to Finland by supporting the specification and conservation of such species. At the same time, it offers an opportunity for studying the genetic, population-biological, and cultural-historical characteristics of landraces and old cultivars, and for their long-term monitoring on the level of individual farms. It also promotes the seed supply of local small-scale production of special plants (such as local organic seed production of the stock of red clover/timothy) and the development of the uses and special products associated with landraces and old cultivars. The system also contributes to the implementation of the Convention on Biological Diversity in Finland.

The precondition for concluding five-year special support contracts for the cultivation of native plants is that the species in question is a registered landrace that differs in its exterior characteristics from other varieties, or is a registered endangered old cultivar. The distinctness of the variety must be ascertained in variety trials. The variety must first be registered and the farmer must conclude the contract for its conservation with the Plant Production Inspection Centre. The farmer undertakes to cultivate annually on one hectare the variety specified in the contract. The right to receive support for contractual conservation of a variety is reserved primarily for the farm where the variety has been cultivated for decades. Conservation primarily takes place on one farm in the original area where the variety has been cultivated.

Contractual conservation must prevent the mixing or cross-fertilisation of the variety with other varieties of the species. Furthermore, the farmer must take into consideration previous cropping and, in the case of cross-pollinating species, to sufficient isolation zones.

On the basis of information gathered during the landrace project, it is estimated that contracts would be concluded for about 120 landraces or old cultivars. Special support contracts are concluded for landraces and varieties still found on farms; for strains of certain varieties of cross-pollinating species no longer in the national catalogue of varieties; for strains of cross-fertilising cultivars of over 30 years old that are no longer in the catalogue and that have been cultivated for decades on the same farm; for cultivars of self-pollinating cereals no longer in the catalogue, provided they have value in cultivation, offer advantageous special characteristics or significant special uses; and old exotic varieties which have been important for Finnish plant production.

Cultivation contracts for native plant species have not yet been concluded, because their registration is still incomplete. The Technology Units of the regional Employment and Economic Development Centres have received ten applications, and contracts may also be applied for in 2001.

2. General Indicators for Sustainable Utilisation of Renewable Natural Resources

In 1999, the Ministry of Agriculture and Forestry completed a set of general indicators (Ministry of Agriculture and Forestry publications 3/1999) for monitoring the sustainability of the utilisation of renewable natural resources and the effects of measures for the enhancement of sustainability, such as environmental programmes. The information thus gathered allows measures to be targeted correctly under the various mandates of the Ministry.

One of the aims of sustainable agriculture (Objective 1.4) is to ensure the appropriate maintenance of the genetic diversity of crops and livestock (Indicators 12 and 13). Maintenance of the genetic diversity of crops is stated to be of primary importance for all agricultural production in Finland, because of the northern conditions in the country. Both modern plant breeding and the conservation and maintenance of landraces and old cultivars are needed to ensure the supply to farmers, also in the future, of crop varieties both winter-hardy and adapted the short growing season with its long days.

The utilisation of the indicators will continue in the future, when monitoring information becomes available regarding varieties accepted under the scope of special support in the agri-environmental programme and on the functioning of the register of landraces.

The indicators for sustainable use also point out that biological diversity must be maintained by agriculture as well (Objective 3.2, Indicator 28). Suggested indicators include, in addition to certain insect species, also changes taking place in the diversity of weed species and plants adapted to growing on ditch edges, for example. The latter are currently under investigation in, for example, the MYTVAS project studying the effectiveness of agri-environmental support.

3. Plant Breeding

Finland is the northernmost country in the world where agriculture is practised on a commercial scale. The supply of varieties developed for these conditions, winter-hardy and adapted to the short growing season with long days, is essential for Finnish plant production to be competitive with more southern agricultural countries. The small size of the seed market in Finland does not encourage foreign breeders to develop varieties for the Finnish markets. Therefore, it is crucial that domestic plant breeding be supported to maintain the development of new, productive varieties of the most important crops adapted to Finnish conditions.

The importance of domestic plant breeding is demonstrated by the large number of domestic varieties in the national catalogue of varieties (Table 7). The proportion of domestic varieties in the

case of the most important cereals is 57%, and the proportion of domestic varieties of all species in the national catalogue of varieties is 37%.

All plant breeding is based on within-species genetic variation, created either in the wild, or artificially (by, for instance, breeding of mutations, or gene transfers). One of the principal reasons for the founding of the Nordic Gene Bank was specifically the conservation of genetic variability of species utilised in agriculture and to make them available for plant breeding. The preparation of the Plant Genetic Resources Programme for Agriculture was also launched in order to ensure the conservation and sustainable use of plant genetic resources for agriculture, and, in particular, access to these resources for breeding needs. Efficient plant breeding is a necessary precondition for safeguarding food security for present and future generations in developing countries in particular, where the growing human population must make a living on diminishing areas of arable land.

Table 7. Number of domestic and foreign varieties in the national catalogue of varieties in 2000.

Species	Nr of varieties /domestic	Species	Nr of varieties /domestic
Oats	15 / 10	Italian ryegrass	11 / -
Barley	27 / 13	Westerwoldian ryegrass	7 / -
Rye	9 / 7	Timothy	14 / 9
Spring wheat	7 / 3	Smooth meadowgrass	12 / -
Winter wheat	7 / 4	Alpine meadowgrass	1 / 1
Triticale	3 / -	Common bentgrass	3 / 1
Field bean	2 / 2	Red fescue	21 / 1
Peas	9 / 5	Sheep's fescue	1 / -
Alfalfa	1 / 1	Flax	2 / 2
Alsike clover	1 / -	Spring rape	4 / -
Red clover	7 / 3	Spring turnip rape	6 / 4
White clover	2 / 1	Potatoes	37 / 7
Fodder vetch	1 / -	Swede	1 / 1
Orchard grass	3 / 2	Goat's rue	-
Meadow fescue	7 / 3	Festulolium	-
Tall fescue	1 / 1	Common sunflower	-
Perennial ryegrass	2 / 1	Hemp	-
Smooth brome	1 / 1	Poppy	-

Breeding of Field Crops

In Finland, breeding of field crops takes place mainly at Boreal Plant Breeding Ltd. Boreal was founded in 1995 through the merger of the plant breeding operations of Hankkija and Jokioinen and the Jokioinen seed centre. The mission of Boreal is to develop varieties of field crops adapted to northern conditions, and to market the varieties and seed produced by the company.

Boreal's breeding programmes include cereals (barley, oats, wheat, rye), oil-seed plants, cultivated grasses, potatoes, and peas, as well as other plant species not as extensively cultivated. Breeding is based on traditional cross-breeding and selection, but the company also employs various new breeding techniques to improve efficiency and accelerate the work.

In addition to Boreal, plant breeding and selection is practised on the experimental farm of Kesko in Hauho, and by Mildola Oy in Tuusula.

Breeding of Horticultural Plants

Horticultural breeding is conducted in Finland at the MTT Agrifood Research Finland's Institute of Horticulture in Piikkiö. Breeding focuses on fruits and berries. Vegetables are not bred, because the domestic market for vegetable seed is relatively small, and the foreign supply of varieties has been sufficient.

One of the key issues in the development of the production of horticultural plants is access to suitable varieties adapted to conditions in this country. Being perennial plants, fruits and berries are particularly susceptible to the harsh climate in Finland. Only a few foreign varieties are hardy enough to survive here. Therefore, it is important that domestic breeding of varieties of apple, apple rootstock, and berries (strawberry, blackcurrant, the red and white currant group, bush blueberry) be maintained to ensure the supply of a sufficiently wide range of varieties.

The Faculty of Agriculture and Forestry at the University of Helsinki has since 1973 bred rhododendrons. The work has resulted in nine varieties that are marketed in Finland, Sweden, Norway, Russia, the USA, and Canada. Breeding is primarily based on an experiment with varieties begun as early as 1930 at Arboretum Mustila, which conducted tests internationally on varieties and hybrids for their winter-hardiness. Since 1995, efforts have also been made to develop varieties of rhododendron with yellow flowers. In 1978, breeding was started on azalea-type rhododendrons, as a result of which new varieties will come onto the above-mentioned markets in the near future. Additionally, the University of Helsinki has since 1990 bred hardy varieties of bush roses adapted to regions with a similar climate to Finland. The new, durable varieties will probably be ready for the market in ten years. The University of Helsinki also has smaller-scale breeding programmes for Japanese quince, sea buckthorn and boysenberry.

4. Seed Trade

In Finland, only certified seed may be marketed that has been officially inspected and that satisfies the quality requirements of EU Directives, the Seed Trade Act, and the decisions of the Ministry of Agriculture and Forestry regarding the production of certified seed as to its provenance, varietal purity, humidity, health, and ability to germinate.

The Plant Production Inspection Centre may certify for marketing in Finland only varieties entered in the national catalogue of varieties that have results from official variety trials from at least one growing season. The Plant Variety Board operating under the Ministry of Agriculture and Forestry annually decides which varieties to accept into the national catalogue of varieties.

The quality categories for certified seed are pre-basic, basic, and certified seed. Classification is determined on the basis of the provenance from parental material, varietal purity and other quality characteristics.

Lots of certified seed may be processed and packaged only by a company, farmer, or other entrepreneur who is entered in the register of certified packagers maintained by the Seed Testing Department of the Plant Production Inspection Centre.

Packagers can conclude contracts for cultivation with seed producers. Inspections are carried out on seed orchards once every growing season to ensure that provisions regarding the production of seed are met.

Samples are taken of the harvest of seed orchards for official laboratory identification.

Owing to the climate in Finland, there is great annual fluctuation in seed harvests. To ensure a continuous supply of certified seed of varieties adapted to Finland, security storages of sowing seed are maintained.

Because of the small market for seed and the low yield of seed harvests, Finland has the right to pay a national seed production support. The support is paid by the hectare for grasses (red clover, timothy, meadow fescue, orchard grass, and perennial ryegrass) and by weight for varieties accepted into the catalogue of varieties. One of the conditions for receiving support is that the seed must be primarily produced in Finland.

The area annually under seed production has been about 8,000 hectares for grasses (primarily red clover, timothy, and meadow fescue) and about 30,000 hectares for cereals. The amount of certified seed on the market has been about 100 million kilos annually, divided between different plant categories as follows: grasses, about 3 million kilos; cereals (wheat, oat, barley, rye), about 70 million kilos, and other crops (potato, rapeseed, peas), about 26.7 million kilos.

The value of trade in certified seed in Finland is about FIM 253 million (EUR 42 million) annually. When also the value of seed for own use is added (about 2/3 of cultivations are sowed with own seed), the total value of the annual seed market in Finland comes to about FIM 566 million (EUR 95 million).

5.2. Forestry

1. Forests and the Principles of their Utilisation

Most of Finland belongs to the boreal coniferous forest zone, which is characterised by a short growth period and a relatively small range of tree species. The growing season of trees lasts no more than five months in the south (May-September), and about three months in the north (June-August). There are four coniferous species native to Finland, and over 20 species of deciduous trees. The most common species, which are also economically most significant, are Scots pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), and silver and downy birch (*Betula pendula* and *Betula pubescens*). Other naturally occurring trees are juniper and yew, as well as aspen, grey and

black alder, rowan, goat willow, European white elm and Scotch elm, lime, European ash, oak, bird cherry, maple, and wild apple tree.

Finnish forestry is based on the management of native tree species. The management of forests seeks to respect their natural growth and mimic the natural cycle of boreal forests. The objective is to secure the production of high-quality timber, and to preserve the biological diversity of forests, as well as the preconditions for the multiple use of forests. Forest legislation, as well as various training and advisory services, aims at ensuring that the sustainable management of forests is also implemented on the practical level.

Approximately 5.4 million hectares of Finnish forests (forest land and low productive forest land), or nearly 25%, is the result of reforestation with direct seeding or planting as the second rotation on the same forest land. Other forests have either been naturally regenerated or have grown naturally. Even in seeded or planted forests, 20–30% of the seedlings is natural stocking. Introduced species have been planted experimentally on more than 20,000 hectares.

2. General Characteristics of Forestry and Forest Industry

Private persons own about 61% of all forest land, the state about 25%, forest industry 9%, and the rest 5%. The number of private forest holdings of at least one hectare is about 440,000. Some private forests are in joint ownership. The number of individual private forests owners in Finland is estimated at nearly 900,000, which means that one out of every five Finns is a forest owner. Private forest holdings are relatively small: on the average, they cover 26 hectares of forest land (holdings of over one hectare).

The importance of private forests for the private and national economy is considerable. In 1999, nearly 90% of domestic roundwood used by the forest industry came from private family forests. Annual stumpage earnings in 1999 were about EUR 1.35 billion.

Forestry and the forest industry accounted for just under 8% of the gross national product (FIM 724 billion, appr. EUR 121 billion) in 1999. The proportion of the forest industry to the added value of all industry was around 20%.

In 1999, forest industry products accounted for 29% of the total value of Finnish exports (FIM 66 billion of the 233 billion, or EUR 11/39 billion, respectively). The proportion of the entire forest cluster (forestry, forest industry, forest machinery industry, forestry-related chemical industry, automation and packaging systems, the printing industry, energy production, forestry-related transportation, and consultation enterprises) was 30–35% of the gross national export income.

The volume of roundwood used in Finland in 1999 was 74.5 million cubic metres. The forest industry used a total of 68.8 million cubic metres of roundwood, of which 11.7 million cubic metres was imported. The number of people employed by forestry and the forest industries in 1999 was 95,000, which is slightly over 4% of the total workforce. The total number of people employed by the forest cluster is about 140,000.

Income from timber sales and forestry supports jobs and livelihoods for the rural population, and often constitute an important source of income locally. The number of jobs in forestry has decreased quite heavily in the past few decades. Whereas in the 1950s, up to 500,000 people worked part-time

in forestry (timber floating, forestry work, or work on private forests of their own), currently forestry provides permanent employment for only some 20,000 people.

3. Conservation of Diversity in Forests

Forest Legislation and Conservation of Biological Diversity in Forest Programmes

Since the first Forest Act of 1886, the basic principle of Finnish forest legislation has been the prevention of forest destruction. This objective still remains in legislation, even though the aims of forest policy have changed and legislation has been reformed. Since the late 1980s, the maintenance of biodiversity, forest protection, the multiple use of forests, and the preservation of forest landscapes have increased in importance as goals for the use of forests.

The entire Finnish forest legislation was reformed in the 1990s, to ensure harmony with the principles of the forest principles of the Rio Summit and the general principles of the Helsinki Ministerial Conference on the Protection of Forests in Europe. The reform of Finnish forest and environmental legislation is also considered as being especially significant in terms of the implementation of international agreements signed by Finland.

The Ministry of Agriculture and Forestry and the Ministry of the Environment jointly ratified in 1994 the Environmental Programme for Forestry, which outlines the strategy for sustainable forest management in Finland for the near future. The programme follows the UNCED forest principles and the general principles for the sustainable management and utilisation of forests laid down at the Helsinki Ministerial Conference. The programme describes the target status for sustainable forestry for the year 2005, as well as the measures and instruments to be used in the attainment of the target.

The purpose of the National Forest Programme 2010 (NFP) adopted by the Government in 1999 is to outline trends in national and international forest management. The programme aims at developing the management, utilisation, and protection of forests in a way which ensures that balance is maintained between the opportunities for employment and livelihood provided by forests, the vitality and biological diversity of forest ecosystems, as well as opportunities for spiritual renewal and physical recreation which only forests can offer.

According to the NFP, an economically profitable and competitive forest cluster creates the prerequisites for securing the biological diversity of forests and for taking social and cultural values into consideration.

Conservation Areas and Biological Diversity

In the last 25 years, the area of protected forests has increased owing to protection programmes and decisions. Protected areas established on state land by acts and decrees on the basis of protection programmes adopted by the Government include national parks, strict nature reserves, mire conservation areas, herb-rich forest areas, old natural forest areas, and other special conservation areas. The management of wilderness areas is governed by the Act on Wilderness Reserves. Forests

with harvesting restrictions in 1998 accounted for 10.6% of all forests (forest land and low-productive forest land), and strictly protected forests for 7.6% of all forests.

The Environmental Programme for Forestry and the management recommendations for private forests based on the programme, as well as the management recommendations for forests of the forest industry companies and state forests, also include instructions for the maintenance and promotion of biological diversity in commercial forests. The maintenance of forest biodiversity is one of the key principles of the Forest Act as well.

About one half of the 43,000 species in Finland live in forests. The status of endangered species is monitored regularly. Of endangered species of flora and fauna, 38% live in forests. The majority of Finnish forest species are able to survive in viable populations in commercial forests, but for some, natural habitats or special features of natural forests, such as decaying or burnt wood, are vital to their survival.

International Agreements on Sustainable Forest Management

The principles for sustainable development in the management, utilisation and protection of forests were first defined globally and on the level of the United Nations at the UN Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992. The conference also adopted principles for the management, utilisation, protection, and sustainable development of forests, the so-called forest principles, on which international and national forest cooperation must be based. The UN Convention on Climate Change and the Convention on Biological Diversity were also signed at the Rio Summit. Furthermore, it was decided to launch negotiations for a convention to combat desertification. These agreements and their implementation also apply increasingly to forest issues.

The Fourth Conference of the Parties to the CBD held in Bratislava in 1998 laid down a forest work programme for 1998-2007. Issues to be addressed during the first stage of the programme include, for example, the criteria and indicators for forest biodiversity. The Fifth Conference of the Parties held in Nairobi in 2000 appointed an ad-hoc group of technical experts to promote the implementation of the forest work programme. The Sixth Conference of the Parties to be held in The Hague in 2002 will be dedicated first and foremost to forest issues.

On the European level, the principles of the CBD are implemented on the basis of resolutions adopted by the Ministerial Conferences on the Protection of Forests in Europe held in Helsinki (1993) and Lisbon (1998). The Lisbon Conference and the "Environment for Europe" Environmental Ministers' conference held in 1998 at Aarhus, Denmark, adopted an action programme for the protection of biodiversity and landscapes and their increase in forest ecosystems 1997-2000. In the EU, forest biodiversity is discussed in conjunction with the implementation of the EU Forest Strategy and the preparation of the 6th Environmental Programme.

Criteria and Indicators for Sustainable Forest Management

Three Ministerial Conferences on the Protection of Forests in Europe were organised in the 1990s. The first conference, called by France and Finland, was held in Strasbourg in 1990, and the second

in Helsinki in 1993, organised by Finland together with Portugal, Poland, and France. In Helsinki, the 37 signatory countries and the European Union made the commitment to implement the resolutions taken in Rio on the national level, as well as in international cooperation, by adopting resolutions H1 and H2 of the Conference. These resolutions contain the general principles for the sustainable management of European forests and the protection of their biodiversity. The Helsinki Conference was also the first time that the concept of sustainable management of forests was given a definition (Resolution H1, Article D), as follows:

"Sustainable forest management means the stewardship and use of forests and forest land in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality, and their potential to fulfil, now and in the future, relevant ecological, economic, and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems."

For the purpose of monitoring the implementation of the Helsinki resolutions, the criteria and indicators for sustainable forest management were adopted on the expert level in 1994. They were ratified by the third Ministerial Conference in Lisbon in 1998 as a basis for international reporting and the development of national indicators.

The Pan-European criteria for sustainable forest management are:

1. Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.
2. Maintenance of forest ecosystem health and vitality.
3. Maintenance and encouragement of productive functions of forests (wood and non-wood).
4. Maintenance, conservation, and appropriate enhancement of biological diversity in forest ecosystems
5. Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water).
6. Maintenance of other socio-economic and cultural functions and conditions.

The Finnish national criteria and indicators for sustainable forest management are based on the European criteria and indicators, with minor changes and additions. The national criteria and indicators were revised during 2000.

4. Forest Tree Breeding

The aim of forest tree breeding is to improve the quality of forest reproductive material, which in turn improves the productivity of forests and thereby the profitability of forest seeding and planting activities as well.

The most important characteristics developed in forest tree breeding are the quality and growth of trees. At the same time, care is taken to ensure the preservation of sufficient genetic diversity and that the reforestation material obtained as the result of breeding is adapted to the climate conditions of the site where it will be used.

Compared with other plant breeding, the breeding of forest trees is exceptionally slow and requires an exceptionally long time. In the case of the Finnish main species of pine and spruce, breeding

must largely follow their natural growth and development, which means that the production of bred material and their large-scale propagation for these species takes several decades. Only the breeding and seed production of birch allows a broad-scale utilisation of greenhouse methods, with which the long period between generations that occurs in the wild has, in the case of birch, been successfully shortened to just a few years.

Because of the sustained nature of forest tree breeding, all activities, funding included, must be planned and organised on a stable basis. In practice, sustained long-term forest tree breeding is possible only with public funding .

The results of forest tree breeding are utilised by using genetically improved reproductive material in forest regeneration. The material may be seed produced in seed orchards or seedlings grown from such seed, or plants propagated from tested individuals.

Planning and Organisation of Forest Tree Breeding

Practical forest tree breeding has since the 1960s been based on national 10-year programmes for forest tree breeding prepared jointly by various forest organisations. The programmes to date have spanned the years 1967-1975, 1976-1985, and 1985-1994. The last programme was amended during implementation in 1989 with the long-term forest tree breeding programme for 1990-1999 and the plan of action contained in it. The programme outlined the tasks of forest tree breeding, their allocation to different actors, and an estimate of the costs incurred by implementation of the programme.

Forest tree breeding activities, which had previously been undertaken jointly by several different organisations, were reorganised from the beginning of 2000 by concentrating operations entirely in the Finnish Forest Research Institute (Metla). After the reorganisation, the preparation of a new long-term national forest tree breeding programme is the responsibility of the Finnish Forest Research Institute. Metla will appoint a special Advisory Board for Forest Tree Breeding to monitor and steer the national planning and implementation of activities.

The proportion of state funding is greatest in forest tree breeding. The total resources for forest tree breeding at the Finnish Forest Research Institute in 2000 were over FIM 14 million (about EUR 2.3 million), and about 54 person workyears. In addition to these, Metla conducted production, commissioned and cooperation projects to about FIM 3 million (EUR 500,000) and 12 person workyears with outside funding.

Since the beginning of 2001, practical breeding activities at Metla were organised into a research programme under the title 'Forest Tree Breeding'. There are plans to build a new programme for practical forest tree breeding at Metla, in order to increase the efficiency of the integration of practical breeding with forest genetic research and other research areas at Metla.

5. Production and Use of Forest Reproductive Material

In order to utilise the results of forest tree breeding, a total of over 3,000 hectares of seed orchards have been established in Finland since the 1950s. The largest owners of seed orchards are the Finnish Forest and Park Service and the Forestry Development Centre Tapio. The register kept by the Finnish Forest Research Institute currently shows seed orchards for the main species as follows:

Species	Number of seed orchards	Area, ha
Scots pine	159	2,485
Spruce	23	277
Silver birch	7	0.5*

*Plastic greenhouse seed orchards

There are 21 seed orchards for other tree species, with a total area of 68 hectares.

Some 12,000 kilos of seed are used annually for forest regeneration, of which nearly 2,000 kilos are used by nurseries, and about 10,000 kilos in forest regeneration by seeding. Nearly all seeding of pine and birch, and the majority for spruce, for nursery seedling production in southern and central Finland is carried out using bred seed produced in seed orchards. Seedlings of pine are, in the entire country, done mostly with seed collected from commercial forests, as are a considerable part of seedlings in nurseries in northern Finland.

About 150 million seedlings of forest trees are produced domestically, in addition to which 5-10 million seedlings are imported annually. The annual area covered by planting in the 1990s was about 87,000 hectares, and the area of forest seedlings about 30,000 hectares.

6. Research and Education on Plant Genetic Resources in Finland

According to the development plan for education and university research (1995-2000), adopted by the Government on 21 December 1995, the principles of sustainable development are taken into consideration in the curricula and instruction in all forms of education. Under the plan, research on the environment and natural resources will increasingly be directed towards a study of the preconditions for sustainable development. The Ministry of Education has obligated all universities to investigate, how these matters are taken into consideration in their research and research programmes.

The responsibility of the educational administration in the promotion of the protection and sustainable use of biological diversity is scientific, instructional, and educational. Scientific responsibility, that is, basic and applied research on biodiversity, is funded by the Academy of Finland and is implemented by universities. The educational administration has actively worked for the maintenance and promotion of biological diversity. This is demonstrated by, for example, the launching of the FIBRE programme (1997-2002), and by current legislation on general and vocational education, as well as by the national principles for their curricula.

The Finnish National Action Programme for Biological Diversity emphasises the importance of inter-ministry cooperation in the preparation of study programmes and training packages related to the conservation and sustainable use of biodiversity.

The Action Programme lists several measures, with which the protection and sustainable use of biodiversity, including plant genetic resources, is to be promoted in research, education, and information dissemination.

75. The maintenance and enhancement of biodiversity will be taken sufficiently into account in the preparation of principles for new curricula required by the reform of education.
76. The maintenance and enhancement of biodiversity will be taken into consideration in the research activities of universities and in the development of the training programmes of universities and polytechnics, as well as in early childhood education.
77. Protection and sustainable use of biodiversity will be integrated into technical, business, economic, social and political, legal and administrative studies, both on vocational and university level education.
78. Broad-based cooperation will be used to develop study programmes that promote the protection, management, and sustainable use of biodiversity integrating ecological, economic, and social themes.
79. In cooperation with regional environmental centres and the environmental authorities of municipalities, educational institutions will prepare local or regional surveys of biodiversity, such as surveys of the distribution of plants and animals.
80. Public knowledge of nature will be increased, for example, by publishing guides, brochures, and reports, and by establishing structures promoting the recreational use of nature, such as bird watching towers, duckboards, and campfire sites.
83. The Research Programme on Biodiversity will be implemented under the Academy of Finland.
84. Authorities responsible for the implementation of the Act on Gene Technology, together with expert organisations, will study possibilities for launching a research programme for increasing Finnish expertise on genetically modified organisms.
88. Research on biological diversity will be continued, and research on methods for the management of habitats and ecological restoration will be increased.

Principles for comprehensive and upper-secondary schools curricula that take biological diversity into consideration were ratified in 1994. One of the criteria in grading primary education school-leaving certificates is that the pupil understands the importance of biodiversity. Under the decision of the Ministry of Education, the structure of upper-secondary vocational education was reformed in three stages, in 1999, 2000, and 2001. The national principles for the curricula required by the reformed structure will take biological diversity and sustainable development into consideration in accordance with sectoral needs. Existing principles for the comprehensive school apply also to early childhood education. The protection and enhancement of biodiversity are included, and will in the future be increasingly included, as compulsory or elective studies in polytechnics curricula, especially in the sectors of renewable natural resources and technology. Research and teaching on biodiversity are interlinked in the universities. In other fields, instruction linked with biodiversity is included in teaching on environmental issues (such as environmental legislation and administration).

Research and education on plant genetic resources is currently practised under the disciplines of botany, plant breeding, plant cultivation, horticultural science, genetics, bio- and gene technology, and environmental protection. People currently working in the field of the plant genetic resources for agriculture have primarily studied either agriculture and forestry, or biology. In addition to training in Finland, plant breeding involves Nordic postgraduate courses, which also include instruction on gene bank activities.

Under the Nordic Strategy for Genetic Resources, the high level of expertise in the protection, maintenance, and sustainable use of genetic resources for agriculture and forestry must also be ensured in the future through appropriate training. In this context, the Nordic Forestry, Veterinary and Agricultural University (NOVA) could function as one of the organisations providing higher-level education.

Together with various administrative sectors, the Academy of Finland has prepared the interdisciplinary Finnish Biodiversity Research Programme (FIBRE) under Government Resolution (VNp 21.12.1995). Conducted from 1997-2002, the programme produces information on biodiversity and its protection, as well as the sustainable use of natural resources. The objective of the FIBRE programme is to produce internationally high-quality research information on the themes of the programme, which are: conservation of biodiversity as part of sustainable use of natural resources, biological and socio-economical aspects of nature conservation as means of conserving biodiversity, and conservation of genetic diversity and biotechnology. One of the aims of the programme is to train experts for national and international positions related to the protection and sustainable use of biodiversity.

Funding for the first stage of FIBRE (1997-1999) was about FIM 62 million (about EUR 10 million). The funds were used to finance 59 research projects, which together form 36 larger research groups (consortia). Included are projects on biology (ecology, systematics, genetics, microbiology), forest research, biotechnology, economics, sociology, cultural research, philosophy, and environmental law. An international interim assessment of the programme, conducted by the Academy of Finland, was completed on 10 March 1999.

The FIBRE programme also addresses the issue of conservation of genetic diversity. Among the key research topics of the programme are genetic variability, the processes contributing to and threatening it, as well as the protection of genetic resources. New DNA techniques and calculation methods and their applications are important issues in the research on the conservation of biodiversity. It is also possible to develop commercial applications of such methods. New, efficient approaches can be found for research, such as those based on genetic markers and gene maps, for example.

The utilisation of genetic resources requires that they be protected and conserved. Conservation takes place using both *in situ* and *ex situ* methods, which are also studied within the FIBRE programme. Economic and legal issues related to biodiversity and the utilisation and right of access to genetic resources are also part of the FIBRE programme, as well as ethical perspectives related to the modification and utilisation of genetic resources.

According to the sub-committee of the monitoring group of the Finnish National Action Programme, working under the title *Research, monitoring and information systems*, links between GMO research and biodiversity research should be strengthened. Opportunities for biodiversity research offered by the methods of genetic technology, especially for the study of intra-specific genetic diversity, should be taken into consideration. The cataloguing and exchange of information on scientific literature concerning the points of juncture between scientific disciplines should also be enhanced. Research on ecological risks caused by genetically modified organisms should be increased. Important issues include research on the risks for the narrowing of varietal diversity caused by GM varieties in arable crops, and research on the effects on ecosystems of insect-resistant crops. The possible release into the environment of GMOs and their effects are also important topics for research.

Biodiversity Research in Agriculture and Forestry

In the agricultural sector, biodiversity research is mainly conducted at the research centres of MTT Agrifood Research Finland. The topics of current research projects in this area include: the genetic diversity of livestock and sheep breeds; development of seed production and utilisation of Finnish wild plants for the needs of landscaping activities; changes in the diversity of agricultural landscapes in Finland and their management; and the effects of changes in land use on soil biodiversity, especially with respect to functionality and the nitrogen cycle.

As an example of research related to plant genetic resources for agriculture, we can mention an ongoing research programme at the botanical gardens of the University of Oulu, which studies the utilisation of northern plant species for the creation of new industry and for the diversification of agricultural livelihoods. One of the projects was POHERIKA (1996-1999), a study on special species of flora in northern Finland, the objectives of which were:

- To find new, alternative forms of production for arable land no longer in use, and to further the diversification of agricultural livelihoods ,
- Promote product development and raise the level of processing of special plants (with special methods, such as extraction and distillation),
- Develop pharmaceutically valuable strains to optimise their production of effective substances,
- Promote business activities based on wild berries and emphasise exoticness in products,
- Develop the quality, markets, and production technologies of northern special species of flora,
- Develop cultivation techniques suited to northern conditions, and test species and varieties,
- Promote cooperation in the area of regional research and development resources for the enhancement of the efficiency in biotechnology.

The plants investigated in the POHERIKA project included tarragon, sundew, Siberian ginseng, bearberry, roseroot, and perforate St John's-wort. In addition to units of the University of Oulu, the project also involved the research and development centre of Kajaani, MTT Agrifood Research Finland, Finnish spice and sweets industry companies, berry breeding companies, and other entrepreneurs from northern Finland in the field of aromatic herbs.

The POHKAS set of projects studying useful northern plants constitutes one of the basic tasks of the University of Oulu botanical gardens. The project studies and maps hardy northern species of ornamental and other useful plants. The set of projects includes sub-projects, whose purpose is to promote landscaping activities in northern Finland, among other things. The results of the projects are gathered in the POHKAS register of northern plants, which contains information on beautiful, healthy ornamental plants adapted to winter conditions in northern Finland. The POHKAS register contains over 300 individual plants, most of which are woody ornamental plants. The register is utilised for directing research, among other things.

One of the POHKAS projects is Hardy Perennials 2001. Funded by the Ministry of Agriculture and Forestry, it is a joint project by the University of Oulu and the Ministry of Agriculture and Forestry for developing the production of domestic perennial plants and for the survey of strains of perennials cultivated in Finland.

The project aims to develop the production of perennials in Finland, and to promote the efficiency and diversification of the production. It focuses on mapping, studying, and developing propagation methods of potential strains of perennials. The goal is to produce healthy mother plants of varietal purity for plant material production.

The PRUNUS project constitutes part of the conservation and utilisation of the genetic variation of horticultural plants that is the objective of the Nordic Gene Bank. Studies on bird cherry conducted at the University of Oulu are part of this work. The *Prunus* genus contains many important fruit plants. Bird cherry was selected as a new species for the project funded by the Nordic Gene Bank in 1991. The botanical gardens at the University of Oulu studies the occurrence of the subspecies and varieties of bird cherry in northern Finland. Special forms as well as especially decorative individual trees have been sought in different areas, which the worst pests and pathogens of the species avoid. At the same time, possible uses of the tree have been studied. In addition to northern Finland, bird cherry is now under survey also in southern Finland and other Nordic countries. Varieties and the best strains of subspecies are registered and gathered into a clone orchard in Oulu. The collection serves as a living gene bank for research as well as commercial plant production.

Research on the protection and conservation of the genetic diversity of forest trees has been conducted for decades, especially at the Finnish Forest Research Institute. Forest trees are strongly cross-pollinating species, which, with but a few exceptions (such as aspen), are regenerated from seed. Research on the biology of flowering and hybridisation ratios has, therefore, yielded extremely important basic information on how the conservation of genetic diversity should be taken into consideration in the production of genetically improved reproductive material. More currently, genetic diversity has been studied using various markers, both isoenzymes and DNA markers. Such studies have been conducted especially at the Department of Genetics at the University of Oulu. The results show that the genetic diversity of reforestation material acquired from seed orchards, currently widely used, is at least as great as of material collected from wild forests.

Finnish forestry first began paying attention to tree species of less value to forestry (hardwood trees, alders) in the 1990s. Research on these species has indeed remained much less developed than that on pine, spruce, and birch. Hardwood trees, such as oak, European ash, and elms, grow in southern Finland at the northernmost edge of their distribution area, and they have never been common in Finland. Their wild populations are either small enclaves or copses, in which opportunities for cross fertilisation can be much more restricted than in the case of large populations of main species. The research programme on the diversity of forest ecosystems conducted by the Finnish Forest Research Institute has launched a study on the population structure and hybridisation ratios of oak and maple. A project for the conservation of forest genetic resources has gathered propagating material from several populations of hardwood species and clonal archives have been established for future research needs using them.

Solutions required for the conservation of forest genetic resources and the maintenance of sufficient genetic diversity of commercial forests are always long-term and they affect large areas. It is important to continue and strengthen research on forest genetic diversity in order to reinforce the knowledge base for taking genetic diversity appropriately into consideration also in forest management.

7. Associations and Other Organisations

Maatiainen r.y.

Founded in spring 1989, Maatiainen r.y. is a non-profit association with over 2,300 members. The association has its domicile in Helsinki, and covers the entire country.

The most important practical work by the association is related to the collection, conservation, and dissemination of plant genetic resources. Maatiainen also aims to promote the biological and genetic diversity of farmyards, gardens, and other traditional landscapes. The objective is to find and popularise hardy strains and varieties that have adapted to the variable climate conditions in Finland. Another aim is to prevent rare and increasingly rare plants from becoming threatened. Maatiainen supplies seed and plant material for home cultivation and to professional gardeners and nurseries. Small producers in particular have expressed their interest in the hardy plant material supplied by the association.

The association's seed catalogue has for several years contained the seed of over 500 plant species collected from Finland. Local strains and varieties included, the different types of seed supplied by the association comes to about two thousand. Most of these are ornamental plants, old perennials especially. Propagation material for edible plants (kitchen plants, herbs, berries and fruits) is just a few dozen species. Many seed collectors and members of the association have their own plant collections, the documentation of which would increase the knowledge of genetic resources maintained in private collections.

Maatiainen r.y. supplies its seed material primarily in small packets under the supervision of the Plant Production Inspection Centre. Information, specific of the farmer, of the seed material supplied is easily traceable. The association keeps a register of farmers and the plants cultivated by them.

The association publishes a quarterly journal called *Maatiainen*, and provides through its seed catalogue information, advice, and know-how in this field. The annually published catalogue contains practical instructions and key information on all plants supplied by the association. Furthermore, the association organises workshops, seminars, trips and excursions for the purpose of promoting the cause of landraces and plant genetic resources.

Cooperation partners of the association include agricultural educational institutions, universities, research institutions, museums, the Nordic Gene Bank, other domestic organisation in this field, as well as twin organisations abroad, plant nurseries, municipalities and various authorities. Cooperation with the partners leads from time to time to the creation of chains of action that supplement each other.

Hyötykasviyhdistys r.y.

Hyötykasviyhdistys r.y. was founded in 1978, and has currently over 5,500 members. The association's office and its horticultural shop, Alku & Juuri, are located in Helsinki. The association has branches in Turku, Pori, and Lahti.

Hyötykasviyhdistys is a non-profit organisation whose main mission is to organise public lectures, courses, and excursions, and to promote organic cultivation for home use in general. The association participates in fairs, produces publications, runs phone advisory services, and rents garden plots. One of the association's key tasks is the conservation of old plant species. Its members maintain in their own gardens old strains that have been long established in Finland. Moreover, the association favours in its seed selection old, historically interesting varieties. Its seed catalogue contains several dozen old cultivars from the 18th and 19th centuries. The mandate of the association also covers ornamental plants.

Hyötykasviyhdistys publishes a magazine for its members called *Pähkylä*. The magazine discusses widely the cultivation and use of culinary plants and herbs as well as the utilisation of wild plants. At the beginning of each year, the association publishes an extensive seed catalogue, which also serves as a cultivation guide.

Finnish 4-H Federation

4-H is a global youth organisation with operations in about a hundred countries. It started operations in Finland in 1928, when the Finnish 4-H Federation was founded and which was initially known as Maatalouskerholiitto (Union of Agricultural Clubs). The Federation has activities in the fields of horticulture and landscape management, care of livestock and pets, forests and nature, collection and processing of wild produce, collection and sale of seed of meadow plants, recycling of raw materials, handicrafts, and home economy.

Collection of Seed of Meadow Plants

The 4-H Federation has been collecting seed of meadow plants for close to ten years now. Initially, seed was produced only by gathering it from the wild, but currently many youths also have small cultivations as well. The seed produced by the Federation are almost always of local strains, and are marketed mostly locally. Seed collected by the 4-H'ers is also sold to the National Road Administration, landscape gardeners, and the green area divisions of municipalities and cities.

Members of the Finnish 4-H Federation collect annually some 30-40 kilos of seed. Most seed are of common local species. The lists of the Federation contain some 100 different species whose amounts vary somewhat annually. The most common species are: red campion, ox-eye daisy, sheep's sorrel, cornflower, yellow chamomile, globeflower, great plantain, spreading bellflower, autumn hawkbit, yellow bedstraw, smooth bedstraw, field scabious, meadow buttercup, yarrow, cumin, wood crane's-bill, Jacob's-ladder, harebell, great mullein, purple loosestrife, meadow campion, tufted vetch, yellow rattle, imperforate St. John's-wort, maiden pink, sticky catchfly, clustered bellflower, bladder campion, Nottingham catchfly, self-heal, silvery cinquefoil, Burnet-saxifrage, cowslip, Devil's-bit scabious and common bird's-foot trefoil. In addition to these, smaller amounts have been collected of about 50-60 species.

The collection of meadow plant seed will also continue as part of the Federation's activities in the future. Several of the Federation's member associations have an interest in, and also resources for collecting seed, provided there is a market for them. They are also prepared to arrange courses on species identification and collecting techniques.

8. Literature

The list contains the principal sources used in the background survey and the preparation of the programme.

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Appendix 1. Finnish seed lots in long-term storage at the NGB (1 December 2000)

	Varie- ties	Land- races	Breeding lines	Wild	Total
<i>Avena sativa</i>	25	9	5		39
<i>Hordeum vulgare</i> ssp.	27	37	38		102
<i>Secale cereale</i>	10	57			67
<i>Triticum aestivum</i> ssp.	22	4	6		32
Total	84	107	49		240
<i>Rubus arcticus</i> ssp. <i>arcticus</i>				1	1
Total				1	1
<i>Solanum tuberosum</i>	7	2 (4)*			9
Total	7	2			9
<i>Agrostis capillaris</i>	1		1	13	15
<i>Agrostis gigantea</i>			1		1
<i>Agrostis stolonifera</i>				1	1
<i>Alopecurus pratensis</i>			1	3	4
<i>Bromus inermis</i>	1				1
<i>Dactylis glomerata</i>	2	1	1		4
<i>Deschampsia flexuosa</i>				1	1
<i>Festuca ovina</i>				5	5
<i>Festuca pratensis</i>	5	1	1	1	8
<i>Festuca rubra</i>	3	1	2	32	38
<i>Lolium perenne</i>	1		2		3
<i>Medicago sativa</i>	1				1
<i>Phalaris arundinacea</i>		1	1	73	75
<i>Phleum alpinum</i>				1	1
<i>Phleum pratense</i> ssp.	6	28	1	22	57
<i>Poa alpigena</i>				6	6
<i>Poa pratensis</i>	1	1		5	7
<i>Trifolium hybridum</i>	1				1
<i>Trifolium pratense</i> ssp.	4	47		4	55
<i>Trifolium repens</i> var. <i>repens</i>	1			4	5
Total	27	82	11	99	219
<i>Brassica napus</i> ssp. <i>oleifera</i>	4		4		8
<i>Brassica rapa</i> ssp. <i>oleifera</i>	5		1		6
<i>Fagopyrum esculentum</i>		4			4
<i>Linum usitatissimum</i>	2				2
<i>Pisum sativum</i> var. <i>arvense</i>	6	3			9
<i>Vicia faba</i> var. <i>equina</i>		2			2
Total	17	9	5		31

<i>Brassica napus</i> var. <i>napobrassica</i>		4			4
<i>Brassica rapa</i> ssp. <i>rapa</i>		6			6
<i>Vicia faba</i>	2	22	2		25
Total	2	32	2		35
Grand total	137	230	67	172	606

*Landrace potato varieties cultivated in Finland

Appendix 2. Strains of plants and their origins included in the KESKAS material tested by MTT Agrifood Research Finland. The strains of *Lonicera*, *Viburnum*, *Rosa* and most of *Spiraea*, as well as the 'Waterton' varieties of *Philadelphus lewisii*, were included in the tests on all sites. Strains of *Forsythia* and *Hydrangea* were included in the tests elsewhere except Rovaniemi, other strains of *Philadelphus* in Piikkiö, Pälkäne, and Sotkamo. *Spiraea* strains 672, 133, 676, 748, 760, and 812 were planted for testing only in Piikkiö. The table gives the new names of renamed strains.

(Source: KESKAS clone selection trials made at MTT Agrifood Research Finland 1988-1999. Clone selection of woody ornamentals in Finland in 1988-1999. Sirkka Juhanoja, Marja Aaltonen, Abbas Aflatuni, Minna Heikkilä, Alpo Heinonen, Riitta Kempainen, Petra Paasikivi, Katja Sorvari, and Arja Virtanen)

Strain	Scientific name	Origin
468	<i>Forsythia ovata</i>	Turku
288	<i>F. ovata</i>	Mikkeli, Otava
258	<i>F. ovata</i>	Jyväskylä
463	<i>F. ovata</i>	Joensuu, Sihtala
403	<i>F. ovata</i> 'Robusta'	Turku, botanical gardens
520	<i>F.</i> 'Northern Gold'	Helsinki, Viikki
230	<i>Hydrangea heteromalla</i> 'Bretschneideri'	Helsinki
486	<i>H. heteromalla</i> 'Bretschneideri'	Helsinki, botanical gardens
485	<i>H. heteromalla</i>	Helsinki, botanical gardens
470	<i>H. heteromalla</i> 'Axel'	Elimäki, Arboretum Mustila
471	<i>H. heteromalla</i> 'Peter'	Elimäki, Arboretum Mustila
472	<i>H. heteromalla</i>	Elimäki, Arboretum Mustila
163	<i>H. paniculata</i> 'Grandiflora'	Renko
466	<i>H. paniculata</i> 'Grandiflora'	Hattula
467	<i>H. paniculata</i> 'Grandiflora'	Jyväskylä
701	<i>H. paniculata</i> 'Grandiflora'	Pälkäne, Häme research station
069	<i>H. paniculata</i> 'Mustila'	Elimäki, Arboretum Mustila
278	<i>H. paniculata</i> 'Praecox'	Helsinki
371	<i>H. paniculata</i> 'Praecox'	Valkeakoski
541	<i>Lonicera x bella</i> 'Mikael'	Helsinki, Meilahti
664	<i>L. x bella</i> 'Sakura'	Helsinki, Taka-Töölö
687	<i>L. x bella</i>	Tampere, Hatanpää Arboretum
715	<i>L. x bella</i>	Renko
571	<i>L. x bella</i> 'Dropmore'	Helsinki, Vallila
524	<i>L. x notha</i>	Helsinki, Katajanokka
193	<i>L. tatarica</i>	Helsinki, Kallio
481	<i>L. tatarica</i> 'Sanna'	Helsinki, Eira
509	<i>L. tatarica</i> 'Minna'	Helsinki, Eira
177	<i>L. tatarica</i> 'Poutapilvi'	Helsinki, Taka-Töölö
677	<i>L. tatarica</i> 'Aleksi'	Turku, Adventure Park
714	<i>L. tatarica</i> 'Rosea'	Renko
457	<i>L. sp.</i>	Helsinki, Taka-Töölö
580	<i>Philadelphus coronarius</i>	Elimäki, Moisio
001	<i>P. x lemoinei</i>	Helsinki, Eira
500	<i>P. x lemoinei</i>	Helsinki, Taka-Töölö
583	<i>P. lewisii</i> 'Waterton'	Haparanda, Sweden
645	<i>P. lewisii</i> 'Waterton'	Helsinki, Munkkiniemi
647	<i>P. lewisii</i> 'Waterton'	Boskoop, The Netherlands

462	<i>P. Lewisii</i> group 'Tähtisilmä'	Rantasalmi
469	<i>P. pubescens</i>	Helsinki, Kulosaari
559	<i>P. pubescens</i>	Helsinki, botanical gardens
646	<i>P. pubescens</i> 'Tuomas'	Tammisaari
644	<i>P. sp.</i> 'Härmälä'	Elimäki
579	<i>P. sp.</i> 'Moisio'	Elimäki, Moisio
018	<i>Viburnum opulus</i> 'Pohjan Neito'	Hankasalmi, Saksalansaari
158	<i>V. opulus</i> 'Pohjan Neito'	Kuopio, Presidentinkatu
464	<i>V. opulus</i> 'Pohjan Neito'	Karstula
465	<i>V. opulus</i> 'Pohjan Neito'	Kuhmo
649	<i>V. opulus</i> 'Pohjan Neito'	Tervola
696	<i>V. opulus</i> 'Roseum'	The Netherlands
178	<i>Rosa pimpinellifolia</i>	Kajaani, Urho Kekkonen National Park
686	<i>R. pimpinellifolia</i> 'Linnanmäen Kaunotar'	Helsinki, Alppila
726	<i>R. pimpinellifolia</i> 'Plena'	Jyväskylä, LAU
728	<i>R. pimpinellifolia</i> 'Plena'	Laukaa, Sikkola
238	<i>R. pimpinellifolia</i> 'Poppius'	Kuopio, Town Hall
271	<i>R. pimpinellifolia</i> 'Poppius'	Helsinki, Taka-Töölö
722	<i>R. pimpinellifolia</i> 'Poppius'	Rovaniemi, Katajaranta
729	<i>R. pimpinellifolia</i> 'Poppius'	Muurame, LAU
730	<i>R. pimpinellifolia</i> 'Poppius'	Jokkala, LAU
918	<i>R. pimpinellifolia</i> 'Poppius'	Helsinki, botanical gardens
725	<i>R. pimpinellifolia</i> 'Juhannusmorsian'	Elimäki, LAU
604	<i>R. pimpinellifolia</i> 'Staffa'	Hämeenlinna, Aulanko
919	<i>R. pimpinellifolia</i> 'Staffa'	Helsinki, botanical gardens
716	<i>R. pimpinellifolia</i> 'Red Nelly'	Piikkiö, Yltöinen
669	<i>Spiraea chamaedryfolia</i>	Nokia, Pitkäniemi hospital
741	<i>S. chamaedryfolia</i>	Piikkiö, Yltöinen
742	<i>S. chamaedryfolia</i>	Oulu, botanical gardens, Altai material
668	<i>S. chamaedryfolia</i> var. 'Flexuosa'	Helsinki, botanical gardens
606	<i>S. chamaedryfolia</i> var. <i>ulmifolia</i>	Heinola, Vainionkatu
670	<i>S. × cinerea</i>	Valkeakoski, Kanavapuisto park
375	<i>S. media</i>	Valkeakoski, Voipaala manor
745	<i>S. media</i>	Oulu, botanical gardens, Altai material
088	<i>S. × multiflora</i>	Tampere, Kaleva
656	<i>S. nipponica</i>	Helsinki, Kaivopuisto park
746	<i>S. nipponica</i> 'Halvard Silver'	Kauniainen, Olsson nursery
754	<i>S. nipponica</i> 'June Bride'	Tuulos, Terola nursery
747	<i>S. nipponica</i> 'Snowmound'	Pälkäne, Saarioinen nursery
133	<i>S. sericea</i>	Helsinki, botanical gardens, Amur
764	<i>S. Chamaedryfolia</i> -hybr.	Oulu, botanical gardens
373	<i>S. trichocarpa</i>	Valkeakoski, Kanavapuisto park
676	<i>S. ussuriensis</i>	Helsinki, botanical gardens, Amur
748	<i>S. × vanhouttei</i>	Kauniainen, Olsson nursery
743	<i>S.</i> 'Grefsheim'	Piikkiö, Yltöinen
412	<i>Spiraea beauverdiana</i>	Ylikiiminki, Huvila nursery

665	<i>S. betulifolia</i>	Lahti, Urheilutalo park
766	<i>S. betulifolia</i> 'Tor'	Denmark, via Terola
763	<i>S. decumbens</i>	Turku, botanical gardens, from north Germany
759	<i>S. densiflora</i>	Helsinki, botanical gardens, Terola
760	<i>S. fritschiana</i>	Helsinki, botanical gardens
362	<i>S. japonica</i>	Tampere, Ahlman agricultural college
616	<i>S. japonica</i> 'Albiflora'	Nokia, Pitkäniemi hospital
291	<i>S. japonica</i> 'Fortunei'	Lappeenranta, N. Karhu Arboretum
757	<i>S. japonica</i> 'Froebelii'	Hämeenlinna, via Terola
756	<i>S. japonica</i> 'Little Princess'	Barkholt, via Terola
758	<i>S. japonica</i> 'Odensala'	Nordplant, via Terola
812	<i>S. japonica</i> 'Schirobana'	Oulu, botanical gardens
761	<i>Spiraea alba</i>	Helsinki, botanical gardens, Terola
279	<i>S. alba</i> var. <i>latifolia</i>	Helsinki, Eira
370	<i>S. alba</i> var. <i>latifolia</i>	Valkeankoski, Apiankatu
596	<i>S. Billiardii</i> -hybr.	Riihimäki, E. Rautatienkatu
667	<i>S. Billiardii</i> -hybr.	Nokia, Pitkäniemi hospital
666	<i>S. billiardii</i> 'Triumphans'	Helsinki, botanical gardens
671	<i>S. douglasii</i>	Helsinki, botanical gardens
672	<i>S. humilis</i>	Helsinki, botanical gardens, Amur
187	<i>S.</i> × <i>rosalba</i>	Elimäki, Arboretum Mustila
119	<i>S. salicifolia</i>	Helsinki, botanical gardens
767	<i>S. tomentosa</i>	Oulu, Ylikiiminki
762	<i>S.</i> × <i>watsoniana</i>	Nordplant, via Terola
081	<i>Syringa</i> × <i>henryi</i>	Helsinki, Oulunkylä
719	<i>S.</i> × <i>josiflexa</i>	Rovaniemi municipality, Hirvas
211	<i>S. josikaea</i>	Helsinki, Kallio
819	<i>S. josikaea</i>	Helsinki, Laajasalo
016	<i>S. Preston</i> -hybr	Helsinki, Vallila park
268	<i>S. Preston</i> -hybr.	Helsinki, Etu-Töölö
771	<i>S. prestoniae</i> 'Macfarlane'	Närpiö, Wickman nursery
772	<i>S. prestoniae</i> 'Royalty'	Närpiö, Wickman nursery
773	<i>S. prestoniae</i> 'Måttsund'	Närpiö, Wickman nursery
021	<i>S. Reflexa</i> -hybr.	Helsinki, Käpylä
223	<i>S. Reflexa</i> -hybr.	Helsinki, Pohjois-Haaga
483	<i>S.</i> 'Holger'	Espoo
774	<i>S.</i> 'Julia'	Närpiö, Wickman nursery
770	<i>S.</i> 'Maria'	Närpiö, Wickman nursery
022	<i>S.</i> sp.	Jyväskylä, Cygnaus.
025	<i>S.</i> sp	Jyväskylä, Lohikoski school
045	<i>S.</i> sp	Jyväskylä, Rajakatu
335	<i>S.</i> sp	Turku, Jaanintie
461	<i>S.</i> sp	Jyväskylä, Dept. of Biology
724	<i>S.</i> sp	Tammela, Viksten nursery

Appendix 3. FinE Species, April 2001

Accepted on the basis of comparative strain trials:

Hydrangea paniculata 'Grandiflora' K-163
Hydrangea paniculata 'Praecox' K-278
Hydrangea paniculata 'Mustila' K-69
Lonicera tatarica 'Sanna' K-481
Lonicera x bella 'Dropmore' K-571
Lonicera x bella 'Sakura' K-664
Philadelphus pubescens 'Tuomas' K-646
Philadelphus Lewisii -hybr. 'Tähtisilmä' K-762
Viburnum opulus 'Pohjan Neito' K-464 and K-465
Rosa pimpinellifolia-hybr. 'Juhannusmorsian' K-725
Rosa pimpinellifolia 'Plena' K-728
Rosa pimpinellifolia-hybr. 'Poppius' K-729
Spiraea alba 'Allikko' K-761
Spiraea beauverdiana 'Lumikki' K-412
Spiraea x watsoniana 'Kruunu' K-762

Accepted on the basis of practical experience:

Fothergilla major 'Velho'
Rhododendron x fraseri K-609

Fruits and berries:

Malus domestica 'Pirja' /A2 or 'Antonovka'
Malus domestica 'Samo'
Malus domestica 'Sandra'
Malus domestica 'Konsta'
Prunus domestica subsp. *domestica* 'Kuokkala'
Prunus domestica subsp. *domestica* 'Sinikka'
Fragaria x ananassa 'Bounty'
Ribes nigrum 'Mortti'
Ribes nigrum 'Vertti'
Rubus idaeus 'Jatsi'
Rubus idaeus 'Maurin Makea'