European Cooperative Programme for Crop Genetic Resources Networks

ECP/GR

Report of a Working Group on *Malus/Pyrus*

IPGRI

Second Meeting 2–4 May 2002, Dresden-Pillnitz, Germany

L. Maggioni, M. Fischer, M. Lateur, E.-J. Lamont and E. Lipman, *compilers*

FUTURE HARVEST
<www.futureharvest.org>

IPGRI is
a Future Harvest Centre
supported by the
Consultative Group on
International Agricultural
Research (CGIAR)

ECP//GR

Report of a Working Group on *Malus/Pyrus*

Second Meeting 2–4 May 2002, Dresden-Pillnitz, Germany

L. Maggioni, M. Fischer, M. Lateur, E.-J. Lamont and E. Lipman, *compilers*

Citation:
Maggioni, L., M. Fischer, M. Lateur, E.-J. Lamont and E. Lipman, compilers. 2004. Report of a Working Group on *Malus/Pyrus*. Second Meeting, 2-4 May 2002, Dresden-Pillnitz, Germany. International Plant Genetic Resources Institute, Rome, Italy.

ISBN 92-9043-611-5

IPGRI
Via dei Tre Denari 472/a
00057 Maccarese
Rome, Italy

CONTENTS

PART I. DISCUSSION AND RECOMMENDATIONS

Introduction

Opening of the meeting

Manfred Fischer, Chair of the Working Group on *Malus/Pyrus*, opened the meeting with an introductory welcome. He was very pleased to host the Group, considering that this was the last possibility to meet under the direction of IPK-Gatersleben. In Germany, two different ministries currently maintain the responsibility for the management of genetic resources: *ex situ* collections fall under the direction of the Federal Ministry of Science, while *in situ* and on-farm conservation is under the direction of the Federal Ministry of Agriculture. As part of the unification of the *ex situ* collections of the former West and East Germany into one German Genebank in Gatersleben, the Fruit Genebank Dresden-Pillnitz was classified, for administrative reasons, as an on-farm genebank and was transferred to the administrative direction of the Federal Ministry of Agriculture. It will therefore become part of the Institute of Fruit Breeding Dresden-Pillnitz on 1 January 2003. The new curator will be Dr Monika Höfer from the same Institute. Since no specialist from the IPK-Fruit Genebank will be transferred to the new Institute, it is feared that this transfer might be accompanied by the loss of relevant know-how.

During the reorganization of the fruit research in Pillnitz in 1991, the Fruit Genebank was established as an external branch of IPK-Gatersleben. It developed from a part of the Department of Breeding of the former Institut für Obstforschung Dresden-Pillnitz. Today it ensures the scientific management of the extensive collections of fruit cultivars and wild species and makes them available to different users.

The Fruit Genebank conserves and evaluates the genetic resources of pome, stone, small and wild fruit and supports projects for breeding, fruit growing, landscaping, pomology, taxonomy and phytopathology. Beside their use for landscape development and conservation of old German cultivars and indigenous wild fruit species, the collections serve as stock and source of basis material for fruit breeding. At present, the identification and preservation of resistance donors is of particular importance.

The entire stock of the Fruit Genebank of Dresden-Pillnitz presently amounts to 3250 accessions (species, cultivars, varieties, clones) plus 127 populations of *Malus sieversii* and other wild species (2180 plants), including 1100 apple, 230 sweet cherry, 100 sour cherry, 150 pear, 25 sea buckthorn cultivars and 375 *Malus* (largest European collection), 55 *Pyrus*, 80 *Prunus* and 170 *Fragaria* (largest European collection) wild species and hybrids. These constitute the documented fruit gene stock in Germany, together with the accessions included in the National Fruit Varieties Inventory of all German Fruit Institutes, universities and some NGOs, which amount to 17 200 accessions belonging to 5779 cultivars from 45 fruit species.

The passport data of the cultivars that are part of established collections are maintained at the Fruit Genebank. Furthermore, in the case of numerous cultivars and entire collections, data exist about pollen fertility, apomixis, mildew and scab resistance, resistance to woolly aphids and viruses, stability of yield, fruit quality, phenology, morphology, frost resistance of shoots and flowers and resistance to fire blight, resistance to sharka virus in plums and to *Valsa* and *Pseudomonas* in cherries. The completion of the evaluation with supplementary data is the main task of the genebank, since several years are necessary for a reliable assessment of these characters in woody plants.

The direct use of the evaluation results of the Fruit Genebank led to the release of numerous new cultivars by the breeding institutions (see also pages 27-31).

In cooperation with state institutions and projects for the natural preservation of cultivar collections at the regional level, non-orchard fruit growing and *in situ* conservation are professionally assisted. Registration of *Malus sylvestris* populations in Saxonia was initiated and some accessions were incorporated into the Pillnitz collections. It was then possible, in cooperation with forest institutes, to establish a seed plantation of *Malus sylvestris*, as a source for the re-introduction of indigenous wild fruit species into new forest plantations. In northern and eastern Germany a project is ongoing for the registration of single, very old, remarkable cherry and apple trees deserving protection, thereby supporting special activities in nature and landscape preservation.

The evaluation of the strawberry cultivar collection is carried out with the aim of establishing a core collection and of eliminating unimportant accessions. The *Fragaria* species collection was completed and contains nearly all known species. The collection will be revised as regards its taxonomy attributions and will be evaluated, especially for use in strawberry resistance breeding.

Some of the evaluation data were integrated into national and international database projects and are available on the Internet (European *Prunus* Database, German EVA database). The evaluation data for pears are planned to be included in the European *Pyrus* Database.

Briefing on IPGRI and recent international developments

Coosje Hoogendoorn, IPGRI Deputy Director General, Programmes, explained that IPGRI was founded in 1974 and is the largest international institute solely dedicated to the conservation and use of genetic resources. It is one of the 16 research centres supported by the CGIAR. IPGRI's headquarters are in Rome, but its 200 staff members are located around the world in the IPGRI offices in more than 15 countries. IPGRI works through partnerships, such as networks and research collaborations. The European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) is a clear example of such a network. Within the framework of its European activities, IPGRI provides the Secretariat to the ECP/GR and its Working Group on *Malus/Pyrus*. Of further interest for the Working Group are, among others, the IPGRI-supported research activities in Central Asia to conserve and use wild relatives of *Pyrus*. Other fruit crops, such as melon, pomegranate and pistachio are also the subject of studies and collaborative work in Central Asia. IPGRI's activities are not only of a technical nature, but also look at the socioeconomic and institutional development in the Central Asian region which influence decisions about conservation and use of plant genetic resources (PGR).

Late in 2001 the FAO Conference adopted the International Treaty on Plant Genetic Resources for Food and Agriculture. When ratified, this Treaty will be very important for PGR conservation activities. *Malus* sp. is on the Treaty's list of crops approved for a Multilateral System ensuring facilitated access to plant genetic resources for food and agriculture.[1] It is hoped that for non-listed crops such as pear, a Multilateral System approach will also be voluntarily developed by parties concerned with the conservation of the crop. Operating in the context of the International Treaty, the CGIAR and FAO are starting a campaign for the Global Crop Diversity Trust. The Trust will be an endowment fund that will support the development of an equitable global system of genetic resources exchange, as called for by the Global Plan of Action (GPA), through providing long-term support for *ex situ* collections that meet internationally agreed criteria and standards or initiatives that will lead to (networks of) such *ex situ* collections.

[1] The text of the International Treaty on Plant Genetic Resources for Food and Agriculture is available on the Internet (ftp://ext-ftp.fao.org/waicent/pub/cgrfa8/iu/ITPGRe.pdf).

Briefing on ECP/GR

Lorenzo Maggioni, ECP/GR Coordinator, welcomed the participants to the second meeting of the Working Group on *Malus/Pyrus*. He mentioned that apologies were received from the member for Israel for being unable to attend and he reminded the Group about the role of corresponding members, who belong to the Group, although they do not take part in the meetings.

The Coordinator briefly explained the history, objectives and mode of operation of ECP/GR and mentioned the Fruit Network's activities carried out and planned within Phase VI of ECP/GR (1999-2003). In particular, he summarized the recommendations made by the Fruit Network Coordinating Group during its meeting in Gembloux, Belgium, in November 1999.[2] These included, *inter alia*, the provision of data to the ECP/GR *Malus* and *Pyrus* databases and the development of Internet access; the definition of standard protocols for evaluation; the analysis of legal and phytosanitary constraints currently limiting the free and safe movement of germplasm; the adoption of a concept for a *Malus* and *Pyrus* decentralized European collection; the establishment of uniform standards for conservation; the establishment of the most appropriate methods for fruit tree conservation; the analysis of databases with genetic diversity indices and the identification of duplicate accessions; and the elaboration of a strategy to include in the databases the available information on molecular markers.

He then gave a brief account of the outcomes of the mid-term meeting of the ECP/GR Steering Committee, held 14-17 October 2001 in St. Petersburg, Russian Federation. Regarding the Fruit Network, the Committee endorsed the establishment of a new Working Group on *Vitis*. It was also decided to organize two separate meetings of the *Malus/Pyrus* and *Prunus* Working Groups in 2002 and 2003, replacing the previously planned Fruit Network meeting.

The future mode of operation of ECP/GR will be defined during the Steering Committee meeting planned for October 2003. In order to develop a strategy for the next Phase VII, two task forces composed of a few Steering Committee members were established to discuss (1) the impact on PGR of recent developments in science, technology and international policy; and (2) how genebanks should implement relevant international agreements and their impact on genebanks' operation.

Report of the Working Group Chair

(by Manfred Fischer)

After the 1999 meeting in Gembloux the activities of the members were more focused on individual work on the national databases and bilateral contacts. This is exactly why this meeting in Dresden is very important to clarify the progress made in the European databases that are under development. Belgium has been working on a *Pyrus* database and the UK has made some improvements to the *Malus* database, and thanks are extended respectively to Marc Lateur and Emma-Jane Lamont for these activities.

In Germany a group of scientists of IPK-Gatersleben is working on two national projects: (i) EVA project (evaluation of cereals, potatoes and fruit, and establishment of national databases for these crops); and (ii) establishment of a German *Pyrus* database (work carried out in Pillnitz). Both projects are ready to provide data to the European databases. All relevant *Pyrus* data have already been sent to Marc Lateur in Belgium, who also received data from all interested countries.

During the 1999 EUCARPIA conference on fruit breeding and genetics in Dresden, some members of the *Malus/Pyrus* Group held a short meeting and during the Gembloux meeting it was agreed that sustainable use of genetic resources is the best way to secure their

---

[2] Report of a meeting of the Fruit Network Coordinating Group (NCG), Gembloux, Belgium, 7 November 1999 (http://www.ecpgr.cgiar.org/publications/fruitncg5.htm).

conservation. Evaluation data must be published and discussion with potential users of the data is very important for the acceptance and promotion of genetic resources work. For breeding work wild species with specific resistances will be used more and more. On the other hand, old cultivars are being evaluated to find new sources of polygenic resistance to scab, mildew and fire blight for breeding of new resistant cultivars with stable and durable field resistance. Several members of the *Malus/Pyrus* Working Group are partners in the European project D.A.R.E. (Durable Apple Resistance for Europe). This project includes the following elements: search for such polygenic resistances in old cultivars and search for new markers for polygenic resistance for crossing programmes, so that monogenic and polygenic resistance is combined with excellent fruit quality in apples.

In the Pillnitz Apple Gene Bank it was found that in the absence of fungicide treatment, 2% of the 900 evaluated old and new apple cultivars did not show infection by scab or mildew. In the Gembloux Apple Gene Bank old cultivars resistant to *Nectria galligena* were found and these may be used as a base for breeding and cultivation. These important results for breeding and agriculture show the value of evaluating the material conserved in the genebanks.

The cultivation of resistant apple cultivars is increasing worldwide. The most important challenge for the near future is the combination of different resistances in one genotype. Research programmes will require close attention to the hosts (cultivars) and the pathogens (scab, fire blight, mildew, canker), in order to monitor and control new pathogen races, the complex reactions between hosts and pathogens and the changes in the host-pathogen interaction. All genebank activities are directed to support these national breeding activities in France, Germany, United Kingdom, Switzerland and other countries.

The safety of the large and important genetic resources collections of wild and cultivated fruit crops of the former Soviet Union is in danger, especially in the Russian Federation, and needs international support that it has not yet been possible to ensure. The German Fruit Genebank was able to safeguard a few *Malus* accessions taken from the Maikop experimental station of the N.I. Vavilov Research Institute of Plant Industry (VIR). These accessions will be returned to VIR when the local situation has improved.

The *EUCARPIA Newsletter No. 5 (*= Prunus *Newsletter)* was printed in July 2001. This issue contains interesting new papers and summaries of papers that were not presented at the EUCARPIA conference, mostly from East European scientists who were unable to participate. Unfortunately, due to a typographical error, the EUCARPIA Newsletter was not indicated as a joint Prunus *Newsletter* issue, as agreed in Gembloux in 1999.

Regarding the exchange of material, restrictions on exchange of new cultivars are becoming increasingly strict. In particular, the new trend for "club cultivars"[3] is not helpful for the grower because it is nearly impossible to test such cultivars before commercial propagation has begun. It is also very difficult for genebanks to obtain such cultivars as accessions for comparison and testing. My opinion is that this practice is a short-term marketing concept but it is not helpful for progress in fruit cultivation generally.

In order to further progress in the database development, the Chairperson planned a meeting of a small group of database and *Pyrus* specialists in Holovousy, Czech Republic. The organization of this meeting was approved by the ECP/GR Steering Committee and funds were available. However it was eventually decided to replace it in this case with intensified email correspondence between the members, until more progress with the *Pyrus* database was apparent. Personal contacts and exchange of experience were still considered essential at a later stage.

---

[3] A "club cultivar" is a cultivar which is not put freely on the market, all partners (breeder, nursery, grower and seller) have to belong to the "club" which takes all decisions (marketing, production level, etc.); the cultivar is protected by a Trade Mark and a fee is charged on each kg of fruit sold.

I am very pleased to meet with you all today in Dresden-Pillnitz to summarize all national activities in recent years. No funds are available for additional projects, so we have perhaps achieved less than was the case for the European *Prunus* Database, which could be successfully developed thanks to EU project funds. As a consequence, we need more time and more patience to make progress with our important workplan – and we need more efforts to succeed. I hope that we can use this meeting to make a big step in the direction of improving the useful European *Pyrus* and *Malus* databases for the benefit of all genebank workers, fruit breeders and fruit growers.

All the new members are very welcome. We are ready to integrate all your opinions and proposals in order to work effectively and successfully.

I wish this meeting success and good results.

Documentation

The European Malus *Database*

Emma-Jane Lamont presented a summary of the status of the European *Malus* Database.

Current status

At the first meeting of the ECP/GR Working Group on *Malus/Pyrus* in 1997 it was agreed that a database should be created of *Malus* accessions maintained at genebanks of the member countries. Imperial College at Wye (UK) offered to create and manage such a database. Subsequently, data were provided by 15 countries and those that were received in electronic format were combined in a Microsoft Access 97 database. The database lists 24 827 accessions from 28 institutes in 12 countries and may be downloaded from the Internet (www.nfc.ic.ac.uk) or via the ECP/GR Web site, or by contacting Emma-Jane Lamont directly.

The Web site also includes details of minimum passport descriptors for *Malus* and minimum descriptors specific to *Malus* as given in the report of the first meeting of the Working Group on *Malus/Pyrus*.[4] However, the database contains only variety names and the institutes in which they are conserved; no further passport data or characterization data are included in the database.

Table 1 lists the countries which have provided data as of May 2002.

Table 1. Countries having provided data for the *Malus* database

Data included in the database			**Data not included in the database (provided on paper)**
Austria	Germany	Romania	Bulgaria
Belgium	Hungary	Switzerland	Ireland
Czech Republic	Italy (17 institutes)	United Kingdom	The Netherlands
France	Poland	Yugoslavia, F. R.[5]	

Issues

The main difficulty with the database is that diacritical marks (accents) were not recognized in the initial version of the database and letters with accents were changed into unrecognizable symbols. The software now being used for the database is more sophisticated and should recognize diacritical marks.

---

[4] Maggioni, L., R. Janes, A. Hayes, T. Swinburne and E. Lipman, compilers. 1998. Report of a Working Group on *Malus/Pyrus*. First meeting, 15-17 May 1997, Dublin, Ireland. International Plant Genetic Resources Institute, Rome.

[5] Country name changed to Serbia and Montenegro since February 2003.

It is clear that as with pears, many varieties are held under different names in different genebanks. In order to start to recognize duplication between genebanks it is proposed that a new field be added to the database in which countries may insert a name from a list of suggested common names provided by the *Malus/Pyrus* database manager.

Workplan

The Group agreed to continue and improve the database; several actions were proposed.

- *The database manager will update the database structure in line with the new FAO/IPGRI Multi-crop passport descriptors (MCPDs)*[6] ***(by end of June 2002)***.
- *Since the first* Malus/Pyrus *meeting several more countries have joined the Working Group and new members agreed to provide digitized lists of* Malus *accessions (**by end of 2002**).*
- *Those countries that previously provided hard copy lists of accessions are requested to donate digitized lists. The information may be in any of the following file types: text file, word processed file, spreadsheet or Microsoft Access (**by end of 2002**).*
- *The database manager will add any newly received information to the database (within 2 weeks of receiving data).*
- *Data previously provided by the member countries in electronic format will be sent to the country representatives for checking and updating (**by end of June 2002**).*
- *Member countries will check records and it is requested that any available passport data be added and the files returned to the database manager (**by end of 2002**).*
- *The database manager will update the database by replacing old records with updated information (within 2 weeks of receiving data).*

N.B. As discussed below (pages 9-10 – Definition of a system for international responsibility), member countries will indicate in files sent to the database manager which accessions are offered as European* Malus *accessions.

Protocols for evaluation data

Marc Lateur and Jan Blazek presented guidelines and detailed standards for the use of the evaluation descriptors agreed upon by the Working Group during its first meeting in Dublin (1997) as priority for inclusion in the European *Malus* database. These descriptors are given as Appendix I and the Group agreed to test them and to review them at the next Working Group meeting.

M. Lateur proposed that the Group could benefit from adopting standardized protocols for the photographic documentation of the accessions, to be included in the central databases. M. Goerre pointed out that the Swiss NGO Fructus had developed such standards.

C. Hoogendoorn also informed the Group that Plant Research International (PRI), Wageningen, the Netherlands was very advanced with image analysis and recommended using a methodology that would allow further analysis of the accessions, based on the illustrations. An IPGRI publication on the use of multimedia databases has been published and could be used as a reference.[7]

---

[6] http://www.ipgri.cgiar.org/publications/pubfile.asp?ID_PUB=124

[7] Puzone, L. and Th. Hazekamp, compilers. 1998. Characterization and documentation of genetic resources utilizing multimedia databases. Proceedings of a Workshop, 19-20 December 1996, University of Naples Federico II, Naples, Italy. International Plant Genetic Resources Institute, Rome, Italy.

The European Pyrus *Database*

Marc Lateur presented the status of the European ECP/GR *Pyrus* Database and the planning for the future.

The database contains more than 7900 accession names coming from 25 curators from 15 countries. A plant finder module has been developed which is available on-line in order to help users finding where specific cultivars are conserved and possibly available. The problem of synonyms was illustrated by the old cultivar 'Beurré d'Hardenpont', for which more than 30 synonyms were found! A specific software has been developed to manage this problem in order to group the cultivars into different families, with the help of algorithms and based on data from the literature. For the moment, five literature sources have been encoded with 800 synonyms.

The following workplan was defined: (i) to contact, through the WG members, the curators who have not yet replied and ask them to send their lists; (ii) to send back to the WG members the lists already encoded from their country and ask them to verify the lists and possibly improve them; (iii) to ask for some reference literature sources to complete the work done on the synonyms and (iv) to start common work on collecting passport data, characterization data and evaluation data for a subset of European cultivars.

The Working Group agreed to start collecting passport data as well as characterization and evaluation data on a proposed subset of the most common European cultivars. These were selected taking into account their presence at many sites in Europe. Two objectives are pursued: (i) to test and possibly improve the minimum descriptor lists proposed to the Group and (ii) to make an analysis to test the descriptors' discrimination capacity in order to decide which would be worth adding to the list.

The agreed minimum descriptor list for *Pyrus* can be found on the European *Pyrus* Database Web site (http:www.cragx.fgov.be/*Pyrus*/index.html).

The proposed list of cultivars, which can be amended, is the following:

1. Alexander Lucas Butterbirne
2. Comtesse de Paris (Gräfin von Paris)
3. Beurré Hardy (Gellerts)
4. Doyenné du Comice
5. Joséphine de Malines
6. Précoce de Trévoux
7. Seigneur Esperen (Esperen Herrenbirne)
8. Williams' Bon Chrétien
9. Conférence
10. Beurré d'Hardenpont
11. Curé (Pastorenbirne)
12. Triomphe de Vienne

The Group encouraged each WG member to add to this list at least **three original** cultivars from her/his country in order to test the descriptors.

Workplan

- *The database manager will update the database structure in line with the new FAO/IPGRI Multi-crop passport descriptors*[8] *(**by end of June 2002**).*
- *M. Lateur to send to each WG member the protocols and standards electronic files **by the end of May 2002**, to be filled in by the curators. He will also ask on which specific cultivars list each of them will be working.*
- *WG members to send passport and agreed characterization and evaluation data to the DB manager **by the end of 2002**.*

N.B. As discussed below (pages 9-10 – Definition of a system for international responsibility), member countries will indicate in files sent to the database manager which accessions are offered as European* Pyrus *accessions.

[8] http://www.ipgri.cgiar.org/publications/pubfile.asp?ID_PUB=124

The EPGRIS project and the new FAO/IPGRI Multi-crop passport descriptors

L. Maggioni explained that this 3-year project (2000-2003) for the establishment of a European Plant Genetic Resources Infra-Structure (EPGRIS) was developed within the ECP/GR Documentation and Information Network and was approved for funding within the Fifth Framework Programme of the European Union. The objective is to establish a European Internet Search Catalogue (EURISCO) with passport information of plant genetic resources maintained *ex situ* in Europe.[9] The catalogue will be frequently updated and publicly accessible via the Internet. Initial data sets will be derived from the European Central Crop Databases (ECCDBs); however the project will promote the creation of national inventories, which are planned to become the main source of data. PGR National Coordinators of the large majority of European countries have nominated national inventory focal persons. These people will be invited to attend two sub-regional meetings to discuss coordination and standardization of the data flow from the national inventories to the central catalogue. The project partners will also provide technical support to the focal persons and a limited number of training visits to the main European documentation support centres will be arranged. EURISCO is seen as an important European contribution to the Clearing House Mechanism (CHM) of the Convention on Biological Diversity (CBD) and the implementation of the Global Plan of Action (GPA). A Web-based interface will allow easy searching of the European national inventories, in the same way as it is possible today to use SINGER (System-wide Information Network for Genetic Resources) to search the CGIAR collections and GRIN to search the USDA collections. The catalogue will carry an important minimum set of passport data, frequently and automatically updated from the national inventories. These data will be based on the revised version of the FAO/IPGRI *Multi-crop Passport Descriptor List* (MCPDL), finalized in December 2001. Changes in the new list, compared to the previous version, were highlighted, such as the new descriptors for "Collecting Institute code", "Species authority", "Subtaxa authority", "Common crop name", "Acquisition date", "Breeding institute code", and "Ancestral data". Some changes in "Biological status of the sample" (former "Sample status") and in "Collecting/acquisition source" were also mentioned. As indicated above, the full list is available on-line (http://www.ipgri.cgiar.org/publications/pubfile.asp?ID_PUB=124).

L. Maggioni also explained the implications for the central databases. The idea will be to take the workload of collecting the passport data away from the central crop database managers, since these data will become directly accessible from the EURISCO catalogue. On the other hand, ECCDB managers will be expected to dedicate more time to compile and analyze characterization and evaluation data.

Recommendation

The Group agreed to adopt the revised FAO/IPGRI Multi-crop Passport Descriptors (MCPDs) for data exchange. The European Malus *and* Pyrus *Database managers agreed to harmonize the structure of the databases to the revised list. Two specific additional* Malus *and* Pyrus *passport descriptors ("Plant use" and "Parentage") were agreed at the first meeting in Dublin (1997). It was noted that descriptor "Parentage" would be replaced by descriptor 21 ("Ancestral data") of the revised MCPDL, while descriptor "Plant use" would be maintained unaltered and used for* Malus *and* Pyrus *data exchange.*

Additionally, it was agreed to add

- *the following passport descriptors:*
  - *Collector's accession name*
  - *Ploidy level*
- *the following state within descriptor 20. Biological status of accession: 416) Amateur breeder's cultivar.*

[9] now available at http://eurisco.ecpgr.org/

Status of national collections

Working Group members presented the status of their national collections. The available information is published in Part II – Communications and Papers (pages 16-66).

Exchange of apple and pear germplasm in Europe – phytosanitary and legal aspects

Manfred Fischer introduced the discussion by saying that genebanks encounter three main problems during exchange of accessions:

- State regulations and demands for the phytosanitary status of the material
- Acceptance of Plant Breeders' Rights
- Financial problems for shipping the material.

He then drew the following conclusions:

1. All genebanks and other users of genetic resources have to accept the state regulations. In order to be able to receive incompletely healthy material, it is proposed that the recipient send a declaration, whenever material is requested for exchange, that the actual phytosanitary status of the material is acceptable. Usually this procedure will be officially accepted. The possibility of using this procedure is mainly relevant for shipments of material entering or leaving the European Union.
2. All genebanks have to accept Plant Breeders' Rights or other legal protection of cultivars (e.g. "club" cultivars). It may be possible for genebanks to receive material from the owner of such cultivars through specific bilateral contracts inhibiting further multiplication. A model Material Transfer Agreement (MTA) is under discussion by the ECP/GR Steering Committee and it will be widely distributed after its approval has been finalized.[10]
3. An appeal is made to members of the Working Group to help genebanks in developing countries and countries in transition by supporting the shipping costs of material exchanged. Curators are expected to deliver material in response to reasonable requests and according to the donor genebank's resources.

Definition of a system for international responsibility for the conservation of apple and pear germplasm in Europe

Martin Geibel introduced the discussion, reporting the example adopted by the subgroup on genetic resources of strawberries in Europe in the framework of the Working Group 1 of COST Action 836. This subgroup has decided to preserve the most important strawberry cultivars in Europe and to assign the responsibility for each cultivar to two institutes. He explained that a "memorandum of responsibility" is signed by the partners in this initiative in order to ensure a formal commitment to conservation. This document was used as a basis to draft a similar memorandum for *Malus* and *Pyrus* (see Appendix II).

The Group agreed on the need to formalize the establishment of a decentralized collection of *Malus* and *Pyrus* accessions to ensure long-term conservation and easy access to the important germplasm for European horticulture, silviculture, cultural heritage or science.

[10] Suggested elements for an interim model MTA of ECP/GR are available from http://www.ecpgr.cgiar.org/SteeringCommittee/outcomes_SC9.htm

In the following discussion the Group examined the document prepared by the Working Group on *Prunus* "Towards the implementation of a European *Prunus* collection". A number of amendments and adaptations were made and a final document for the "Establishment of a European *Malus/Pyrus* Collection" (see Appendix III) was approved.[11]

Workplan

1. *In agreement with the principles defined in Appendix III (Establishment of a European* Malus/Pyrus *Collection), Working Group members will make sure that,* ***by December 2002****, apple and pear curators compile a list of accessions for which their institute offers to take responsibility and provide this list to the database managers.*
2. *Central Database managers coordinate the analysis of the offers and convene a meeting (****early/mid-2003****) of a small subgroup of three to five Working Group members, with the aim of finalizing a proposal that defines a preliminary list of accessions to be regarded as part of the European Collection. An application to support this meeting with available ECP/GR funds should be sent to the ECP/GR Coordinator six months in advance of the meeting and will be subject to the approval of the Steering Committee.*
3. *The agreed preliminary list of accessions to be regarded as part of the European Collection is notified to the interested genebanks, that are expected to sign Memoranda of responsibility (Appendix II) and send the original to the ECP/GR Secretariat and a copy to the database manager (****by end of 2003****).*

Collection, evaluation and use of wild species of *Malus* and *Pyrus*

François Laurens asked all Working Group members to mention the ongoing activities on wild species of apple and pear. The information provided is compiled in Table 1 below.

Recommendations

- *The Group agreed on the importance of including in the central database information on the wild species collections and encouraged all European collection holders of wild* Malus *and* Pyrus *species to send passport data to the respective database managers.*
- *The Group acknowledged the advantage of sharing information on methodologies used in research on wild species and recommended exploring opportunities to promote a multilateral project to study the genetic diversity of the wild* Malus *and* Pyrus *species.*
- *The Group recognized the need to learn more about diversity and distribution of wild* Malus *and* Pyrus *species in their centres of origin and differentiation and recommended exploring possibilities for joint collecting missions to Central and East Asia, also seeking collaboration and advice from IPGRI regional offices.*
- *The importance of establishing links with the Noble Hardwoods Network of EUFORGEN was acknowledged, considering that the conservation of the genetic resources of* Malus *and* Pyrus *should be a matter of common concern, independently from the specific objectives and uses of these resources. M. Lateur, F. Laurens and E.-J. Lamont expressed interest in attending the next Noble Hardwoods EUFORGEN meeting, planned in the UK in March 2003.[12] Their travel would be funded by ECP/GR and their objective would be to exchange ideas and information.*

[11] Appendix III includes the latest version of the document, which was agreed with few modifications at the extraordinary meeting in Angers, France, 2 September 2003 (see Appendix IV).

[12] During its meeting in June 2002, the Noble Hardwoods Network expressed the intention to hold its following meeting in Arezzo, Italy (22-24 April 2004). The Network expressed strong interest in welcoming in this occasion a subgroup of the ECP/GR Working Group on *Malus/Pyrus.*

Table 1. Status of wild species of apple and pear in Europe

Country	Status
Austria	Existence of *Pyrus pyraster* and *Malus sylvestris* of Austrian origin.
Belgium (*)	New Federal scientific project entitled "Studying apple biodiversity: opportunities for conservation and sustainable use of genetic resources" aimed to develop "ready-for-use" conservation strategies for wild apple biodiversity in Belgium, based on a thorough evaluation of the present diversity within the *Malus* genepool.
Czech Republic	Limited use of wild species. One accession of *Pyrus ussuriensis* was found to be resistant to fire blight. The majority of the wild species is used for ornamental purposes.
Estonia	Collection existed in the botanical garden, in the 1950s. Now there are hybrids and species, but their taxonomy remains uncertain.
France	Collection of wild species exists in Angers, with 150 accessions, but their taxonomic identity is uncertain. An ongoing project focuses on *Malus sylvestris*. The intention is to get more involved in research work and to obtain a better idea of the general diversity in *Malus*, especially to use disease resistance.
Germany (**)	One of the most important collections of the world with 367 accessions of 32 *Malus* species. Evaluation is focused on seedling populations which germinated from seeds collected from natural habitats. The largest project is the evaluation of 35 *Malus sieversii* offsprings (1050 seedlings) collected in Kazakhstan. Other activities on wild species include: collecting (*M. kansuensis, M. toringoides, M. transitoria, M. sieboldii, M. prattii and M. hupehensis,* 2001, P.R. China); evaluation of populations with potential ornamental value; preservation of the indigenous *Malus* and *Pyrus* genepool.
Hungary	Very limited use of wild species.
Ireland	No collections.
Italy	Several institutions hold and use in breeding programmes wild *Malus* and *Pyrus* species (Istituto Sperimentale per la Frutticoltura-Roma, Dipartimento Colture Arboree-Bologna, Dipartimento Produzioni Vegetali e Tecnologie Agrarie-Udine, Azienda Sperimentale Agraria Laimburg-Bolzano, Dipartimento Coltivazione e Difesa delle Specie Legnose-Pisa, Istituto sulla Propagazione delle Specie Legnose-Firenze).
Lithuania	Existence of *M. sylvestris.*
Macedonia F.Y.R.	Re-collection of wild species is planned.
Nordic countries	No collections of wild species, apart from the botanical gardens.
Poland	The Research Institute of Pomology and Floriculture in Skierniewice is maintaining a collection of wild species of *Malus* and *Pyrus* genera. Other wild species of *Malus* and *Pyrus* are also conserved in botanical gardens and dendrology centres in different parts of Poland.
Portugal	In the 1990s a screening programme was set up for resistance/tolerance to the root rot fungus (*Roselinia necatrix* Prill.), using wild material of *Malus*, *Pyrus* and *Prunus*. However, since no positive results were obtained the study was discontinued. As a result, the plant material is no longer kept. In order to ascertain the phylogeny and the taxonomy of the wild *Pyrus* species occurring in Portugal, based on a careful survey of material kept in herbariums and field observations, Amaral Franco and Afonso, in 1965, made a detailed botanical description and mapped the distribution of the species. The species studied were: *Pyrus cordata* Desv., *P. pyraster* Burgsd. and *P. bourgaeana* Dcne. In spite of the careful localization of the species' occurrence, germplasm of the native material was not collected and it is not represented in germplasm collections.
Russian Federation	26 wild *Pyrus* species are kept in Maikop and are used for crossings. Hybrids between wild species and existing cultivars were introduced, not only for fruit production, but also as genetic material for further breeding, such as for scab resistance and other diseases. Natural interspecific hybrids exist in the Caucasus, such as *P. caucasica* x *P. salicifolia* and others. All these were collected and are maintained in Maikop.
Slovenia	No collections.
Spain	Collection of *M. sylvestris* is planned.
Switzerland	Only a few wild species in collections. Private nurseries sell wild species.
United Kingdom	Several collections at the botanical gardens, including at Edinburgh, where living material of wild *Malus* was imported from China.
Yugoslavia F.R.	Wild species used for ornamental purposes and as pollinators.

(*) more details available in Part II, page 67

(**) more details available in Part II, pages 68-71

Research activities

A project proposal on molecular identification of fruit genetic resources

Monica Goerre informed the Group of a project proposal for a COST Action on molecular identification of fruit genetic resources which was unsuccessfully submitted to the EU (see details in Part II, pages 72-73).

In the following short discussion, several Working Group members expressed their interest and made suggestions for a second submission of the proposal, either as a COST Action or possibly as a research proposal to be fully funded within the Sixth Framework Programme.

The D.A.R.E. project for durable apple resistance evaluation

François Laurens outlined the results of an EU-funded project (1998-2002) to achieve durable resistance against two pathogens (see also http://www.inra.fr/Internet/Projets/DARE/). The project included 8 partners, coordinated by INRA-Angers, France. The five main tasks consisted of: (i) characterization of the resistance status of a wide range of apple cultivars; (ii) assessment of risk of resistance breakdown related to the appearance of new virulence; (iii) genetic dissection of resistance; (iv) development of marker-assisted selection; and (v) market and consumer studies. Scab and mildew tests were performed on cultivars carrying partial resistance. Twenty-two cultivars were tested, of which three were resistant to all inocula and eight were resistant to a large range of inocula. A European core collection of *Venturia inaequalis* strain was established. The *Vg* gene was localized. A new project on fruit quality (texture, sugars) is planned to start in 2002 (under Framework Project 5) and will be called HiDRAS (High-quality Disease Resistant Apples for a Sustainable Agriculture).[13]

Methodological aspects of the evaluation of Malus *and* Pyrus *genetic resources collections for disease resistance*

Marc Lateur presented some basic rules for a better methodology of the multiannual evaluation of the collections for disease resistance based on a PhD study devoted to *Nectria galligena*. Very little work has been done to evaluate resistance to *Nectria* canker in the European collections of apple genetic resources. There is also a lack of methodological tools suitable for (1) assessment of *Nectria* canker resistance in large collections; (2) management and analysis of the evaluation data; and (3) validation of the evaluation data. Because of this, there are only a limited number of resistance sources available for breeding. Nevertheless, in Western Europe, *Nectria* canker constitutes one of the most important apple diseases. This work was based on a 10-year evaluation of a collection including 271 apple cultivars distributed over three orchards. Results show that some conditions need to be met when we want to integrate data from different orchards: (1) it is of the utmost importance to verify that averages of disease incidence in the orchards are comparable; (2) disease incidence must be within a well-defined range of optimal values; and (3) disease dispersion in the orchards must be homogeneous. The best susceptibility ranking of cultivars is based on their relative value compared with the mean disease intensity present in the orchards as a common reference. Using this system, evaluation data from various collections can be integrated into international databases. This method of grouping cultivars into susceptibility classes clearly underlines the most resistant. A high level of correlation is obtained between this cultivar classification and the rare data available in the literature. Of the 50 least susceptible cultivars surveyed, nearly 90% are new potential sources of resistance. No case of immunity to *Nectria*

[13] The start–up meeting was held in Como, Italy, on 31 January and 1 February 2003. For further information, see the project Web site (http://users.unimi.it/hidras/).

canker was observed. The study shows that cultivars express a differential susceptibility according to the entry sites of the disease and some landraces show an extreme tolerance to the disease by producing wound callus that stops the progression of the disease. Finally, as a practical conclusion, standard protocols are explained that define an appropriate methodology for the primary evaluation of *Nectria* canker resistance for *Malus* genetic resources collections.

Development of a Belgian network for in situ *and on-farm conservation of* Malus *and* Pyrus *genetic resources*

Marc Lateur presented the work of CRA Department, started in 1975. Since 1975, the Department has been working on the collection, conservation, evaluation and exploitation of regional genetic resources. Besides 1450 apple accessions, 930 pear, 340 plum, about 60 cherry and about 40 peach trees are held at Gembloux as a result of collecting expeditions in the country. The Belgian cultivars which are either Belgian amateur's cultivars or "landraces" were the first to be collected. They are probably the best adapted to our soil and climatic conditions. These cultivars are planted both in a repository orchard and in an experimental orchard in which the trees are evaluated without any plant protection. The collecting work is not yet finished and during autumn several hundred people send 600 to 800 fruit samples every year asking us to identify them and offering bud wood for conservation. Severe selection is applied prior to introducing new material into the collection. Only original cultivars which present useful characters or which have historical and regional value and/or which enlarge the diversity of the species are still introduced. After the phase of evaluation and characterization of the material planted in the experimental orchards, we started to create a few years ago an *in situ* and on-farm conservation orchard network with very limited funds. Our objectives are firstly to develop a safety-duplication of our *ex situ* collection and secondly to return genetic material to the regional landscape. This network is therefore complementary to our *ex situ* collection. Thanks to media publicity, several people or associations request our advice and assistance for planting or to restore historical orchards. At present there are 14 regional orchard projects running, with a total area of more than 25 ha.

The ISHS Pear Working Group

Fabrizio Grassi explained that the ISHS Pear Working Group was established in 1972 in Angers and has held several meetings since then. The current Chairperson is Tom Deckers. The Group is involved in several areas of activity, including genetics and breeding. The next meeting is planned to be held in Stellenbosch, South Africa, at the beginning of 2004.

Research activities at SERIDA, Spain

Enrique Dapena presented the research on apple genetic resources at Servicio Regional de Investigación y Desarrollo Agroalimentario del Principado de Asturias (SERIDA), involving the conservation and characterization of 800 cultivars. Agronomic and technological evaluation was carried out on 135 Asturian cultivars, of which 16 were selected for denomination of Asturian origin, with special characters such as regular bearing.

Local Asturian apple cultivars are used in a breeding programme to improve the resistance of cider apple cultivars, to obtain cider apple varieties of regular bearing and scab resistance, to improve technological and agronomic characters of Asturian cultivars and to improve resistance production and storage of Asturian yeasting apple cultivars.

A study was made of the resistance to scab and the variability of the pathogen, and *Venturia inaequalis* races 1, 3 and 4 were found to be present. Selection, assisted with markers, is carried out for scab resistance, aphid and mildew resistance.

Conclusion

Presentation and adoption of the report

The section *Discussion and Recommendations* of the report was presented to the participants and was approved with minor modifications.

Selection of a new Chair and Vice-Chair for the Working Group

Marc Lateur was elected Chair of the Working Group and Bronislovas Gelvonauskis Vice-Chair.

Closing remarks

It was announced that the EUCARPIA Symposium on Fruit Breeding and Genetics will be held in Angers, France, on 1-5 September 2003 and a full day will be dedicated to genetic resources (see the report of this meeting in Appendix IV).

The Group wished to thank Manfred Fischer for the excellent organization of the meeting and for chairing the Working Group in recent years, together with Jan Blazek.

PART II. COMMUNICATIONS AND PAPERS

National Collections

Malus *and* Pyrus *germplasm in Austria*

Siegfried Bernkopf
Bundesamt für Agrarbiologie[14], Linz, Austria

Introduction

During the last 40 years the number of apple and pear trees in Austria has decreased by more than 50%. The main reasons for this reduction were technical and economical changes in the farms, changes in consumer behaviour and frequently an amateurish approach to marketing of fruit and fruit products such as juice, cider, perry, spirits and others.

The substantial reduction in the number of fruit trees was associated with a considerable decrease in the number of varieties, especially old local varieties and landraces suitable for fruit processing. Nevertheless, the number of apple and pear trees in the farmers' orchards cultivated extensively may be estimated at 2 to 3 million (about 2000-3000 varieties and landraces). However, most of the trees are very old and in bad condition.

In order to stop the genetic erosion of Austrian fruit trees, in 1981 our institute started conducting systematic pomological inventories in farmers' orchards and in home gardens of Upper Austria and adjacent regions of Lower Austria and Styria. A selection of varieties was collected and planted out in our genebank. The characterization and evaluation of the accessions take a long time and are still underway.

After 1981 other governmental institutes and private associations followed our example.

Since 1984 Prof. Dr Karl Pieber (Institute of Fruit Growing and Horticulture, University of Agriculture, Vienna) has maintained fruit inventories and research on old fruit cultivars and landraces.

In 1996 a Working Group on Genetic Resources was established at the Ministry of Agriculture and Forestry. It included subgroups for vegetables, cereals, fruit and grapes, animals, etc. In the subgroup "Fruit and Grapes" the curators of the governmental and semi-governmental genebanks decided to cooperate. Subsequently a provisional national programme for fruit genetic resources was drawn up.

Moreover, in 1996 Dr Siegfried Bernkopf (Bundesamt für Agrarbiologie, Linz) was nominated as representative to the ECP/GR Working Group on *Malus/Pyrus* by the Ministry of Agriculture and Forestry. This marks the beginning of our international genebank activities.

"ARGE Streuobst", a forum for persons and associations dealing with the collection of fruit germplasm, fruit processing, fruit marketing and other related matters was established in 2000. Staff of the governmental genebanks have occasionally cooperated with it.

At the moment, there is no national programme for fruit genetic resources financed by the government and coordinating all activities in that field in Austria.

[14] This institute is now the Austrian Agency for Health and Food Safety - AGES Linz.

Governmental and semi-governmental fruit genebanks in Austria

The main task is to collect, conserve, characterize and evaluate fruit germplasm. In the case of agricultural colleges the genebanks are also important for providing material for courses in pomology.

Nine genebanks are currently cooperating in the "Arbeitsgruppe für Öffentliche Obstgenbanken Österreichs" (Working Group on Governmental Fruit Genebanks of Austria) (Table 1).

Collections of private associations (NGOs)

Other fruit collections are maintained by five associations (Table 2).

National Fruit Database

The National Fruit Database is being established at the Austrian Agency for Health and Food Safety, Linz (formerly Bundesamt für Agrarbiologie, Linz). Minimum passport data have been collected for the Austrian apple accessions. Unfortunately, the private associations have not yet provided passport data. By the end of 2002 we hope to have also obtained the data for pears.

The collected data will then be provided to the European *Malus* and *Pyrus* database manager. Subsequently, the characterization and evaluation data, based on the Austrian Descriptor Lists which include the IPGRI minimum specific descriptors, will be collected. This will take several years.

National safety-duplication

The Working Group on Governmental Genebanks of Austria decided to maintain at least 4 trees from each variety, distributed over at least 2 sites. Duplication at national level will start in 2003.

Conclusion

There are no fruit breeding activities in Austria. Nevertheless, the collecting, characterization, evaluation and utilization of apple and pear germplasm in Austria are still important for farmers, consumers, nurseries and the typical landscape in several Austrian regions.

Table 1. Governmental and semi-governmental fruit genebanks in Austria

Institute	Institute code	Date of foundation of the genebank	Head of the genebank	No. of accessions		Rootstocks	
				Apples	Pears	Apples	Pears
University of Agriculture Vienna - Institute of Fruit Growing and Horticulture	AUT006	1960	Dipl.Ing. Peter Modl	230	50	M9, M26, M106, M111	*Pyrus betulifolia* selections, OHF 333
Federal College and Research Institute for Viticulture and Fruit Growing Klosterneuburg	AUT024	1890	Dipl.Ing. Stefan Mader	380	58	M9, seedling	quince, seedling
Agricultural Research Center Styria - Fruit Research Station Haidegg	AUT023	1972	Dr Herbert Keppel	214	66	seedling	seedling
Austrian Agency for Health and Food Safety – AGES Linz	AUT002	1984	Dr Siegfried Bernkopf	123	83	seedling 'Bittenfelder'	seedling 'Kirchensaller Mostbirne'
Chamber of Agriculture Carinthia - Experimental Station for Fruit Growing, St. Andrä	AUT048	1985	Ing. Herbert Gartner	120	90	M9	quince
Agricultural College Warth	AUT054	1953	Ing. Maria Haring	100		seedling	
Agricultural College Guessing	AUT049	1997	Ing. Gerhard Müllner	80		M9	
Agricultural College Eisenstadt	AUT051	1988	Ing. Martin Prieler	110		M9	
Federal College of Agriculture St. Florian	AUT067	2002	Ing. Franz Möslinger	24	23	seedling	seedling

Table 2. Fruit collections held by private associations (NGOs) in Austria

Institute	Institute code	Date of foundation of the collection	Curator	No. of accessions		Rootstocks	
				Apples	Pears	Apples	Pears
Hortus Association, Ranshofen	AUT052	2001	Ing. Guenter Linecker	67	18	M111, seedling	OHV 333, seedling
Neue Alte Obstsorten Association, Gießhuebl	AUT050	1995	Dipl.Ing. Gerlinde Handlechner	50	50	seedling	seedling
Oekokreis Association, Zwettl	AUT055	2001	Dipl.Ing. Ute Blaich	430	57	?	?
Fruit and Horticulture Association St. Marienkirchen / Polsenz	AUT053	1997	Franz Moisl	54	39	seedling	seedling
Arche Noah Association, Schiltern	AUT046	2001*	Dipl.Ing. Bernd Kajtna	data not available			

* *In situ* conservation

Short note on Malus/Pyrus *genetic resources in Belgium*

Marc Lateur

Département Lutte Biologique et Ressources Phytogénétiques, Centre de Recherches Agronomiques (CRA), Gembloux, Belgium

The collection of endangered and original pome fruit material still plays an important role at the CRA, Gembloux and especially for old pear landraces (50 original cultivars collected). This is collaborative work between a public sector institute, NGOs and the public, who are very enthusiastic. Much work is needed to organize and share the work between formal and informal sectors (NGOs, associations, etc.) and to develop a national strategy for a better management of the collections. These last five years we have observed a real revival in the planting of standard tree orchards with old cultivars that receive some financial support from regional (Flemish Limburg and Flemish Region, Walloon Region) or municipal administrations. After characterizing and evaluating the collections, several preliminary *in situ* conservation orchards were planted with the aim of restoring the original diversity at the local level, to be used for teaching and economic purposes and also to be used as a safety-duplication of *ex situ* collections. The 936-accession pear collection at Gembloux is now more than 20 years old and it must be completely renovated by grafting new trees onto quince and, for landraces, onto OHF 333 rootstocks for solving incompatibility problems.

Status of the national Malus/Pyrus *collection in the Czech Republic*

Jan Blazek
Research and Breeding Institute of Pomology, Holovousy, Horice, Czech Republic

The *Malus/Pyrus* collection is located in the Research Breeding Institute of Pomology at Holovousy (Table 1). It has been part of the national programme of conservation and evaluation of genetic resources since 1984. The programme is coordinated by the Research Institute of Crop Production (RICP) in Prague-Ruzyne.

Table 1. Status of the Czech *Malus/Pyrus* collection

Genus	Total no. of accessions	Botanical species and hybrids	Varieties of Czech origin	New Czech varieties
Malus	1120	74	161	57
Pyrus	177	6	36	19

Conservation methods

- *Malus*: orchard collection
  6 trees per accession on M9 rootstock with 4 x 2 m spacing (3 replications of 2 trees, including 1 replication without chemical protection).
- *Pyrus:* orchard collection
  Usually 3-5 trees per accession on pear seedling rootstock without replication, spacing 5 x 3 m.

Most of the accessions are safety-duplicated in the Slovak Republic.

Evaluation

Selected characters are evaluated regularly (yearly for health status). The characters evaluated are listed below:

1. Tree vigour
2. Tree – density of branches
3. Tree – winter hardiness
4. Branch spurring
5. Extent of bare wood
6. Fruit weight
7. Fruit shape
8. Fruit – surface smoothness
9. Fruit – symmetry
10. Fruit – thickness of skin
11. Fruit – ground colour of skin
12. Fruit – over colour
13. Fruit – amount of over colour
14. Fruit – skin greasiness
15. Fruit – size of lenticels
16. Fruit – length of stem
17. Fruit – flesh colour
18. Fruit – flavour
19. Fruit – flesh firmness
20. Fruit – flesh juiciness
21. Fruit – total eating quality
22. Fruit – amount of russeting
23. Fruit – resistance to bruising
24. Fruit – type of russeting
25. Fruit – resistance to shrivelling
26. Fruit appearance
27. Fruit – overall market value
28. Flower – time of flowering
29. Flower set
30. Flower – resistance to frost damage
31. Fruit set
32. Time of ripening
33. Resistance to scab on leaves
34. Resistance to scab on fruits
35. Resistance to mildew
36. Resistance to brown rot
37. Resistance to bitter pit
38. Resistance to water core
39. Resistance to internal breakdown
40. Resistance to canker
41. Maximum storage life

Funding of the programme

Entirely state-funded (Ministry of Agriculture), for the time being to a reasonable extent.

Documentation

EVIGEZ, the National Information System on Plant Genetic Resources, has been developed since 1984 in the Research Institute of Crop Production as a special user programme for documentation of plant genetic resources in former Czechoslovakia. Since 1992 it has been used by all institutions dealing with plant genetic resources in the Czech Republic (11 institutions, in 14 locations). The documentation system EVIGEZ consists of three main data sets:

- **passport** data which are fully available on the Internet (www:vurv.cz/database/);
- **characterization and evaluation data** (scored according to a 1-9 scale, on the basis of national descriptor lists, which are presently available for 27 crops) but not publicly available; and
- **documentation of seed stored** in the Genebank.

Characterization/evaluation data for the *Malus* database

- **Disease resistance**

Protocols for evaluation of canker (*Nectria galligena*), scab (*Venturia inaequalis*) and mildew (*Podosphaera leucotricha*) resistance: in the orchard without fungicide application under severe incidence of the pathogen (susceptible cultivars are severely damaged).

Ratings: 9 – resistant; 5 – medium; 1 - susceptible.

- **Fruit firmness, fruit storage quality, fruit sugar/acid ratio**

Fruit can be evaluated just after harvest, or at the beginning of ripening, or at the end of ripening.

Fruit firmness

- with skin by penetrometer or fruit pressure tester (Magness Taylor plunger) in kg
- without skin by penetrometer or fruit pressure tester (Magness Taylor plunger) in kg
- general impression of the fruit firmness estimated subjectively by the evaluator through touching or patting

Ratings: 7 – firm; 5 – medium; 3 – soft.

Sugar

- % of soluble solids by refractometer
- taste

Acidity

- pH (by pH meter)
- malic acid (= titratable acidity)
- taste

Fruit storage quality

- normal cold store (1-4°C)
- start date
- end date

An inventory of apple and pear cultivars of Estonian origin

Kalju Kask
Polli Horticultural Institute, Estonian Agricultural University, Karksi-Nuia, Estonia

Estonian apple cultivars

Introduction
Apple orchards existed in Estonia in the 16th century on private estates. However, archaeologists have found seeds of large-fruited apples already in the 13th-century layers of the excavations of the town Tartu in South Estonia.

The climate changed and fluctuated greatly throughout history. The most severe winter in the last century occurred in 1939-1940 when the temperature dropped to -43.5°C in January and 69% of the 2.28 million apple trees were killed. The following three winters of World War II were also very cold, and in 1945, only 16.5% of the apple trees remained from those present in 1939. After that, every new winter-hardy apple cultivar was eagerly awaited.

Apple breeding in Estonia
The first information on two apple cultivars (landraces) of Estonian origin can be traced back to the 18th century. The next century added only one landrace and one cultivar, bred by amateurs. The others were bred in the 20th century.

After World War II, collecting missions to hobbyists' gardens were organized. By the autumn of 1954, 440 apple seedling trees had been discovered and propagated and an orchard was established at the Polli Horticultural Institute. However, many accessions proved to be insufficiently winter-hardy. Up to 1998, only 148 accessions were saved.

As early as 1946, the Polli Horticultural Institute successfully used some old landraces to breed new cultivars.

Since 1978 Elsa Kukk, a retired researcher, has collected fruit tree cultivars, mostly landraces. She propagated them and established two orchards in the Lahemaa State National Reserve, on two old estates, Palmse and Sagadi. There were over 300 accessions originating from seedling trees which were grown mainly on a large island in the Baltic Sea, Saaremaa (2674 km^2), which has a milder climate than that of mainland Estonia. The choice of material for these orchards was based on their local origin, peculiarity and taste. Productivity criteria were seldom taken into consideration. The majority of the accessions, including almost all pear trees, have now disappeared, owing to political reasons and the change in ownership in the 1990s when the Soviet system collapsed.

List of apple cultivars of Estonian origin
Since 2002, a government project has been responsible for financially supporting the conservation of fruit tree genetic resources in a collection maintained at the Polli Horticultural Institute. The aim is to devise a system that encourages research, conservation and sustainable use of landraces and old cultivars. The project also deals with the search for local apple trees, the best of which will be chosen for testing in orchards for better adaptability to local soil and climatic conditions. This revealed a specific market demand for local cultivars of traditional taste and the return of previously abandoned germplasm. On the other hand, more extensive use of landraces is limited because of farmers' perception that modern cultivars are better yielding.

Table 1 lists all existing apple landraces and cultivars of Estonian origin.

The following criteria were used to define a cultivar: the cultivar is (1) one which has the author's certificate, or (2) it is included into the "List of fruit cultivars" officially recommended for growing in Estonia or other countries, (3) it was officially taken for testing in cultivar-testing farms (in the Soviet Union years), or (4) it is protected or registered as a new cultivar by the state authorities. The last of these criteria has been in use only since the late 1990s.

According to these criteria, there were 53 apple cultivars of Estonian origin at the beginning of 2002 (Table 1). Many original trees are certainly grown in home gardens, planted from a seed or grown from spontaneous seedlings. The owners never thought to register or protect them. However, some of these selections have been grafted or transferred to other gardens and repeatedly propagated. These are not recorded as cultivars. On the other hand, nobody knows how many potential cultivars have been lost forever.

In-garden conservation should be considered to safeguard germplasm obtained as a result of hobby breeding. Support by local or state authorities for conservation purposes and for research studies would be necessary in this case. In Estonia, the conservation of some gardens (25-45 years old or more) was formerly included in the state programme, but the current measures do not guarantee the further existence of this valuable germplasm.

Estonian pear cultivars

Introduction

The domesticated forms of *Pyrus communis* L. have been grown in Estonian gardens for many centuries. Pear cultivars were introduced mainly from Germany. The climate of Estonia is not suitable for pear growing. Winter killing is a serious constraint to fruit production. During the most severe winter 1939-1940, 87% of the pear trees were killed. The winter freeze and spring frost damage is more hazardous in mainland Estonia (minimum -43.5°C). The large western islands of Saaremaa, Muhu and Hiiumaa and the coastal zone are the most favourable areas for growing pears.

The first known cultivar (landrace) 'Karmla' dates back to the 19th century. All other cultivars were bred in the 20th century by amateur breeders; only one cultivar was bred by professional breeders, the programme beginning in 1948.

Expeditions were organized in the late 1940s and in the 1950s in Estonian orchards, especially in the western part of the country, to collect selections of amateur breeders for the Polli Horticultural Institute. Thus 135 pear accessions were brought to the institute's collection up to 1954. However, the severe winters that followed killed most of them and by 1970 only 14 selections survived.

Results of amateur and professional breeding in Estonia are very important for pear production: during the last 30 years or more, only cultivars of Estonian origin have been included into the "List of pear cultivars recommended for growing in Estonia", due to better winter hardiness. Unfortunately, all Estonian pear cultivars ripen in summer or autumn. The pear is not a commercial crop in Estonia. The number of pear trees amounts to approximately 2% of all fruit trees.

List of pear cultivars of Estonian origin

Table 2 lists the cultivars (and one landrace) of Estonian origin. There are many selections. The definition of a cultivar follows the same criteria as for apples. According to these criteria, there were 10 pear cultivars and 1 landrace of Estonian origin at the beginning of 2002 (Table 2).

Table 1. Apple cultivars and landraces of Estonian origin

Cultivar	Parents	Beginning of breeding	Year of introduction	Breeder(s)	Author's certificate (at Moscow)	Registered (+) or protected (++) after 1998
Aamisepa 14	Yellow Transparente x ?	1921	1957	Julius Aamisepp		
Aia Ilu	Antonovka x ?	1945	1957	Aleksander Siimon	1963	
Banaanõun	Streifling Herbst x Wealthy	1947		A. Siimon		
Eerika	Wealthy x ?	1961	1999	Uno Kivistik		+
Eleegia	Treboux Sämling x ?	1947		A. Siimon		
Eva Kuld	not known	1920-1930?	1985	landrace		
Kaja	Liivi Kuldrenett x Suislepp	1947	1961	A. Siimon		
Karamba	Talvenauding x Cortland	1969	2001	Kalju Kask		++
Karksi	not known	1920-1930	1981	landrace		
Karlapärl	Sahvraal x ?	1957	1999	U. Kivistik		+
Kasper	not known	1970-1980	2001	Asta Kask		++
Katre	Tiina x L8	1982	2001	K. Kask		++
Kiir	Suislepp x ?	1947	1957	A. Siimon	1963	
Koidurenett	Sipolinš x ?	1920-1930	1957	Aleksander Lange		
Koit	Suislepp x ?	1947	1961	A. Siimon	1971	++
Koonik	not known	1970-1980	2002	A. Kask		++
Krameri Tuviõun	Lietuvos Pepinas x ?	about 1935	1951	Otto Kramer	1962	
Krista	L25 x ?	1978	2001	K. Kask		++
Laulutaat	Sõstraroosa x Streifling Herbst	about 1960	2000	U. Kivistik		+
Lembitu	Liivi Kuldrenett x Wealthy	1946		A. Siimon, K. Kask		
Lemmikõun	Antonovka x Akerö	1946		A. Siimon		
Maimu	Streifling Herbst x Wealthy	1947		A. Siimon		
Meelis	Borovinka x Tallinna Pirnõun	1946	1957	A. Siimon		
Mõnu	Antonovka x ?	1960-1965?	1999	U. Kivistik		+
Paide Taliõun	not known	about 1850	about 1910	landrace		
Polli Kaunitar	Antonovka x Akerö	1946	1957	A. Siimon		
Põltsamaa Taliõun	not known	about 1920	1930s	landrace		
Raeda 1003	Streifling Herbst x Lord Suffield		1951	Jaan Raeda		
Raeda 1048	Antonovka x Wealthy		1951	J. Raeda		
Raeda 1076	Treboux Sämling x Lietuvos Pepinas		1951	J. Raeda		
Raeda Suviõun	Martsipan x Streifling Herbst	about 1930	1957	J. Raeda		
Roogoja	not known	1940-1945		Jaan Kivistik		
Roogovka	Roogoja x Antonovka	1959	1999	U. Kivistik		+
Rusikaõun	not known		1951	J. Raeda		
Rõõsa	Säfstaholm x Liivi Kuldrenett	about 1970?	1999	U. Kivistik		+

Table 1 (continued). Apple cultivars and landraces of Estonian origin

Cultivar	Parents	Beginning of breeding	Year of introduction	Breeder(s)	Author's certificate (at Moscow)	Registered (+) or protected (++) after 1998
Saku	Meelis x Antonovka	about 1970?	1999	U. Kivistik		+
Salla	not known		1999	U. Kivistik		+
Sidrunkollane Taliõun	Antonovka x Akerö	1946	1957	A. Siimon	1963	++
Suislepp	not known	18th century	18th century	landrace		
Sõstraroosa	not known	1920-1930	1957	J. Raeda, Jaan Jürgenson		
Sügisdessert	Antonovka x Wealthy	1946	1957	A. Siimon	1963	++
Sügisrõõm	Lietuvos Pepinas x ?	1956	1999	U. Kivistik		+
Taavi	Anis Krasnyi x ?	1959	1999	U. Kivistik		+
Talipirnõun	not known		1957	landrace		
Tallinna pirnõun	not known	18th century	18th century	landrace		
Talvenauding	Akerö x Streifling Herbst	1946	1957	A. Siimon	1963	++
Talverõõm	Roogoja x Borovinka	1958	1999	U. Kivistik		+
Tellissaare	not known	1920-1930	1957	Jaan Tellisaar		
Treboux Sämling	not known	about 1880	1930s (1905?)	Jules Treboux		
Tiina	Streifling Herbst x Liivi Kuldrenett	1947	1985	A. Siimon, K. Kask		++
Vahur	Antonovka x ?	1947	1985	A. Siimon		
Vambola	not known	1920-1930	1957	J. Roose		
Veiniõun	Roogoja x Komsomolets	1959	1999	U. Kivistik		+

Table 2. Pear cultivars and a landrace of Estonian origin

Cultivar	Parents	Beginning of breeding	Year of introduction	Breeder(s)	Author's certificate (at Moscow)	Protected after 1998
Eesti Pirn	Tongre x ?	1947	1967	A. Kurvits	1971	
Järve	not known	1940	1951	J. Järv		
Karmla'	not known	19th century	1961	landrace		
Krameri Võipirn	Williams Christ x Dr. Jules Quyot	1937	1961	O. Kramer		
Krameri 21 (Tallinna Pikk)	Curé x Napoleon	1936	1951	O. Kramer	1962	
Kurvitsa Lemmik	Marguerite Marillat x ?	1947	1961	A. Kurvits	1971	
Kägi Bergamott	not known	end of 19th century	1951	J.Kägi		
Lutsu Võipirn	not known	about 1920	1938	J. Luts		
Pepi	Précoce de Trevoux (reputedly)	1952 or 1953	1990	K. Kask, A. Siimon		+
Seiu	not known	1940s	1961	A. Aav		
Tartu Pirn	Notaire Lepin x ?	1946	about 1985	A. Kurvits		

Short note on Malus/Pyrus *genetic resources in France*

François Laurens
Station d'amélioration des espèces fruitières et ornementales - INRA Angers, Beaucouzé, France

Various participants are involved in *Malus* and *Pyrus* germplasm conservation in France: associations of amateurs, regional and national repositories, botanical gardens, nurseries, experimental centres and research institutes. A recent survey funded by the "Association Danone pour les fruits" recorded 19 883 accessions of apples and 6905 of pears. They are distributed over 179 and 124 sites respectively all over the country.

The management of genetic resources in France is coordinated by the BRG (Bureau des Ressources Génétiques), a government-funded organization. The establishment of a national charter is in progress for apples and pears which aims to define a national list, to set up a new national database and to manage exchange of data and material. In order to reach these goals, INRA-Angers is leading a new project with six partners: associations of amateurs (Croqueurs de pommes, Société pomologique du Berry), regional repositories (Conservatoire végétal régional d'Aquitaine, Conservatoire régional de Puycelsi, Centre régional des ressources génétiques Nord Pas-de-Calais) and one national repository (Conservatoire botanique national alpin de Gap). At this moment 3246 accessions have been listed; the database contains passport data for 75% of the accessions and characterization data for 50% of the accessions. This project will lead to an increase in the number of accessions in the database and to the creation of a national list which will contain only cultivars of French origin.

Work on fruit genetic resources in Germany and application to fruit breeding and growing

Manfred Fischer[1], Martin Geibel[1] and Christa Fischer[2]
[1] *IPK Gatersleben, Genbank Obst Dresden-Pillnitz, Germany*[15]
[2] *BAZ Quedlinburg, Institut für Obstzüchtung Dresden-Pillnitz, Dresden, Germany*

Introduction

The Fruit Genebank has the task of conserving and evaluating the genetic resources of pome, stone, small and wild fruit and supporting projects for breeding, fruit growing, landscaping, pomology, taxonomy, phytopathology, pollination studies and teaching. PCR analysis will be integrated to identify cultivars and species. Apart from the conservation of old German cultivars and indigenous wild fruit species, the collections of the genebank serve as a stock and a source of basis material for fruit breeding. At present, the identification and preservation of donors for resistance is of particular importance (Büttner *et al.* 2000a, 2000b).

The entire stock of the Fruit Genebank Dresden-Pillnitz (Genbank Obst Dresden-Pillnitz) currently amounts to 3600 accessions, including 1100 apple cultivars and 330 wild *Malus* accessions. Together with data of other German fruit institutes and some NGOs, about 17 200 accessions from nearly 5800 varieties of 45 species are documented as the German fruit germplasm in a database provided by the Fruit Genebank (http://www.dainet.de/genres/bosr/).

In addition to the passport data of the pome and stone fruit accessions, numerous evaluation results are documented for pollen fertility, morphology, phenology, apomixis, cropping behaviour, fruit quality, as well as resistance to viruses, fire blight, mildew, scab, aphids and frost-hardiness of shoots and flowers. The main task in evaluating the collections is the permanent recording of these evaluation data, since in woody plants several years are needed for a reliable assessment of these characters. The evaluation data of apples and stone fruit are available in the EVA Database (http://www.dainet.de/genres/eva/).

The accessions of the Fruit Genebank are all maintained as field collections; thus a yearly evaluation of all important characters is possible. All evaluation data are used in fruit breeding programmes and help under specific conditions in fruit growing. The multiple-resistant old cultivars are especially valuable for breeding. Crossings with distant relatives of wild species bring some problems due to cross incompatibility. However, new techniques may help to break these barriers in the near future.

Apples

The direct use of the evaluation results of the Fruit Genebank led to the release of numerous new cultivars by the breeding institutions, including the apple cultivars of the Pi-series ('Piros', 'Pinova', 'Pilot', 'Piflora', 'Pirella', 'Pia', 'Pingo'), the resistant apple cultivars of the Re-series ('Retina', 'Remo', 'Reglindis', 'Reanda', 'Renora', 'Rebella', 'Relinda', 'Rewena', 'Regia' and others) and apple rootstocks (Supporter rootstocks) (Fischer 1999; Fischer 2000b; Herr and Schmitz-Hübsch 2000).

[15] The Fruit Genebank Dresden-Pillnitz was transferred to the administrative direction of the Federal Ministry of Agriculture. It has therefore become part of the Institute of Fruit Breeding Dresden-Pillnitz as of 1 January 2003.

Donors used in cross combinations of the apple breeding programme after evaluation in the Fruit Genebank are (Fischer and Fischer 1999):

- sources for high yield and fruit quality: 'Cox Orange', 'Oldenburg', 'Baumann Renette', 'Hammerstein', 'Northern Spy', 'Alkmene', 'Auralia', 'Clivia', 'Elstar', 'Golden Delicious', 'Helios', 'Jonathan', 'Pilot', 'Pinova', 'Piros', 'Undine', and others;
- sources for scab resistance: 'Steinantonovka' (*VA*) for polygenic resistance, *Malus* x *floribunda (Vf), M.* x *micromalus (Vm), M.* x *atrosanguinea (Vf?), M. pumila (Vr);*
- sources for mildew resistance: *Malus* x *zumi* 'Calocarpa', *M.* x *robusta* 'Persicifolia', *M.* x *floribunda, M.* x *micromalus*, 'Dülmener Rosen', 'James Grieve', 'Helios', 'Alkmene', 'Lord Lambourne', and others for polygenic resistance; a new source was found as *Malus sylvestris* (Büttner 1999);
- sources for fire blight resistance: *M.* x *robusta* 'Persicifolia', *M.* x *sublobata, M.* x *floribunda, M. prunifolia, M. fusca,* 'Remo', 'Rewena', 'Reanda', 'Rebella', 'Regine'.

One of the most important results of the Pillnitz apple resistance breeding programme was the selection of a number of desirable cultivars resistant to economically important diseases through conventional combination breeding methods. An important activity is the breeding of triple- and multiple-resistant cultivars with resistance to scab, mildew and fire blight such as the Re-cultivars® 'Remo', 'Rewena', and 'Rebella'. The last of these was found resistant not only to fungi and fire blight but also to bacterial canker, red spider mite, aphids and abiotic damage (Fischer 2000a). All other cultivars have a different level of multiple resistance. Results so far show that a very significant reduction of fungicidal sprays (about 80%) is possible without risk of attack by scab and mildew.

In the first step of the apple resistance breeding work the selected cultivars possess only one source of resistance, but from different donors.

- *Vf* (*M. floribunda*): 'Reanda', 'Rebella', 'Regine', 'Releika', 'Relinda', 'Remo', 'Rene', 'Renora', 'Resi', 'Retina', 'Rewena';
- *Vr* (*M. pumila*): 'Realka', 'Regia', 'Reka', 'Releta', 'Remura';
- *VA* ('Antonovka kamienna'): 'Reglindis'.

The best resistant cultivars from Pillnitz have been tested under a wide range of environmental conditions. They demonstrated their ability to maintain their resistance. Their resistance properties make them suitable for organic and integrated fruit production and also as parents for breeding programmes. Highly susceptible cultivars need intensive plant protection measures and their fruits cannot be produced with standard quality in organic production (Fischer *et al.* 2000). Resistant cultivars are more suitable for such methods of production. With the Re-cultivars® we offer an example for a direct use of genetic resources of *Malus* and on the other hand a concept for a new system of crop management in the orchards. Different resistance sources can be combined with different maturation periods of cultivars. In this way, complete cross-pollination and fruit set of the resistant cultivars is guaranteed. The combination of different resistant cultivars for different production aims—table fruit, processing, landscape improvement—is possible (Fischer *et al.* 1999).

In the evaluation of more than 850 old and newly bred apple cultivars, the most susceptible cultivars were found to be ones which are grown all over the world. To find donors of polygenic resistance against apple scab and mildew the collection of apple cultivars was not sprayed with fungicides in 1997 and 1999. Only 25 old cultivars and 4 cultivars from resistance breeding programmes showed a low level of infection for both scab and mildew. Some important old cultivars with the best performance are 'Roter Bellefleur', 'Bittenfelder Sämling', 'Börtlinger Weinapfel', 'Cidor', 'Discovery', 'Engelshofer', 'Engelsberger Weinapfel', 'Gewürzluiken', 'Hibernal', 'Jacob Fischer', 'Juliane', 'Kardinal Bea', 'Merton Prolofic', 'Peasgoods Nonsuch', 'Prinzenapfel', 'Rote Sternrenette', 'Spätblühender

Taffetapfel' and others. These old cultivars can be regarded as carriers of polygenic scab and mildew resistance, but the confirmation of this hypothesis requires crossing experiments. A marker analysis gave no indication of the existence of the well-known genes for monogenic resistance to scab or mildew. These old cultivars are suitable for use in landscape improvement, for small orchards and home gardens and as crossing partners for transferring polygenic resistance in fruit breeding. This result is important for the breeding of resistant apple cultivars with polygenic and monogenic sources of resistance (pyramiding of genes), especially in view of the early results acquired on the overcoming of the monogenic scab resistance (Fischer and Dunemann 2000).

The evaluation of scab-resistant cultivars shows that most of these had problems with mildew infection. The combination of both scab and mildew resistance is very important for breeding and growing. This is the only effective way to reduce the use of fungicides in commercial orchards.

Pears

The Fruit Genebank was directly involved in the German pear breeding programme. The aims of selection were an excellent fruit quality, a good appearance and shape of the fruit, early and high yield, resistance to scab and fire blight, and good keeping qualities. The evaluation was held in comparison with 150 accessions of pear cultivars.

Of 25 artificially tested pear cultivars only 'Harrow Delight' was found resistant to fire blight. The susceptibility of the other cultivars varied from medium to very high, most cultivars being highly susceptible. The German selection 'Uta' fell into the group of medium-susceptible cultivars like 'Harvest Queen'.

The new selected cultivars are:

- summer ('Bunte Juli'): 'Hermann', 'Isolda'®
- autumn ('Bonne de Longueval'/'Gute Luise'): 'Gräfin Gepa', 'Thimo'®
- late autumn ('Conférence'): 'Armida'®, 'Graf Dietrich'®, 'Graf Wilhelm', 'Hortensia'®
- winter ('Alexander Lucas'): 'David'®, 'Eckehard'®, 'Gerburg'®, 'Uta'®.

The new cultivars are not susceptible to scab, but susceptible to fire blight to different degrees. Fruit quality is good ('Hermann', 'Isolda', 'Hortensia', 'Eckehard', 'Gepa') to excellent ('Uta', 'Gerburg', 'Graf Wilhelm', 'Thimo'); yield capacity is high ('Gepa', 'Graf Dietrich', 'Gerburg') to very high ('Uta', 'Eckehard', 'Hortensia', 'Thimo'), and growth is very dwarf ('David', 'Uta', 'Armida') to semi-vigorous. The storage life of the winter cultivars in cold storage lasts until February-March ('Gerburg', 'Eckehard', 'Uta') and April ('David'). The cultivars are an improvement on those currently available for the fresh market (Fischer and Mildenberger 2000).

Malus wild species[16]

The Pillnitz *Malus* species collection is one of the most important collections in Europe. The *Malus* wild species and hybrids have been evaluated for several years for morphology, phenology, resistance and fertility. The evaluation of scab and mildew resistance shows that only 4% of 330 accessions are free from both mildew and scab. All evaluation data lead to a definite taxonomic classification of the present *Malus* collection and provides data that are useful for breeding (see above, section on apples) and landscaping. A similar project has been started with the *Pyrus* wild species collection.

In the last 10 years recent expeditions collected *Malus* material outside the centres of origin of cultivated apple (Büttner et *al.* 2000a). Such material can be important for understanding the domestication of apple. After screening the seedlings from different regions, sources of resistance are being discovered. Further collecting trips would be useful because the original

[16] See also "Research on *Malus* wild species at the Fruit Genebank Dresden-Pillnitz", pp. 68-71.

habitats of the majority of the classical species accessions in collections are unknown. Additionally, in present collections many species are restricted to only a few accessions. Therefore they are neither representative of the extent of variability within the species or for usable traits. Evaluation of newly collected material is supported by molecular marker methods to generate and upgrade core collections, which facilitates more efficient evaluation. Much effort remains to be invested in the computerization of evaluation data so that research work on *Malus* wild species can be shared effectively between different working groups around the world. These cooperative projects can increase the knowledge about the genus *Malus* and enlarge the genetic base for future apple breeding.

1100 seedlings from 35 populations of *Malus sieversii* will be assessed for the diversity of phenotypic and genotypic characters in Dresden-Pillnitz (Geibel et *al.* 2000). The seeds were received from the Kazakhstan expeditions of the US Genebank at Geneva, New York state. The analysis of the geographic data of their provenance should help to map the spread of characters of the ancestor of the cultivated apple, *Malus domestica*, from its centre of genetic diversity. New sources of genes for resistance and fruit quality are thought to be present within this material and will be available for apple breeding.

In addition to these leading *ex situ* collections of *Malus* and *Pyrus* wild species in Europe we promote the *in situ* conservation of the indigenous fruit species *Malus sylvestris* and *Pyrus pyraster,* in particular in eastern Germany, focusing on the differentiation between typical representatives of the wild species and their hybrids with cultivated species (Keller *et al.* 1999).

Outlook

The best method of conservation of genetic resources is their sustainable use. Trustworthy international cooperation is very important, so that the costs of conservation and evaluation can be minimized for a single genebank. The exchange of accessions should follow simple rules. The issues of plant breeders' rights and national ownership of genetic resources should be addressed by new international regulations (Fischer 1998).

References

Büttner, R. 1999. *Malus sylvestris* (L.) Mill. – eine potentielle Quelle für Mehltauresistenz in der Apfelzüchtung [*Malus sylvestris* (L.) Mill. – a potential source of mildew resistance in apple breeding]. Erwerbsobstbau 41:100-101.

Büttner, R., M. Fischer, P.L. Forsline, M. Geibel and V.V. Ponomarenko. 2000a. Genebank work for preservation of the genetic diversity of apple. Acta Hort. 538:39-42.

Büttner, R., M. Geibel and C. Fischer. 2000b. The genetic potential of scab and mildew resistance in *Malus* wild species. Acta Hort. 538:67-70.

Fischer, C. 2000a. 'Rebella' and 'Regine' – new multiple resistant apple cultivars from the Institute for Fruit Breeding at Dresden-Pillnitz. Acta Hort. 538:703-705.

Fischer, C. 2000b. Multiple resistant apple cultivars and consequences for apple breeding in the future. Acta Hort. 538:229-234.

Fischer, C., W. Dierend, M. Fischer and A. Bier-Kamotzke. 2000. Stabilität der Schorfresistenz an Apfel – Neue Ergebnisse, Probleme und Chancen ihrer Erhaltung [Stability of scab resistance in apple – New results, problems and chances for their preservation]. Erwerbsobstbau 42:87–92.

Fischer, M. 1998. Schutz und Nutzung der Biodiversität – wissenschaftliche und politische Aspekte [Preservation and use of biodiversity – scientific and political issues]. Erwerbsobstbau 40:84–87.

Fischer, M. 1999. New dwarfing and semidwarfing Pillnitz apple rootstocks: Supporter 1, 2, 3 and 4. Pp. 27–28 *in* Proceedings of the International Seminar on Apple Rootstocks for Intensive Orchards, 18-21 Aug. 1999, Warsaw Agricultural University, Warsaw-Ursynów, Poland.

Fischer, M. and F. Dunemann. 2000. Search for polygenic scab and mildew resistance in apple cultivars at the Fruit Genebank Dresden-Pillnitz. Acta Hort. 538:71-77.

Fischer, M. and C. Fischer. 1999. Evaluation of *Malus* species and cultivars at the Fruit Genebank Dresden-Pillnitz and its use for apple resistance breeding. Genetic Resources and Crop Evolution 46:235-241.

Fischer, M. and G. Mildenberger. 2000. New Naumburg/Pillnitz pear breeding results. Acta Hort. 538:735-739.

Fischer, M., W. Schüler, C. Fischer and H.J. Gerber. 1999. Nutzung Pillnitzer Apfelsorten für die Herstellung von Verarbeitungsprodukten aus biologisch orientiertem Anbau [Utilisation of Pillnitz apple cultivars for production of juice from organic orchards]. Erwerbsobstbau 41:93-99.

Geibel, M., K.J. Dehmer and P.L. Forsline. 2000. Biological diversity in *Malus sieversii* populations from Central Asia. Acta Hort. 538:43-49.

Herr, G. and E. Schmitz-Hübsch. 2000. Deutsche Apfelsorten schlagen zurück – 'Pinova' läutet die erste Runde ein [German apple cultivars are in progress – 'Pinova' is the first]. Fruttabel, Aventis Crop Science 1:12-15.

Keller, J., K. Schüler, M. Gäde, M. Fischer and K. Hammer. 1999. Present situation in the field collections of vegetatively propagated species in the Gatersleben Genebank. Pp. 21–24 *in* Management of field and *in vitro* germplasm collections (F. Engelmann, ed.). International Plant Genetic Resources Institute, Rome, Italy.

Malus/Pyrus *genetic resources in Greece*

Constantinos Tsipouridis and Athanasios Manganaris
National Agricultural Research Foundation (NAGREF), Pomology Institute, Naoussa, Greece

Greece is very rich in plant genetic resources for the following reasons:
- it is close to the Central Asian centre of origin of many crops;
- in addition to the large and ecologically variable mainland, the country is composed of over 2000 islands with different microclimates;
- the spread of principal cultivars of many temperate crops throughout Greece followed that of early Greek civilisations.

In Greece, *Malus* and *Pyrus* material is kept officially only at the NAGREF Pomology Institute in Naoussa, established in 1962; the institute has farms in Naoussa, Veria and Skydra. *Malus* germplasm is kept in Naoussa, the main area of apple production, while *Pyrus* material is kept in Naoussa and Veria.

There are two types of collection:
- commercial cultivars grafted onto M9 and MM106 for apples and on BA29 and EMA for pears. They are evaluated for important agronomic characters (productivity, fruit quality, etc.).
- older cultivars and selections that carry certain agronomic characters, e.g. resistance to diseases, drought, etc.

Two to six trees of each accession are maintained. Beside local cultivars and advanced breeding selections, most of this material has been imported. At the moment there is no *in situ* conservation.

The conservation of *Malus/Pyrus* material is funded by NAGREF. No funds are available for completing the characterization of non-commercial plant material or for collecting new plant material.

Due to an incomplete national law protecting the patented cultivars in Greece, private nurseries from foreign countries are reluctant to send new cultivars for evaluation. In all cases a phytosanitary certificate should accompany the imported material.

There is no national or international project funding the collection and characterization of non-commercial *Malus/Pyrus* material, although the genetic resources for *Malus/Pyrus* and other species have been reduced the last year due to:
- rapid spread of new varieties, more productive and of better quality;
- rapid spread of other species that replace *Malus/Pyrus* species;
- abandonment of mountainous and insular areas by their inhabitants;
- deterioration of climatic conditions, which are becoming drier and in addition to other problems become susceptible to fire damage;
- spread of diseases, etc.

The surviving genetic material is found in isolated, non-cultivated areas, meadows, mountainous areas, roadsides, fences, farmlands and backyards and is under severe threat of genetic erosion. In these areas there are wild populations of many species, local cultivars cultivated for a long time, primitive landraces, wild relatives, seedlings, etc. Some material also exists in national parks and monasteries. It is expected that the opportunity will arise for collecting and characterizing this potential *Malus/Pyrus* material. Council regulation EC 1467/94 provides a chance to move in this direction.

The adaptation of different national databases for *Malus/Pyrus* to match the respective European databases also appears necessary.

Despite all the restrictions in funding, there is optimism for the future. For Greece it is very important to share the experience of other countries in the collection, conservation, characterization, exchange and utilization of *Malus/Pyrus* material.

Data are available for 30 apple and 33 pear cultivars and selections on the basis of UPOV descriptors.

The existing plant material includes:

- apple: 151 cultivars, 35 selections and 14 *Malus* species
- pear: 73 cultivars and 33 selections.

For the breeding programme 1270 apple and 1310 pear hybrids are under evaluation.

Update on the Hungarian Malus *and* Pyrus *genebank*

Tibor Szabó and László Csiszár
Research and Extension Centre for Fruit Growing, Újfehértó, Hungary

The conservation of natural genetic material and individual plants with special or valuable biological and agronomical characters for future plant breeding can be carried out only in suitable genebanks. Genebanks contain local varieties, improved and cultivated varieties, natural varieties related to cultivars, different breeders' lines and hybrids.

The need to collect the Hungarian natural genetic resources became urgent in the mid-1970s; the changes in land ownership (establishment of state farms and cooperatives) increased the speed of eradication of the old orchards. In Hungary the Plant Genebank Council and the Ministry of Agriculture commissioned the Research Station of Újfehértó to establish and maintain vegetative field collections of apple (*Malus domestica*), pear (*Pyrus communis*), quince (*Cydonia oblonga*) and medlar (*Mespilus germanica*) for long-term germplasm conservation.

Collecting of genetic resources started in 1978. The large-scale collecting work was finished in 1982, and by 1983 a 5-ha genebank was established, with two trees per accession, on M4, wild pear and quince rootstock. The number of accessions per species is given in Table 1 and fruit ripening periods in Table 2.

Table 1. Material maintained in the genebank of Újfehértó

Accession type	Apple	Pear	Quince	Medlar	Total
Cultural variety	7	12	5	2	26
Superseded variety	10	4	-	-	14
Assortment variety	447	224	7	-	678
Collected local variety	189	182	41	21	433
Collected wild variety	4	19	1	-	24
Hybrid	49	31	1	-	81
Total	**706**	**472**	**55**	**23**	**1256**

Table 2. Ripening time of accessions

	% of accessions ripening in					
Species	July	August	September	October	November	Total
Apple	10	12	30	48	-	100
Pear	9	39	29	23	-	100
Quince	-	-	55	45	-	100
Medlar	-	-	-	-	100	100

Data recording for each accession started in the first year of fruit bearing. Knowledge of the date of flowering and ripening, fruit characteristics and growing habit of the tree allows the identification of varieties and duplicates. Table 3 lists the characters recorded. The identification of all the accessions is difficult because of shortage of funds and qualified staff.

Most of the pear and quince varieties are very susceptible to fire blight (caused by the bacterium *Erwinia amylovora*) and the infection risk is very high in our region (northeastern Hungary) because of the customary warm weather during blossom time. Therefore the Ministry of Agriculture decided to establish a second pear genebank at the Research Station of Fertőd in the northwestern part of Hungary (close to the Austrian border), for safety reasons. All 472 accessions have already been propagated (2 trees/accession) in 2001, and they were planted in spring 2002.

Table 3. Characters recorded in the apple and pear genebank

Accession name	
Site of collection	
Cultivation date of accession	
Date of budburst	Cover of skin (*)
Date of beginning of flowering	Skin thickness
Date of full bloom	Over colour ratio (% of fruit surface covered with over colour)
Date of end of flowering	Lenticel colour
Flower density	Lenticel density
Fruit density	Flesh colour
Harvesting or maturation time	Flesh firmness
Maturity	Taste of the flesh
Fruit size	Smell of the flesh
Fruit picked (kg)	Juiciness of the flesh
Fruit fallen (kg)	Marble pattern of the flesh
Stalk length	Putrescibility of the flesh
Stalk thickness	Openness of ovary
Fruit size (length, width, thickness)	Inside of ovary (**)
Fruit surface	Shape of ovary
Attractiveness	Number of seeds
Ground colour	Trunk circumference (cm)
Over colour	

(*) 1 = rough, rugged; 2 = dry; 3 = waxy (the wax is transparent, e.g. Jonagold); 4 = greasy; 5 = slightly covered with whitish, translucent wax (e.g. Florina); 6 = richly covered with whitish, translucent wax

(**) 1 = spongy; 2 = waxy, greasy; 3 = mouldy; 4 = hollow, cavernous

One of the major pests of pears is pear psylla (*Psylla pyri*). Chemical control is very difficult and expensive; furthermore the mould-covered fruit have hardly any market value. After six years of observation (1996-2001) seven pear varieties in the genebank showed no pear psylla damage. Some of the properties of these varieties can be found in Table 4. Most of these varieties belong to the 'Sommer Christen Birne' type pears, except 'Füge alakú körte' and 'Viki körte'.

Table 4. Some properties of pear varieties tolerant to *Psylla pyri* (Újfehértó, 1996-2001)

Varieties	Picking time	Fruit		Shape index (length/width)	Flesh taste
		length (mm)	width (mm)		
Bókoló körte (Dunaföldvár)	15-25 Aug.	74	65	1.14	sweet-acidic
Füge alakú körte (Velence)	1-15 Oct.	70	62	1.13	sweet-acidic
Nagyasszony körte	20-30 Aug.	77	72	1.03	sweet
Nyári Kálmán (Érd)	20-30 Aug.	80	72	1.11	sweet
Nyári körte (Dunaföldvár)	20-30 Aug.	81	72	1.12	sweet
Rozsnyári körte 2	20-30 Aug.	76	69	1.10	sweet
Viki körte	20-30 Aug.	80	73	1.09	sweet-acidic

Short note on Malus/Pyrus *genetic resources in Ireland*

Doug Dudley and Anita Hayes
Irish Seed Savers' Association (ISSA), Capparoe, Scariff, County Clare, Ireland

The Irish Seed Saver Association (ISSA) has a 3-ha site with two workers on the *Malus* collection for at least the next three years.

There are three collection sites in Ireland:

1. University College of Dublin field station in the East;
2. the Armagh Orchard Trust in the North;
3. Irish Seed Savers' Association at Capparoe, Scariff, County Clare in the West.

Unfortunately Peadar Mc Niece, who ran the Armagh Orchard Trust, died recently and the state of this collection is currently not known. The ISSA now has 230 trees of 117 varieties on various Malling rootstocks (M9, M26, MM106, MM111 and M25). Also 64 accessions from field research, yet to be identified, are conserved. The site is run on biodynamic principles. A survey of self-rooting varieties included in the collection was recently concluded. Work on accession data is planned for 2002. Only five of the 58 varieties that were seen by Dr Lamb in the 1940s are still missing.

ISSA is engaged in an education project on apples for primary schools and also in courses on apple propagation. The propagation of the varieties in the collection for sale to the public is the only way the Irish *Malus* collection can be safeguarded for the future, by being used by the public.

Malus *and* Pyrus *germplasm conservation in Italy*

F. Grassi, M.G. Piazza and A. Sartori
Istituto Sperimentale per la Frutticoltura (ISF), Rome, Italy

The Istituto Sperimentale per la Frutticoltura (ISF), with the support of the Ministry for Agriculture and Forestry Policy (MiPAF), responsible in Italy for plant genetic resources for food and agriculture (PGRFA), is carrying out and coordinating a project on plant genetic resources (Grassi *et al.* 2000a).

One part of this project, aimed at coordinating and harmonizing the *ex situ* collection, conservation, characterization, evaluation and utilization activities on PGRFA in Italy by different institutions, is exclusively focused on the assessment and study of the management and conservation of fruit tree genetic resources present in most Italian research institutes belonging to MiPAF, universities, the National Research Council, regional research centres, NGOs and private sector (Grassi *et al.* 1999; Grassi *et al.* 2000b).

The survey carried out with the public and private sector showed that 27 species of fruit trees, for a total number of 17 377 accessions, are conserved *ex situ.* Peach, apple, pear, apricot, cherry and plum are, in this order, the species with the highest number of accessions (Fig. 1).

Concerning the use, only 8.7% of the accessions are not utilized, while the remaining 91.3% are mainly used for research (47%), breeding (22.3%), germplasm exchange between different scientific institutions (24.3%) and exchange with the private sector (6.4%) (Fig. 2).

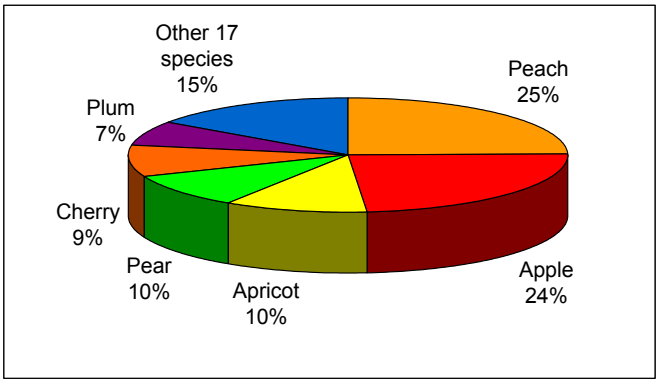

Fig. 1. Distribution of species in Italian fruit collections.

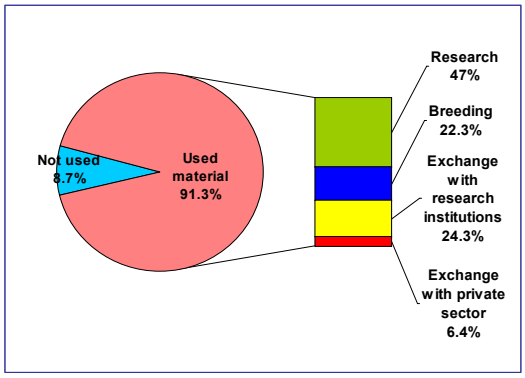

Fig. 2. Uses of the accessions.

There are 29 institutions conserving *Malus* and *Pyrus* germplasm; these include 15 scientific institutions, 5 regional authorities, 2 local authorities, 2 schools, 1 NGO, 2 plant nurseries and 2 farms (Tables 1 and 2). On the total number of accessions, about 49% are of Italian origin. Considering the different species, in general, the local accessions are more numerous in pome fruit than in stone fruit.

Table 1. Italian institutions conserving *Malus* and *Pyrus* germplasm

Institutes	Funding authority	*Malus*		*Pyrus*	
		Total no. of accessions	No. of Italian accessions	Total no. of accessions	No. of Italian accessions
Dip. Agronomia Ambientale e Produzione Vegetale - Univ. di Padova	MIUR[1]	72	54	29	27
Dip. Biotecnologie Agrarie ed Ambientali - Univ. di Ancona	MIUR	26	23	29	6
Dip. Coltivazione e Difesa delle Specie Legnose – Univ. di Pisa	MIUR	12	0		
Dip. Colture Arboree - Univ. di Bologna	MIUR	1233	407	336	154
Dip. Colture Arboree - Univ. di Torino	MIUR	108	79	66	61
Dip. Ortoflorofrutticoltura - Univ. di Firenze	MIUR	18	5	269	97
Dip. Produzioni Vegetali Sez. Ortofloroarboricoltura – Univ. di Viterbo	MIUR	59	47	35	27
Istituto Coltivazioni Arboree – Univ. di Napoli	MIUR	8	3	7	6
Istituto Sperimentale per la Frutticoltura	MIPAF[2]	1484	590	566	303
Istituto Coltivazioni Arboree - Univ. di Palermo	MIUR	21	19		
Istituto di Fruttiviticoltura - Univ. del Sacro Cuore, Piacenza	MIUR	95	55	40	34
Istituto Coltivazioni Arboree - Univ. di Milano	MIUR	68	17		
Dip. Produzioni Vegetali e Tecnologie Agrarie - Univ. di Udine	MIUR	36	6		
Istituto sulla propagazione delle specie legnose – CNR Firenze	CNR[3]	18	5	269	97
Istituto per la Fisiologia della Maturazione e della Conservazione del Frutto delle Specie Arboree Mediterranee - CNR Sassari	CNR	29	29	97	97
RPV - Centro Ricerche Produzioni Vegetali	Regional authority	39	21	25	15
ERSA – Ente Regionale Sviluppo Agricolo Friuli Venezia Giulia	Regional authority	123	123	36	36
ASSAM - Agenzia Servizi Settore Agroalimentare delle Marche	Regional authority	90	90		
Veneto Agricoltura	Regional authority	99	99	19	19
SeSIRCA - Regione Campania Assessorato all'Agricoltura	Regional authority	92	92		
Azienda Sperimentale Agraria Laimburg - Ora BZ	Local authority	179	17		
Comunità Montana della Carnia	Local authority		29		24
Istituto Tecnico Agrario Statale “Fabio Bocchialini” - Parma	MIUR		172		51
Scuola Media Statale “Andrea Balletti” - Reggio Emilia	MIUR		17		

[1] Ministry of Education, University and Research
[2] Ministry for Agriculture and Forestry Policy
[3] National Research Council

Table 2. Private organizations conserving fruit tree germplasm

Institutes		*Malus*		*Pyrus*	
		Total no. of accessions	No. of Italian accessions	Total no. of accessions	No. of Italian accessions
Archeologia Arborea - Perugia	NGO	36	36	18	18
Il Vecchio Melo - Vercelli	Farm	95	90		
Fruttantica - Lecco	Farm	91	70	40	26
Vivaio Clorofilla - Peschiera Borromeo (MI)	Plant nursery	13	9	11	9
Vivaio Dalmonte - Brisighella (RA)	Plant nursery	66	52	32	28

Most of the material collected consists of cultivars (41.4%) and obsolete varieties (36.4%). Other material, generally breeders' selections and of unknown origin, amounts to 14.7%, while landraces represent 7.5% of the accessions (Fig. 3).

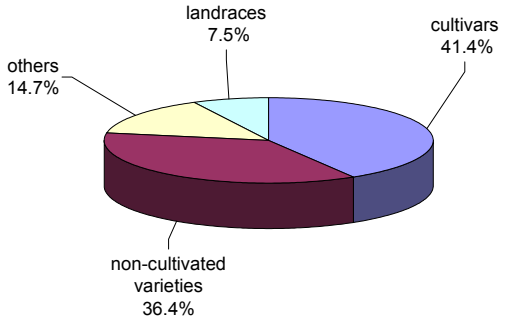

Fig. 3. Type of material collected.

Regarding the risk of genetic erosion, the survey has shown that 67% of the accessions are present in only one institute, and 33% are safety-duplicated in two institutes or more.

Fig. 4 shows the number of apple and pear varieties compared to the total number of accessions, and Fig. 5 the number of unique accessions (foreign and Italian) collected.

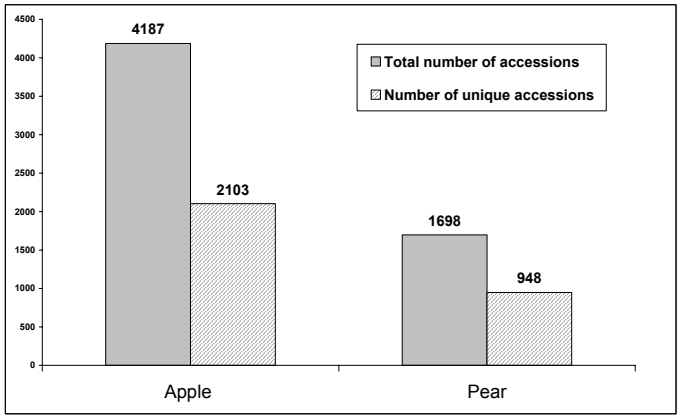

Fig. 4. Comparison between the total number of accessions and the number of unique accessions in apple and pear collections.

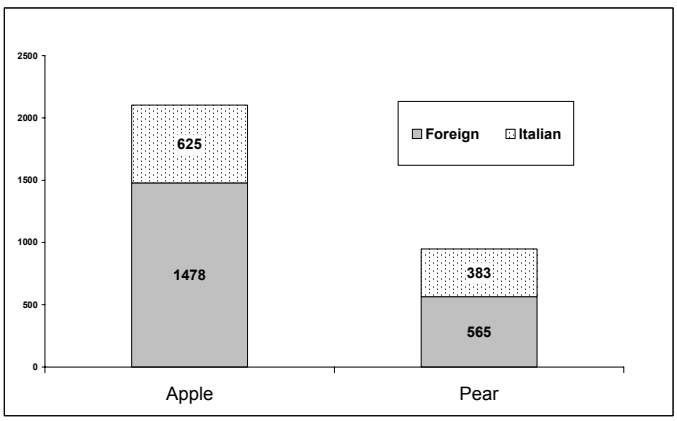

Fig. 5. Unique accessions collected for apple and pear.

In order to harmonize the collection of data, a general minimum descriptor list, suitable for all the species conserved, was defined in collaboration with the PGR managers of the different institutions according to the passport descriptors used by UPOV and IPGRI. This list is given below.

Minimum descriptor list elaborated for the collections of the Agricultural Research and Experiment Institutes (IRSA)

1. Genus
2. Species
3. Subtaxa
4. Collecting Institute code
5. Accession number
6. Accession name
7. Synonyms
8. Country of origin
9. Origin site
10. Accession status (wild, selection, cultivar, landraces, unknown, other)
11. Genetic status of the accession (outbred population, inbred population, pure line strain, clone, mutation, hybrids, synthetic variety, backcross, other, unknown)
12. Accession use (fresh consumption, processing, ornamental, medicinal, wood, animal feed)
13. Type of maintenance (*in vivo*, *in vitro*, cryopreservation, seed and several other methods)
14. Duplication (none, at the same institute, unknown, at another institute)
15. Data collection (morphological, agronomic, biochemical-molecular characterization)
16. Availability of the material (yes/no)

Species-specific descriptors were developed for apple and pear. These are listed below.

Apple-specific descriptors

1. Season of flowering
2. Harvest maturity
3. Fruit shape
4. Fruit size
5. Skin ground colour
6. Skin over colour
7. Type of over colour
8. Russet amount
9. Flesh quality

Pear-specific descriptors

1. Season of flowering
2. Harvest maturity
3. Fruit shape
4. Fruit size
5. Skin ground colour

At present, the only missing data, in order to complete the database according to the minimum descriptors, are the "country of origin" (13%) and the "genetic status" (6%), while for the species-specific descriptors the missing data vary from 10% to 20%.

All the data collected for the accessions conserved will be available on-line this year.

A catalogue of the IRSA collections has been published by ISF, containing a brief description of all plant genetic resources accessions of Italian origin conserved at the IRSA. An associated CD also includes the accessions of foreign origin (Sartori *et al.* 2001). A second catalogue containing passport data of the fruit accessions of Italian origin conserved at the IRSA is in print (Sartori *et al.* 2004; Vitellozzi *et al.* 2004).

Conclusions

In Italy, in spite of the large number of institutions that have been involved for many years in activities related to fruit genetic resources, a pressing need for coordinated action has been identified. Coordination is important to fill up the many gaps still existing in terms of conservation, characterization and exploitation of Italian fruit genetic resources. The project "Plant Genetic Resources" is the first attempt to centralize the information related to conservation, characterization, evaluation and utilization of PGR. Furthermore, the

coordination activity carried out by ISF, particularly on fruit genetic resources, will lead to the establishment in Rome of the "Centro Germoplasma Frutticolo" within the ISF, which will contribute to a more efficient conservation activity both from a technical and an economic point of view.

References

Grassi, F., A. Sartori, F. Vitellozzi and G. Della Strada. 1999. Centro di coordinamento risorse genetiche vegetali: coordinamento delle attività inerenti al germoplasma frutticolo [Coordinating centre for plant genetic resources: coordination of activities related to fruit germplasm]. Italus Hortus 6(4):11.

Grassi, F., F. Vitellozzi, A. Sartori and C. Fideghelli. 2000a. Risorse genetiche ortofrutticole presso gli Istituti di Ricerca e Sperimentazione Agraria: stato, consistenza ed organizzazione delle collezioni [Horticultural genetic resources of the Agricultural Research and Experiment Institutes: status, composition and organization of the collections]. Atti V Giornate Scientifiche SOI (Società Orticola Italiana), 28-30 March 2000, Sirmione. Vol. II:399-400.

Grassi, F., F. Vitellozzi, A. Sartori, G. Della Strada and C. Fideghelli. 2000b. Indagine sul germoplasma frutticolo conservato presso le principali istituzioni di ricerca italiane [Survey of fruit germplasm conserved by major Italian research institutions]. Atti V Giornate Scientifiche SOI (Società Orticola Italiana), 28-30 March 2000, Sirmione. Vol. II:397-398.

Sartori, A., F. Vitellozzi, F. Grassi, G. Della Strada and C. Fideghelli, editors. 2001. Le risorse genetiche vegetali presso gli IRSA [Plant genetic resources conserved by the Agricultural Research and Experiment Institutes]. 2 volumes. Istituto Sperimentale per la Frutticoltura/Ministero delle Politiche Agricole e Forestali, Rome, Italy.

Sartori, A., F. Vitellozzi, F. Grassi, G. Della Strada and C. Fideghelli. 2004. Il germoplasma frutticolo in Italia. Vol. 1: Drupacee [Italian fruit germplasm. Vol. 1: Drupaceous fruits]. Istituto Sperimentale per la Frutticoltura/Ministero delle Politiche Agricole e Forestali, Rome, Italy.

Vitellozzi, F., A. Sartori, F. Grassi, G. Della Strada and C. Fideghelli. 2004. Il germoplasma frutticolo in Italia. Vol. 2: Pomacee e altre specie frutticole [Italian fruit germplasm. Vol. 2: Pomaceous and other fruits]. Istituto Sperimentale per la Frutticoltura/Ministero delle Politiche Agricole e Forestali, Rome, Italy.

Short note on Malus/Pyrus *genetic resources in Macedonia*

Bojan Popovski
Faculty of Agriculture, Skopje, Macedonia F.Y.R.

The establishment of the fruit collection plantations in Macedonia F.Y.R. dates back to 1952. From 1990 to 2002, collecting, maintenance and research on a great number of cultivars of fruit species continued. Important cultivars of apple (180) and pear (90) have been gathered. Over 85-90% of the fruit genetic resources conserved in the country are included in the collections of the Institute of Agriculture in the Department of Fruit Growing in Skopje. Twenty smaller field collections were also established in various production regions throughout the country.

The laboratory for micropropagation in the Department of Fruit Growing is planning to establish an *in vitro* collection of fruit cultivars.

The genetic resources sector is facing a number of problems, including shortage of funds, unofficial introduction of cultivars without adequate documentation of origin and lack of a standardized methodology for description and evaluation.

The compilation of a catalogue with original names of cultivars and their synonyms and local (production) names is also necessary, as well as a standardized national database of fruit species.

Short note on the core apple collection in Randwijk, The Netherlands

Henk Kemp
Fruit Research Station (FPO), Zetten, The Netherlands

Data on the small core apple collection held at the Applied Plant Research (PPO) Sector Fruit, Randwijk, will soon be made searchable on the Internet through CGN's Web site (http://www.cgn.wageningen-ur.nl/pgr/).

Short note on Malus/Pyrus *genetic resources in the Nordic countries*

Inger Hjalmarsson
Nordic Gene Bank (NGB), Alnarp, Sweden

Nordic apple and pear genetic resources are preserved in field genebanks. Denmark and Finland have central collections at KVL-Copenhagen (Royal Veterinary and Agricultural University) and MTT-Piikkiö (Agrifood Resarch Finland) respectively. In Norway and Sweden collections are kept at the national fruit breeding institutes (Planteforsk-Njos and SLU-Balsgård, respectively). In addition Norway and Sweden have numerous small clonal archives, which were established with the aim of maintaining varieties in the area from where they originated. To maintain the collections is a national responsibility, while the Nordic Gene Bank is in charge of the documentation of the material. The work so far has concentrated on collecting passport data for accessions held in the collections. In addition each country has defined a national list for so-called mandate varieties. According to the criteria used, a mandate variety should either originate in the actual country or be a foreign variety with a long growing tradition there. Both local varieties and varieties marketed from national breeding programmes belong to the former group. The number of varieties included on each national list amounts to about 200 apples and 50 pears. However, the number of pear varieties on the Finnish list is lower due to cold climate and limited tradition of pear growing. Future evaluation work will focus on the mandate varieties. National programmes for plant genetic resources are in the process of being established in the Nordic countries. Those programmes also involve fruit genetic resources. The Swedish model will include a central clonal archive (Balsgård) comprising two trees of each national mandate variety. Furthermore, the idea is that each mandate variety should have a corresponding back-up in a selected relevant local clonal archive. The local archives, normally situated in botanical gardens or outdoor museums, have an additional important task in providing information to the public.

Update on the status of the national fruit collections at the Research Institute of Pomology and Floriculture, Skierniewice, Poland

Zygmunt S. Grzyb and G. Hodun
Research Institute of Pomology and Floriculture, Skierniewice, Poland

Fruit tree genetic resources are being maintained in 12 field collections including apple, pear, plum and prune, sour and sweet cherry, peach, apricot, hazelnut, walnut, rootstocks of pome and stone fruits as well as wild species and types of *Malus*, *Pyrus* and *Prunus*. By the end of 2001 the Polish collection included a total of 2316 accessions.

Apple (*Malus* spp.)

The apple collection contains 990 accessions on an area of 2.6 ha. It was increased in 2001 by 39 old local cultivars, mainly collected in the southern part of Poland.

In 1997-2001, 140 cultivars were described pomologically using the UPOV descriptors and the fruit of each cultivar was photographed.

In the growing period, the most important characters are the intensity and time of flowering, yield and time of fruit ripening.

Pear (*Pyrus* spp.)

The pear cultivar collection contains 260 accessions planted on 1.15 ha. It was increased in 2001 by 24 cultivars, mostly local, all obtained from home gardens in the southern part of Poland.

In 1997-2001, 70 cultivars were described according to the UPOV descriptors and the fruit of each cultivar was photographed.

Collections of wild species and hybrids

The wild species and hybrids of *Malus* and *Pyrus* maintained at the Research Institute of Pomology and Floriculture in Skierniewice are listed below. Other wild species of *Malus* and *Pyrus* genera are maintained at the Botanical Gardens and dendrology centres situated in different parts of Poland.

Wild species and hybrids of *Malus* maintained at the Research Institute of Pomology and Floriculture in Skierniewice

M. arnoldiana Rehd.
M. baccata Borkh.
M. baccata (dwarf type)
M. baccata (fructus rubro)
M. baccata type XVI-D-4
M. baccata var. *sibirica*
M. coronaria L.
M. niedzwetzkyana Dieck
M. prunifolia (big fruit)
M. prunifolia Borkh.
M. prunifolia var. Sikora
M. prunifolia XII
M. pumila Mill.
M. pumila Mill. (*praecox)*
M. purpurea
M. robusta A
M. robusta from USA
M. sieboldii var. *colocarpa*
M. sylvestris from Jeleniów
M. sylvestris from Ołtarzewo
M. sp. from China
M. sp. from China (small fruit)
M. virginiana
*M. zumi (*Mats.) Rehd.
Beta Red
Blanche Ames
Everestii - crab (*Malus pumila*)

Wild species and hybrids of *Pyrus* maintained at the Research Institute of Pomology and Floriculture in Skierniewice

P. caucasica Federov
P. caucasica No. 1 from Pruszków
P. caucasica No. 13 from Kraków
P. caucasica No. 14
P. caucasica No. 30
P. caucasica No. 31
P. caucasica No. 35
P. caucasica No. 37
P. caucasica No. 51
P. caucasica No. 53
P. caucasica No. 78
P. caucasica No.1 from Świerklaniec
P. caucasica types Belia, Doria, Elia
P. communis L.
P. communis LA 62
P. communis WW-1
P. sp. from Kirchensaller Mostbirne seedling
P. sp. from Mazowiecka str.
P. sp. Heng-xing
P. sp. O x F 40
P. sp. O x F 69
P. sp. O x F 97
P. sp. P 2263 F 28/120
P. sp. S-5
P. ussuriensis Max
Patten Seckel Sead. 1
'Saharnaja'

Status of Malus/Pyrus *germplasm collections in Portugal*

Eliseu Bettencourt

Genebank, Department of Genetic Resources and Breeding, Estação Agronómica Nacional/Instituto Nacional de Investigação Agrária (EAN/INIAP), Oeiras, Portugal

Introduction

According to Watkins (1979), apples and pears have existed in Europe from prehistoric times and have been cultivated in both Europe and western Asia since at least earliest historical times. Cato noted several varieties of apples and the Elder Pliny listed 22, while both Homer and Pliny recorded the names of many pears.

With their primary centre of origin in the Chinese-Japanese region, the introduction of apple and pear into the Iberian Peninsula occurred in very early times, most probably before the Greeks and Romans who, later on, played an important role in their spread to new regions.

Fruit and vegetable production contributed, in 2000, to 22% of the total Portuguese agricultural production. Fruit represented 38% of this share. In the same year, fresh fruit production occupied an area of 92 000 ha with a total production of 855 MT. The most important groups of fruits – apple, orange, pear, peach, table grape, tangerine and cherry – accounted for 86% of the area and 93% of the total fresh fruit production (GPPAA 2001).

The national degree of self-sufficiency in fresh fruit (except citrus) in the agriculture season of 1999-2000 was 66.6% – an increase over the previous season. Citrus, however, showed a different trend, with self-sufficiency decreasing from 81.9% in 1998-99 to 77.8% in 1999-2000 (GPPAA 2001).

In 2000, apple production in Portugal was 246 MT, occupying an area of 21 200 ha. Apple trade by the producers' associations represented 25% of the total fruit transactions' value. Due to unfavourable weather this represents a substantial reduction of 17% when compared with the previous year (GPPAA 2001).

According to available statistics, the apple orchards can be categorized by age as follows: 31% between 0-4 years; 15% between 5-9 years; 13% between 10-14 years; 34% between 15-24 years; and 7% aged 25 years or more (GPPAA 1997).

Concerning the density of plantations, and citing the same source, the apple orchards are classified as follows: 14% with fewer than 400 trees/ha; 44% with 400-799 trees/ha; 33% with 800-1599 trees/ha; and 9% with 1600 or more trees/ha.

According to 1998 data, the apple production of that year was based on 14 cultivars, 4 of which are national varieties (GPPAA 2000).

In recent years pear production has been very unstable due to adverse weather characterized by late frosts and/or rainfall at blossoming. 1998 production was 90% less than that of the previous year, followed by an increase, roughly five-fold, in the following year. In 2000 the pear crop occupied an area estimated at 12 400 ha with a total fresh fruit production of 110 MT. However, in 1999, exports increased by 43% while imports fell by 13% (GPPAA 2001).

In 2000, sales of pears by producers' associations represented 42.2% of the total value of the pear trade. The most representative fruits – pear, apple and orange – together represented, for the mainland, 81% of the total value of fruit sales (GPPAA 2001). Available data for 1998 indicate that 11 cultivars, including 4 national varieties (GPPAA 2000) were grown.

Pear orchards are slightly older than those of apples. According to the same source (GPPAA 1997) the categories are: 18% between 0-4 years; 16% between 5-9 years; 18% between 10-14 years; 37% between 15-24 years; and 11% aged 25 years or more.

Planting density data are similar to those for apples. The values estimated for 1997 are: 11% with fewer than 400 trees/ha; 47% with 400-799 trees/ha; 38% with 800-1599 trees/ha; and 4% with 1600 or more trees/ha (GPPAA 1997).

Status of germplasm collections

Malus

There are three types of apple germplasm collections in Portugal: collections of genetic variability, collections of traditional varieties, and collections of commercial varieties. All collections are maintained in the field as "field collections".

The first type, collections of genetic variability, refers to a collection of clones of the same variety. There is a germplasm collection of a traditional apple variety called 'Bravo de Esmolfe'. This apple has been known since the beginning of the 18th century and originated in the village of Esmolfe in Penalva do Castelo County, District of Viseu, situated in north central Portugal. Its distribution includes the Beira Interior and Beira Littoral regions. It has a white, sweet and soft pulp, with an intense and pleasant aroma, but low acidity. The variety is protected by a "Denomination of origin" status. The area occupied by this variety is estimated at 140 ha. Planting density is around 400 trees/ha for the older orchards, while for the newly planted ones it is between 800 and 1600 trees/ha (GPPAA 2000).

The collection of genetic variability for the 'Bravo de Esmolfe' was planted in 1997 and includes 149 clones, three trees per clone, all of them grafted on EMLA9 rootstock.

This collection is fully characterized. The morphological characterization was done during the period 1997-2000. The characterization was based on a total of 37 descriptors distributed in the following five groups: trunk (5); branches (9); flower (10); fruit (4); and leaves (9) (Neves *et al*. 2000).

A second collection for genetic variability, for three traditional varieties, is in the process of initiation. Material will be identified, collected and the germplasm field collection planted.

For traditional varieties there are four germplasm collections maintained by different institutions in various regions of the country. The four collections maintain, in total, 246 accessions, each represented by 3 trees and grafted onto EMLA9 and MM106 rootstocks.

For commercial varieties three germplasm collections were identified, maintained by three institutions in different parts of the country. In total, 110 accessions are maintained in the field. In this particular case, different rootstocks are used and different numbers of individuals per accession are maintained.

In the 1990s a screening programme was set up for resistance/tolerance to the root rot fungus (*Roselinia necatrix* Prill.), using wild material of *Malus*, *Pyrus* and *Prunus*. However, since no positive results were obtained, the study was discontinued. As a result, the plant material is no longer kept.

Tables 1, 2 and 3 summarize, for the genus *Malus* and for each type of collection, data on the maintaining institution, germplasm holdings, rootstock used, date of grafting/planting, planting density and number of plants per accession.

Table 1. *Malus* genetic variability germplasm collection

Maintaining institution	Person in charge	Germplasm holdings (no. of clones)	Rootstock used	Date of grafting/ planting	Planting density	No. of plants per accession
Direcção Regional de Agricultura da Beira Litoral (DRABL) – Estação Agrária de Viseu	Engª Arminda Dias Lopes	149	EMLA9	1997	4 m x 1 m	3
Direcção Regional de Agricultura da Beira Interior (DRABI) – Unidade Experimental Qtª Lamaçais – Teixoso	Engº F. Matos Soares / Engº Luís Vaz	3 varieties (? clones)	Collection in the process of installation			

Table 2. *Malus* germplasm collections of traditional varieties

Maintaining institution	Person in charge	Germplasm holdings (no. of accessions)	Rootstock used	Date of grafting/ planting	Planting density	No. of plants per accession
Direcção Regional de Agricultura da Beira Litoral (DRABL) – Estação Agrária de Viseu	Engª Arminda Dias Lopes	158	EMLA9	-	4.5 m x 1 m	3
Estação Nacional de Fruticultura Vieira Natividade (ENFVN) – Alcobaça	Engº Olímpio Jorge	45	MM106	-	4.5 m x 2 m	3
Direcção Regional de Agricultura do Algarve (DRAAl)	Engº Vasco Branco / Engº António Marreiros	14	MM106	1998-95	5 m x 2.5 m	3
Direcção Regional de Agricultura da Beira Interior (DRABI)	Engº F. Matos Soares / Engº Luís Vaz	29	EMLA9	2000	4 m x 1.5 m	3/4/5

Table 3. *Malus* commercial varieties' germplasm collections

Maintaining institution	Person in charge	Germplasm holdings (no. of accessions)	Rootstock used	Date of grafting/ planting	Planting density	No. of plants per accession
Direcção Regional de Agricultura da Beira Litoral (DRABL) – Estação Agrária de Viseu	Engª Arminda Dias Lopes	34	MM106 / EMIX	1989-99	4.5 m x 2 m	11/12/18
Direcção Regional de Agricultura da Beira Litoral (DRABL) – Centro Experimental do Baixo Mondego, Quinta da Capa Rota, Soure	Engº Nuno Neves	18	MM106/ M7, 9, 27, 111/ PAJAM1	1994-95	4 m x 2.5 m	35/70
Estação Nacional de Fruticultura Vieira Natividade (ENFVN) – Alcobaça	Engº Rui Maia de Sousa	50	MM106	1999	4.5 m x 1.5 m	2

Pyrus

In Portugal, and for the genus *Pyrus*, there are three types of germplasm collections: collections of genetic variability; collections of traditional varieties and a reference collection. All collections are maintained in the field as "field collections".

There are two germplasm collections of a traditional pear variety called 'Pêra Rocha'. This Portuguese variety is from a hazard seedling that appeared in the area of Sintra County, District of Lisbon, and is protected by a "Denomination of origin" status. Its main region of production is in the Centre-West region of the country, north of Lisbon. The area occupied by this variety has been expanding due to the market demand.

The collections of genetic variability for the 'Pêra Rocha' were planted/grafted in 1988-89 and in 1989-90, maintaining 113 and 9 clones respectively. The number of trees per clone varies greatly, ranging from 1 single tree to 15 trees. The material is grafted on BA29 and EMA rootstocks.

Traditional varieties are maintained in three germplasm collections holding a total of 104 accessions. All material is grafted on BA29 rootstock. The number of individuals per accession varies from 1 to 7 trees, most of them being represented by 3 or 7 trees each. In two of the three germplasm collections there is a small number of reference varieties maintained, both of Portuguese and foreign origin.

A pear reference collection is maintained near Chaves, in the North. It contains 116 accessions and includes material of Portuguese and foreign origin grafted on BA29 and OHF rootstocks, each variety being represented by five trees.

In order to ascertain the phylogeny and the taxonomy of the wild *Pyrus* species occurring in Portugal, based on a careful survey of material kept in herbaria and field observations, Amaral Franco and Afonso, in 1965, made a detailed botanical description and elaborated a map with the geographical distribution of the species. The species studied were: *Pyrus cordata* Desv., *P. pyraster* Burgsd. and *P. bourgaeana* Dcne. In spite of the careful localization of the species' occurrence, germplasm of the native material was not collected and it is not represented in germplasm collections.

Tables 4, 5 and 6 summarize, for the genus *Pyrus* and for each type of collection, data on maintaining institution, germplasm holdings, rootstock used, date of grafting/planting, density of plantation, number of plants per accession and, in the case of the traditional varieties' collection, number and origin of the reference varieties.

References

Amaral Franco, J. do and M.L. da Rocha Afonso. 1965. Das pereiras bravas portuguesas. [About the Portuguese wild pear trees]. Separata da Revista da Faculdade de Ciências de Lisboa. 2ª Série–C XIII(2):175-213

GPPAA. 1997. Agricultural numbers. Gabinete de Planeamento e Política Agro-Alimentar. Ministério da Agricultura, do Desenvolvimento Rural e das Pescas.

GPPAA. 2000. Anuário Hortofrutícola [Fruit and Vegetables Yearbook]. Gabinete de Planeamento e Política Agro-Alimentar. Ministério da Agricultura, do Desenvolvimento Rural e das Pescas.

GPPAA. 2001. Panorama Agricultura 2000. [Panorama of the agriculture in 2000]. Gabinete de Planeamento e Política Agro-Alimentar. Ministério da Agricultura, do Desenvolvimento Rural e das Pescas.

Neves, N., A. Lopes, D. Ponteira, A. Assunção, A. Crespí and A. Santos. 2000. Projecto PAMAF 6114 – Preservação de variedades regionais de pomóideas na região Centro-Norte. [Project PAMAF 6114 – Conservation of pome fruit local varieties in the Centre-North region].

Watkins, R. 1979. Apple and Pear. Pp. 247-250 *in* Evolution of crop plants (N.W. Simmonds, ed.). Longman, London and New York.

Table 4. *Pyrus* genetic variability germplasm collections

Maintaining institution	Person in charge	Germplasm holdings (no. of clones)	Rootstock used	Date of grafting/ planting	Planting density	No. of plants per accession
Estação Nacional de Fruticultura Vieira Natividade (ENFVN) – Alcobaça	Engº Rui Maia de Sousa	9	BA29	1989-90	4.5 m x 2 m	10
Direcção Regional de Agricultura do Ribatejo e Oeste (DRARO) – Centro Experimental da Qtª de S. João	Engº Amado Ventura da Silva	113	BA29 /EMA	1988-89	4.5 m x 2.5 m	1 to 15

Table 5. *Pyrus* traditional varieties' germplasm collections

Maintaining institution / Responsible person	Person in charge	Germplasm holdings (no. of accessions)	Rootstock used	Date of grafting/ planting	No. of reference varieties (national/ foreign)	Planting density	No. of plants per accession
Estação Nacional de Fruticultura Vieira Natividade (ENFVN) – Alcobaça	Engº Olímpio Jorge	43	BA29	-	-/5	4.5 m x 2 m	3
Direcção Regional de Agricultura da Beira Litoral (DRABL) – Centro Experimental do Baixo Mondego, Quinta da Capa Rota, Soure	Engº Nuno Neves	40	BA29	1998	1/2	4 m x 2.5 m	5
Direcção Regional de Agricultura da Beira Litoral (DRABL) – Centro Experimental do Baixo Mondego, Quinta do Loreto, Coimbra	Engº Nuno Neves	21	BA29	1996	-/-	4 m x 3 m	7

Table 6. *Pyrus* reference germplasm collection

Maintaining institution	Person in charge	Germplasm holdings (no. of accessions)	Rootstock used	Date of grafting/ planting	Planting density	No. of plants per accession
Direcção Regional de Agricultura de Trás-os-Montes (DRATM) – Centro Experimental de Horto-Fruticultura	Engº Orlando Álvaro Meireles	116	BA29/OHF	-	5 m x 2 m	5

Status of the Pyrus *collection in the Russian Federation*

Leonid A. Burmistrov
N.I. Vavilov Research Institute of Plant Industry (VIR), St. Petersburg, Russian Federation

All activities relating to the conservation and evaluation of *Pyrus* genetic resources are supervised and carried out by the Department of Fruit Crops Genetic Resources at VIR. Conservation of the collection is funded by the Russian Academy of Agricultural Sciences. The *Pyrus* collection of VIR consists of a total of 1811 accessions including old cultivars, advanced cultivars, landraces, wild species and hybrids (both intervarietal and interspecific) (Table 1).

Table 1. Status of the pear collection as of 1 Jan. 2002

Status	No. of accessions
Pyrus species	26
Wild species forms	175
Primitive forms	12
Landraces	170
Advanced cultivars	1332
Hybrids	96
Total	**1811**

These accessions are maintained as field collections in orchards at VIR's experimental stations.

- The leading station is the Maikop Experimental Station (located in Maikop, Krasnodar Territory), which is the richest in both the number of accessions and their genetic diversity. All the wild species, as well as local varieties, landraces, primitive forms and modern commercial cultivars occurring throughout the Russian Federation and former Republics of the USSR are maintained there.
- The Far-Eastern Experimental Station (Vladivostok, Maritime Territory) stores indigenous germplasm, especially forms and cultivars of Ussurian pear (*Pyrus ussuriensis* Maxim) collected in this region of the country.
- The Volgograd Experimental Station (Krasnoslobodsk, Volgograd Region) maintains in its collection many local pear varieties and landraces from the Lower Volga River Region.
- The Pushkin Branch of VIR (Pavlovsk, Leningrad Region) has accumulated northern winter-hardy cultivars.

Also, indigenous wild pear species of different origins are collected by exploration missions in the country and abroad and incorporated into VIR's collections.

The quarantine regulations in the Russian Federation are strict enough. The following restrictions are applied to pear accessions (imported): budwood from North-American and some European countries must be from the stocks under regular plant quarantine supervision, in which no occurrence of fire blight has been found. The imported material has to be free from all dangerous virus and mycoplasma diseases. This has to be stated in the phytosanitary certificate.

The pear accessions in VIR's collection are evaluated for morphological and biological characteristics as well as agronomic traits.

The main task at hand is the consolidation of these evaluation data through several years of observation. Direct results of the evaluation of VIR's collections led to the publication of catalogues containing information about various cultivars and wild species for further use by breeders.

VIR's experimental stations also supply initial genetic material to research institutions and breeding centres in Russia. Pear germplasm is provided upon request and is used in plant breeding programmes. These programmes on pear have been developed for and carried out in all major climatic regions of the country.

The Malus/Pyrus *collections in Slovenia*

Metka Hudina

University of Ljubljana, Biotechnical Faculty, Department of Agronomy, Institute for Fruit Growing, Viticulture and Vegetable Growing, Ljubljana, Slovenia

In order to preserve as much valuable fruit plant material as possible, the Department of Agronomy of the Biotechnical Faculty, Ljubljana, started collecting fruit cultivars in 1992. They were planted in the area of the Pleterje Carthusian monastery, a perfect location owing to its suitably isolated plots. Over the period 1992-1995, 116 apple and 48 pear varieties were gathered and grafted onto rootstocks (Beurré Hardy). Apple and pear trees were planted in 1994 and 1996 respectively. The apple trees were grafted onto M11 rootstock. Five trees were planted for each accession.

Tables 1 and 2 list the apple and pear cultivars stored in the genebank.

Table 1. Apple cultivars collection in Slovenia

Cultivar	Cultivar	Cultivar
1. 55185 Pesnica	40. Herbertova reneta	79. Pisani kardinal
2. Akane	41. Imperial mcintosh	80. Priam
3. Alkmene	42. Ingol	81. Priolov žlahtnik
4. Ananasova reneta	43. Jakob lebel	82. Priscila
5. Arlet	44. Jamba	83. Puhovka
6. Aurora	45. James grieve	84. Quinte
7. Baumanova reneta	46. Jerseyred	85. Rdeči astrahan
8. Belfler	47. Jonadel	86. Red stayman
9. Beli zimski kalvil	48. Jonatan	87. Red transparent
10. Belični k	49. Kanada	88. Red winston
11. Berlepševa reneta	50. Karla	89. Ribstonski peping
12. Berlon	51. Karmelitska reneta	90. Ropotač
13. Bismark	52. Karmijn	91. Rubin
14. Blauacher wadenswil	53. Koksova	92. Salgirska
15. Blenheimska reneta	54. Krivopeceli	93. Saljut
16. Bobovec	55. Lepocvetka	94. Sevastopolska
17. Bojkovo jabolko	56. Liberty	95. Solnečna
18. Bordin	57. Lobo	96. Spartan
19. Borodobna	58. Londonski peping	97. Šampanjska reneta
20. Boskopski kosmač	59. Lonjon	98. Šampion
21. Burgundy	60. Lord lambourne	99. Šarlamovski
22. Carievič	61. Macfree	100. Šmitbergerjeva reneta
23. Charden	62. Majda	101. Štajerski mošancelj
24. Close	63. Mantet	102. Štajerski pogačar
25. Damasonka	64. Mečta	103. Tavira
26. Debela vahna	65. Medenček	104. Tydeman
27. Delbare estivale	66. Melrose	105. Velika vahna
28. Doleniska voščenka	67. Merton worcester	106. Vista bella
29. Ducat	68. Mollies Delicious	107. Vivanka
30. Evrika	69. Mutsu	108. Zap. št. 33 Pesnica
31. Fantazja	70. Nova easygro	109. Zelenec
32. Francoski kosmač	71. Nova mac	110. Zeleno zimsko jabolko
33. Gdanski robač	72. NY18491	111. Zgodnja jesenska Kavčič
34. Glockenapfel	73. NY623452	112. Zgodnja Kavčič
35. Gloria	74. Obilnaja	113. Zgodnja zimska
36. Gloria mundi	75. Odin	114. Zgodnje zimsko Kavčič
37. Goldjon	76. Ontario	115. Zimski (es.) ramburn
38. Goreniska voščenka	77. Ozark gold	116. Zlata parmena
39. Grafenštajnc	78. Paradox	

Table 2. Pear cultivars collection in Slovenia

Cultivar		Cultivar	
1.	Amaniiska	25.	Passa crassana
2.	And Des Portes	26.	Petrovka
3.	Avranška	27.	Pirus Vilmos
4.	Branquila	28.	Pituralka – Ozimka
5.	Bučka	29.	Raimerred
6.	Canalred	30.	Rana Viljamovka
7.	Concord	31.	Rdeča Viliamovka
8.	Dišečka	32.	Red Butira Hardy
9.	Druardova	33.	Risovka
10.	Ercoler Dieste	34.	Rogverd
11.	Farovšca	35.	Rosada
12.	Hardijeva	36.	Rosired
13.	Hartilian	37.	Salzburgerca
14.	Harvest	38.	Santa Maria
15.	Hruška – Kog	39.	Sensation
16.	Ivanščica	40.	Sirene
17.	Japonska Moštnica	41.	Slavonska
18.	Julijska lepotica	42.	Sršenka
19.	Klapovka	43.	Starkrimson
20.	Konferans	44.	Šmarješca
21.	Kresnica	45.	Trevuška
22.	Madame Verte	46.	Verdi
23.	Margarit Marillat	47.	Viljamovka
24.	Moretinijeva	48.	Zimska postrvka

Observations started immediately after planting; however, thorough observations of the apple trees were carried out in 2000 when most of the cultivars started bearing fruit. The observations were based on the previously defined descriptors.

In 2000 the growth and fruitfulness were described in 116 apple cultivars, as well as the cultivars' resistance to pests and diseases. In 102 cultivars there were enough fruit to determine the time of optimal technological maturity. The current year's data on optimal technological maturity differ somewhat from those of previous years. This may be due to the extremely hot season. Ten fruits of each of the 102 cultivars were described in detail.

During the observations made in 2000 on 48 pear cultivars the following properties were described: growth, fruitfulness and resistance to pests and diseases. In 18 cultivars the optimal technological maturity was also determined in 2000 and the fruit were described (10 fruits/cultivar).

In the cultivars mentioned above the phenological development was observed (beginning, peak and end of flowering, date of maturity), as well as growth, fruitfulness, onset of diseases and occurrence of pests (for apple: apple scab, sooty mould, aphids, red fruit mite; for pear: pear scab, pear psylla, red fruit mite). The height, width, weight, firmness of fruits, contents of individual sugars and organic acids were also measured.

The growth and fruitfulness were evaluated according to the following scale:

1. not vigorous
2. not or moderately vigorous
3. moderately vigorous
4. moderately vigorous to very vigorous
5. very vigorous

Disease and pest incidence was evaluated as follows:

1. no visible signs
2. a few signs visible
3. 5% of leaves (organs) infected
4. 5 to 20% of leaves (organs) infected
5. 20% of leaves (organs) infected
6. 20 to 50% of leaves (organs) infected
7. 50% of leaves (organs) infected
8. 50 to 75% of leaves (organs) infected
9. more than 75% of leaves (organs) infected.

In future years observations will concentrate on the cultivars considered indigenous and therefore useful for breeding purposes in Slovenia and other parts of the world.

Update on Malus *and* Pyrus *collections in Spain*

Enrique Dapena de la Fuente
Servicio Regional de Investigación y Desarrollo Agroalimentario del Principado de Asturias (SERIDA), Villaviciosa, Spain

The Spanish Programme for the conservation and use of plant genetic resources is coordinated by INIA (Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria). Management of the genetic resources is decentralized.

Apple collections

In Spain the apple collections are located in the north (Fig. 1).

Fig. 1. Geographic distribution of apple collections in Spain.

The Spanish collections maintain a total of 1543 accessions of apple cultivars (Table 1).

Table 1. Composition of the Spanish apple collections

Institution	No. of accessions	Type of material
Apple Germplasm Bank - SERIDA (Servicio Regional de Investigación y Desarrollo Agroalimentario del Principado de Asturias) (Asturias)	800	525 Asturian cider apple cultivars 57 Basque cider apple cultivars 25 French and English cider apple cultivars 35 Asturian eating apple cultivars 19 Galician eating apple cultivars 22 other national eating apple cultivars 109 old and new foreign apple cultivars 8 clones of wild *Malus* species
Regional collection - CIA (Centro de Investigación Agraria de Galicia) (Galicia)	350	local cultivars
Regional collection - UPN (Public University of Navarra)	282	local cultivars
Regional collection - Estación Aula Dei CSIC (Centro Superior de Investigación y Ciencia) in Zaragoza	64	local cultivars
Regional collection - UL (University of Lleida)	47	local cultivars
Total	**1543**	

Each germplasm bank is financially supported by its corresponding Autonomic Community (regional government) and the INIA, through the previously mentioned plan.

Documentation: the available information is shown in Table 2.

Table 2. Data documented

	SERIDA	CIA Galicia	UPN Navarra	CSIC Zaragoza	UL Lleida
Passport data	yes	yes	yes	yes	yes
Characterization data	115 Asturian cultivars	yes	yes		
Evaluation data					
Agronomic characters	325 cultivars				
Technological characters	115 cultivars				
Primary evaluation		yes	yes	yes	yes
Isoenzymatic analysis		yes	yes	yes	yes
SSR analysis	(work in progress)				

Pear collections

The Spanish collections maintain a total of 223 accessions of pear cultivars (Table 3).

Table 3. Composition of the Spanish pear collections

Institution	No. of accessions	Type of material
National Pear Germplasm Bank - SIA-DGA (Servicio de Investigación Agroalimentaria de la Diputación General de Aragón)	148	71 Spanish cultivars of which 38 have been collected in the period 2000-01
Collection in University of Lleida	75	
Total	**223**	

Documentation: the following data are available:

- Passport data
- Evaluation data in the SIA-DGA collection. Primary evaluation at the University of Lleida.
- Characterization data: in progress.

Swiss activities in fruit genetic resources conservation, 1997-2002

Monica Goerre

Swiss Federal Research Station for Fruit-Growing, Horticulture and Viticulture (FAW)[17]*, Wädenswil, Switzerland*

Multiplication effect after Rio 1992

The Global Plan of Action (Leipzig declaration, 1996) was the basis for the Swiss national plan of action, finalized in 1997. Among other observations, the national plan revealed major gaps in fruit variety conservation (BLW 1997). For this reason fruit genetic resources had a high priority in the first call for projects by the Swiss Federal Agricultural Office in 1998-99. Eleven projects were accepted in 1999, which provided opportunities for significant progress in fruit genetic resources conservation. Projects with a 4-year duration (1999-2002) could be proposed. These include those listed in Table 1.

Table 1. Fruit projects accepted by the Swiss government in 1999

Project	Responsible organization	Executing organization
National concept on conservation of fruit genetic resources and international cooperation	SKEK (Swiss Commission on the conservation of crop plants)	Swiss Federal Research Station for Fruit-Growing, Horticulture and Viticulture, Wädenswil
National fruit genetic resources inventory	Fructus	Swiss Federal Research Station Wädenswil
National fruit genetic resources database	Pro Specie Rara	Pro Specie Rara
On-farm conservation	Pro Specie Rara	Pro Specie Rara
Long-term conservation of fruit genetic resources (methods, support for field collections)	Fructus	Fructus
Inventory of nut genetic resources in western Switzerland	Fructus	Fructus and University of Applied Horticultural Sciences, Nyon
Conservation of chestnut genetic resources in southern Switzerland	Fructus	Swiss Federal Research Institute for Landscape, Forest and Natural hazards, Birmensdorf
Pomological characterization of a pear collection	Rétropomme	Rétropomme
Collection of Swiss small fruit varieties	Pro Specie Rara	Pro Specie Rara
Regional collection of stone and pip fruit at Roggwil (Thurgau)	Association fruit collection Roggwil	Association fruit collection Roggwil

- **Main points of the Swiss fruit conservation system**

Thirteen private organizations are involved in the conservation of old fruit varieties, partly since the 1970s. This decentralized structure will be retained. These organizations are in charge of all existing collections. It is therefore important to establish a national coordination, accompanied by a national database where all the decentralized data can be collected, evaluated and fruit genetic resources monitored. For some aspects a professional support system should be established.

[17] As of 01.01.2004 name changed to "Agroscope FAW Wädenswil".

- **Main points in the national concept**

With this rather complicated existing structure it seemed useful to develop a national concept on the conservation of Swiss fruit genetic resources. The concept gives a description of the *status quo* and on this basis proposes and defines several new elements (Goerre 2000). A definition of the varieties to be conserved in Switzerland is given. The main criteria are Swiss origin or strong sociocultural relation to Switzerland or, as the only qualitative criteria, extraordinary traits of a variety. Varieties will be conserved temporarily if they are not available from abroad, or not truly identified, or of uncertain origin.

Several standards are defined:

- standards for the minimal health status of accessions (to avoid spreading of fire blight, soil-borne viral diseases, plum pox virus);
- standards for evaluation plots (defined rootstocks, at least 2 replicates);
- standards for long-term conservation: there are 2 levels: (i) for the minimal conservation type (not particularly interesting varieties, at least from a short-term point of view) 2 semi-standard trees at 2 different sites; (ii) for the optimal conservation type: 2 semi-standard trees at 3 different sites and 2 standard trees either at 1 or at 2 sites (in total 8 trees per variety).

A protocol to assess the conservation value of a variety has been defined, high conservation value leading to optimal conservation and low value leading to minimal conservation.

Additional projects have been proposed in the concept in order to fill the existing gaps (see below, "Work planned for the future ").

The total annual costs of the conservation for an estimated number of 5000 varieties amount to about 1.5 million EURO (= 2.4 million CHF). This includes payment for most activities which so far have been carried out on a voluntary basis.

Current status of fruit genetic resources conservation as of May 2002, last year of the first 4-year-phase

- **National concept on the conservation of fruit genetic resources and international cooperation**

The concept was completed in 2000. Meanwhile several NGO partners, together with the research station Wädenswil and the Swiss Federal Institute of Technology, Zürich applied for an additional project on molecular identification of fruit genetic resources as proposed in the concept. A small pilot trial on cryopreservation of dormant apple buds is also underway.

For the international cooperation the Swiss *Prunus* data have been collected from the individual organizations and been updated by now.

Malus and *Pyrus* data are not yet collected and updated. After discussion with the manager of the existing and future multicrop passport database and the officer in charge of the newly developed national fruit genetic resources database, it was agreed that data entry from the organizations should be achieved by the end of summer 2002. They will then be sent also to the European databases.

- **National networking**

Before much work can be done, the different players engaged in conserving fruit genetic resources have to get used to working together. Coordination has to be established with an efficient structure and easy and democratic decision procedures. This takes time, as everybody involved in the National Plan of Action projects probably has experienced in the last two years. The national working group for fruit genetic resources of the Swiss Commission on the conservation of crop plants (SKEK) is the existing coordination group.

Within it a pomological and a technical subgroup have been defined in 2001. It was agreed that the project proposals for the second phase should be first discussed in the working group and forwarded to the Swiss Federal Agricultural Office with a recommendation of the group.

- **National fruit genetic resources inventory**

By the end of 2001 about 2/5 of the Swiss territory had been inventoried. The project is planned to run for 3 more years.

Results achieved so far:

- 1000 varieties worth being conserved were visited, labelled and located on maps and their traits and health status described. 250 interesting and rare varieties are already propagated for planting in collections. Graftwood of 700 varieties has been ordered from the original site of the varieties.
- Dozens of lost varieties have been rediscovered, hundreds of yet unknown local varieties have been found.
- Approximately 3000 varieties have been described in the database.
- Evaluation of the rarity of the identified varieties is continually being revised.

For the inventory the following method is applied: early in spring a questionnaire is sent to farmers and horticulturists in the part of Switzerland that will be inventoried next. The addresses are from the cantonal agricultural or horticultural offices (Switzerland is divided into 26 cantons with autonomy in many areas like education, street building and maintenance, police, etc.). At the same time a public campaign in this region also draws the attention of individuals to this activity and encourages everyone to send information about their own varieties to the project office. Much public interest in collecting and saving fruit varieties can be observed everywhere.

For each reported variety a short description should be given by the owner or curator. With the help of these characterizations the questionnaires are evaluated: well-known varieties are excluded, unknown varieties or varieties with unknown names are taken into consideration. If they seem interesting, the trees are visited, described on the spot, pictures are taken, the trees are labelled with durable labels (aluminium), their health status is assessed, fruit samples are tasted and described or samples ordered if not yet ripe. A number of varieties can be identified every year from fruit samples. Averaged over the last 2 years, 20% remains unidentifiable. For this work in the field mostly local experienced horticulturists are employed on an hourly payment basis. They are trained at the beginning of the season. The data collected are sent to the project office and entered into the database. After the end of the season the varieties suitable for conservation have to be sorted out. Then graftwood is ordered and given to a nursery for propagation.

- **National fruit genetic resources database**

The database is fully designed. Data from Pro Specie Rara and the inventory project are integrated. The data from other organizations are not yet entered.

Procedures on how to work with the data have to be defined: regular updating, decision procedure in case there are several descriptions of the same variety, verification procedure, access allowances and restrictions. A rough, but not verified overview of the conserved varieties and numbers of duplicates can be expected as soon as most data are entered. Coordination with the national multicrop passport database containing all collected crop species of Switzerland is sought.

- **Long-term conservation of fruit genetic resources**

Detailed task lists, more or less in accordance with the national concept, are being elaborated. The state of most of the existing collections has been evaluated in order to decide which need to be supported.

Most of the work for conserving fruit genetic resources has so far been carried out on a voluntary basis. But with new tasks to be carried out, the amount of work for every organization increases and cannot be expected to be done voluntarily. There must be a reward system and for the sake of steady progress it should be established soon. Voluntary workers will not be able and willing to attend several meetings of the working group each year. But their active involvement in developing the national strategy is important.

- **Regional collection of stone and pip fruit in Roggwil**

The association Roggwil (in the Canton Thurgau, northeastern part of Switzerland) has finished this spring with planting all 320 planned varieties (first planting in 1994 on a private basis). One standard tree per variety is planted. Duplication of this plot will be necessary. The association plans to plant an evaluation plot on half stem for first observation, identification and description of newly discovered local accessions.

Work planned for the future

Missing topics in fruit conservation have been pointed out in the national plan of action of 1997 as well as in the national concept in 2000. In the concept new projects are proposed in order to fill the gaps:

- centralized management of graftwood distribution and of a small nursery for old varieties, separate from those used commercially (for phytopathological reasons);
- identification of fruit varieties by molecular methods;
- evaluation of varieties (pomologically, agronomically and socioculturally);
- development of methods for cryopreservation of budwood and of a cryopreserved duplicate collection of pip fruit varieties (free from fire blight);
- legal aspects of information management and international graftwood exchange from national collections;
- promotion of conserved varieties so that they are used again.

It is hoped that these topics will be implemented sooner or later in order to conserve the Swiss fruit genetic resources efficiently and carefully.

References

BLW. 1997. Bericht über die Umsetzung des globalen Aktionsplanes der FAO in der Schweiz zur Erhaltung und nachhaltigen Nutzung der pflanzengenetischen Ressourcen für Ernährung und Landwirtschaft, 1997. Bericht des Eidgenössisches Volkswirtschaftsdepartmentes, Bundesamt für Landwirtschaft (BLW) [Report on the implementation in Switzerland of the FAO Global Plan of Action for the conservation and sustainable utilization of plant genetic resources for food and agriculture, 1997. Report of the Federal Department of Economic Affairs, Federal Office for Agriculture], Bern, Switzerland.

Goerre, M. 2000. Konzept zur Obsterhaltung in der Schweiz. Eigendruck, erhältlich an der FAW Eidg. Forschungsanstalt Wädenswil und bei der Geschäftsstelle der SKEK/CPC an der Forschungsanstalt Changins in Nyon [Concept for fruit conservation in Switzerland. Document available from the Federal Research Station for Horticulture (FAW) Wädenswil and from the SKEC/CEC office at Research Station Changins (RAC) in Nyon, Switzerland].

Current state of the United Kingdom National Apple and Pear Collections

Emma-Jane Lamont
National Fruit Collections, Imperial College, Faversham, Kent, United Kingdom

The National Apple Collection

The composition of the National Apple Collection is shown in Table 1.

Table 1. Contents of the UK National Apple Collection

	No. of accessions	% of total
Number of culinary/dessert apple accessions	2176	
unknown varieties	125	
unnamed seedlings	28	
Number of named culinary/dessert apple accessions	2023	93
Number of cider apple accessions	106	
unknown varieties	4	
unnamed seedlings	1	
Number of named cider apple accessions	101	95
Total number of named apple accessions	**2124**	**93**
Total number of apple accessions	**2282**	

Verification status of accessions in the National Apple Collections

A current project at the UK National Apple Collection is verification of accessions against published pomological descriptions. The aim is to verify 95% of accessions against published descriptions where available. This project builds on the work of M.W.G. Smith, who verified many of the accessions for her publication *National Apple Register of the United Kingdom* (Smith 1971). Since 1971 several hundred accessions have been added to the collections and new books and papers describing apple varieties have been published. In addition, many old books that were unavailable to Ms Smith have been surveyed. Table 2 shows the number of accessions verified.

Table 2. Verification of the status of accessions in the National Apple Collection

	No. of accessions	% of total
Number of accessions for which published descriptions have been obtained (**excluding** the National Apple Register*)	1541	68
Number of accessions that have been verified against published descriptions (**excluding** the National Apple Register*)	1196	52
Number of accessions for which published descriptions have been obtained (**including** the National Apple Register*)	1855	81
Number of accessions that have been verified against published descriptions (**including** the National Apple Register*)	1510	66
Total number of apple accessions	**2282**	

* Several hundred apple varieties were described in the National Apple Register with no reference to other published descriptions.

Information known about accessions in the UK National Apple Collection

The archives have been searched for passport data and this was digitized, so that the donation date and donor name is now readily available for almost all apple accessions. In addition, the literature survey has provided information about the place and date of origin for a large proportion of apple varieties in the collection. Where known, the parentage of varieties has been entered into the database.

Table 3. Information available for the accessions in the National Apple Collection

	No. of accessions	% of total
Accession donation date known	2247	98
Accession donor identity known	2166	95
Variety date of first published record	1863	82
Variety country of origin known	1837	80
At least one parent known	791	35
Total number of apple accessions	**2282**	

Fig. 1 shows the date of the first published record for apple varieties in the UK collection. Just over half of the varieties in the collection for which data is available appeared in the 20th century, or were first recorded then. Just over 40% of the varieties in the collection appeared or were first recorded in the 19th century. Comparatively few of the varieties date back to before 1800, or at least there is no published evidence to date the varieties to the 18th century or earlier.

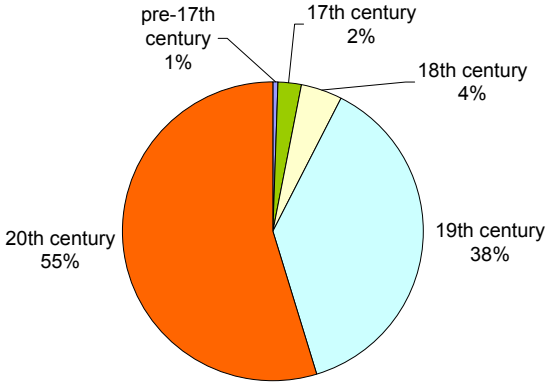

Fig. 1. Date of first record of apple varieties in the UK National Apple Collection (data obtained for 1863 accessions).

Fig. 2 shows that 44% of the apple varieties for which a country of origin is known originated in the UK. Large numbers of varieties in the collection originated in France, the USA, Germany, the Netherlands and Canada. The collection also includes smaller numbers of varieties from many countries including almost all European countries, some Asian countries, Australia, New Zealand and South Africa.

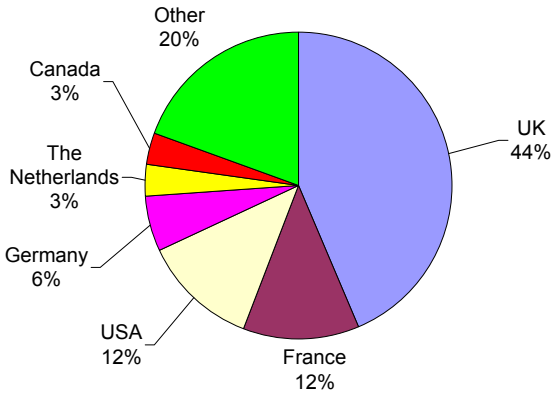

Fig. 2. Country of origin of varieties in the UK National Apple Collection (data obtained for 1837 accessions).

Th e UK National Pear Collection

Donor details for the pear collection have also been digitized and the literature surveyed for historic information about the varieties. However, at present, verifying the apple collection is of a higher priority than verification of the pear collection.

Table 4. Information available for the accessions in the National Pear Collection

	Total	% of total
Accession donation date known	485	97%
Accession donor identity known	454	91%
Variety country of origin known	342	69%
Variety date of first record	352	71%
At least one parent known	123	25%
Total number of culinary/dessert pear accessions	498	
Total number of named culinary/dessert pear accessions	**473**	**95%**

References

Smith, M.W.G. 1971. National Apple Register of the United Kingdom. Ministry of Agriculture, Fisheries and Food, London.

Malus *and* Pyrus *germplasm in Yugoslavia*

Dušan Gvozdenović
Faculty of Agriculture, Novi Sad, Yugoslavia F.R.

Since the last meeting of the Working Group on *Malus/Pyrus*, activity has been very limited. However the work of a few institutions and their breeders ensured the preservation of the collections and their partial expansion with introduced varieties. Paunović (1996) and Mratinić (1998) described the status of this germplasm in Yugoslavia. It appears that the local genetic potential could still be enhanced through germplasm collection.

Malus and *Pyrus* germplasm is conserved by research institutes and faculties. Non-governmental organizations are not involved.

Although it is known that a significant number of *Malus* and *Pyrus* varieties and species are conserved, complete records are not available and the high rate of duplication has made it impossible to record the actual number for Yugoslavia (Tables 1 and 2). This task is to be carried out in 2002.

Table 1. Number of *Malus* accessions in Yugoslavia*

Institution	Foreign cultivars	Indigenous	Hybrids or selections	Wild species
Center for Fruit Growing, Čačak	222	57	191	24
Faculty of Agriculture, Belgrade	98	242	-	-
Faculty of Agriculture, Novi Sad	132	87	265	12
PKB, INI Agroeconomic, Belgrade	19	11	6	-
Agricultural Institute, Podgorica	25	-	-	-

* Most collections are maintained *ex situ*.

Table 2. Number of *Pyrus* accessions in Yugoslavia*

Institution	Foreign cultivars	Indigenous	Hybrids or selections	Wild species
Center for Fruit Growing, Čačak	197	22	12	-
Faculty of Agriculture, Belgrade	131	135	-	-
Faculty of Agriculture, Novi Sad	79	41	83	-
PKB, INI Agroeconomic, Belgrade	3	-	-	-
Agricultural Institute, Podgorica	-	-	-	-

* The number of accessions *ex situ* and *in situ* has not been determined.

The basic principles of apple breeding based on Yugoslav and foreign sources of genetic variability are:

- selection of the parents presenting the best combination of good disease resistance and agronomic characters,
- hybridization and selection of the columnar type of apple resistant to diseases.

Although the number of accessions of *Pyrus* varieties recorded is high, a considerably smaller number is found in active collections. Great efforts should be invested in the protection of the indigenous germplasm, especially in *ex situ* conditions (Fischer *et al.* 2000).

The data for *Malus* variety have been obtained mostly according to the modified IBPGR descriptors.

A computer program for data gathering on varieties has been developed; most of the characters are recorded according to a numeric scale.

Conclusion

The limited financial support for systematic work and coordination has resulted in similarly limited results. In the near future, the basic task will be to compare and systematize the data from the five institutions dealing with these accessions. The analysis of the collecting and evaluation data showed that the methods used were not similar and that some data were missing for some characters. A common methodology needs to be developed and followed by all those involved, so that all biological and technological characteristics of particular accessions are recorded consistently. Special attention should be paid to the evaluation of the fruit quality and in particular the resistance to diseases and unfavourable ecological conditions. Greater attention should be paid to the work on wild species and indigenous varieties of apples and particularly pears, considering that sources of biodiversity are still available. The protection of the most valuable indigenous genotypes will require financial support from the state to avoid further loss of genetic material.

References

Fischer, M., M. Geibel and C. Fischer. 2000. Work on fruit genetic resources in Germany and using results in fruit breeding and production. Jugosl. voćar. 34(129-130):21-31.

Mratinić, E. 1998. National conservationof *Malus/Pyrus* germplasm in the Federal Republic of Yugoslavia. Pp. 62-64 *in* Report of a Working Group on *Malus/Pyrus*. First meeting, 15-17 May 1997, Dublin, Ireland (L. Maggioni, R. Janes, A. Hayes, T. Swinburne and E. Lipman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

Paunović, A.S. *et al.* 1996. Banka gena voćaka Jugoslavije: genetički resursi i mogućnost konzervacije germplazme voćaka [Fruit Gene Bank of Yugoslavia: genetic resources and conservation **possibilities** of fruit germplasm]. Jugosl. voćar. 30(113-114):39-50.

Collection, evaluation and use of wild species of *Malus* and *Pyrus*

Research in Belgium on wild Malus

Marc Lateur

Département Lutte Biologique et Ressources Phytogénétiques, Centre de Recherches Agronomiques (CRA), Gembloux, Belgium

A new Federal scientific project entitled "Studying apple biodiversity: opportunities for conservation and sustainable use of genetic resources" has been set up. The initial work has been done by the CLO-DvP (Agricultural Research Centre, Department of Plant Genetics and Breeding), Gent (E. Coart, I. Roldán-Ruiz) and the project is coordinated by KUL (Catholic University of Leuven) (Prof. W. Keuleman) with the following partners: CRA (Centre de Recherches Agronomiques) (B. Watillon and M. Lateur), the CLO-DvP, the regional Forest Institutes, CRNFB (Nature, Forests and Wood Research Centre) (D. Jacques), IBW (Institute for Forestry and Game Management), (K. Vander Mijnsbrugge) and a NGO, NBS **(**National Orchard Society) (L. Royen). The first action is to make an inventory and to collect in Belgium, and especially in the south of the country, a representative sample of the *Malus sylvestris* diversity still existing in the wild. The aim of this project is to develop 'ready-for-use' conservation strategies for wild apple biodiversity in Belgium, based on a thorough evaluation of the present diversity within the *Malus* genepool. In addition, the information gathered will also provide the apple breeder with basic knowledge and suitable technologies for the exploitation of natural resources of wild apple and old regional varieties of *M.* x *domestica* in apple breeding programmes.

First of all, the vast majority of wild apple trees in Belgium will be mapped and leaf and graft material collected (we expect to collect material from ca. 800 trees). Material from 500 old regional varieties and 100 modern varieties will also be included in the study. The phenotypes of all trees will be described, including morphological parameters and disease resistance traits. By applying different types of molecular markers in combination with morphological traits, different levels of organization of the genetic diversity will be studied. An in-depth study of the Belgian *Malus* genepool will be enabled through the use of neutral molecular markers (microsatellites and SSAP, an AFLP-like method to visualise retrotransposon insertions), study of functional diversity (markers derived from sequences of gene families involved in disease resistance and fertility traits) and investigation of phylogenetic origins.

This study will result in an extensive description of the biodiversity of the Belgian *Malus* genepool, reveal information on the present distinctness between wild and cultivated apples, and give insights into past and present hybridization events. Based on these findings, conservation guidelines will be devised together with stakeholders and end-users. The participation of many end-users in the project provides a strong group of partners willing to implement the developed conservation guidelines.

The usefulness of wild apple trees and regional varieties to expand the genetic basis of current apple breeding programmes will be determined. Finally, the applied techniques and designed strategies will be evaluated for use in conservation programmes for related Rosaceae species (*Pyrus pyraster, Prunus spinosa, Prunus avium*).

See also:

Coart, E., X. Vekemans, M.J.M. Smulders, I. Wagner, J. van Huylenbroeck, E. van Bosckstaele and I. oldán-Ruiz. 2003. Genetic variation in the endangered wild apple (*Malus sylvestris* (L.) Mill.) in Belgium as revealed by amplified fragment length polymorphism and microsatellite markers. Molecular Ecology 12:845-847.

Research on Malus *wild species at the Fruit Genebank Dresden-Pillnitz*

***M. Geibel*[1], *R. Büttner*[1], *D. Berndt*[1], *B. Hohlfeld*[1], *C. Fischer*[2] *and M. Fischer*[1]**

[1] *Fruit Genebank, Institute of Plant Genetics and Crop Plant Research, Dresden-Pillnitz, Germany*[18]
[2] *Institute for Fruit Breeding, Federal Centre for Breeding Research on Cultivated Plants, Dresden-Pillnitz, Germany*

Introduction

The whole genepool of *Malus* comprises about 30-35 wild species and thousands of cultivars, a large resource of traits for multiple use. The wild species are used mainly as ornamental plants and as basic material for breeding resistant apple cultivars as well as rootstocks and new ornamental forms. Therefore this irreplaceable genepool is to be preserved now and in the future. Besides *in situ* conservation—mainly by the forestry administration—*Malus* wild species are preserved *ex situ* in genebanks and arboreta as grafted trees, seedling populations and as seed lots in storage. Most of the material was collected decades ago, exchanged between different arboreta—partially as seeds from open pollination—and often the original passport data were missing (Büttner *et al.* 2000a). The situation was similar in the Fruit Genebank in Dresden-Pillnitz before 1991. In the last decade it was possible to intensify the work with wild apples in Dresden-Pillnitz. This will be outlined in this article.

The *Malus* base collection in Dresden-Pillnitz

The base of the collection in Dresden-Pillnitz is the material which was transferred from Naumburg in 1981. About 250 accessions were preserved there since the 1950s and came from nurseries and arboreta from Europe and North America. However, the origin of these genotypes remains unknown. Nevertheless, this representative collection was and still is one of the most important *ex situ* collections of the world, now containing 32 *Malus* species and 367 accessions. The evaluation of scab and mildew resistance in 269 accessions over several years shows that 61% are slightly resistant (classes 1-4 out of 9) to either scab or mildew, and 28% to both. Twelve accessions (4.8%) never showed symptoms of scab or mildew (Büttner *et al.* 2000b). Additionally, much information about the ornamental value of these accessions was collected (Büttner, unpublished; Berndt 2000). The evaluation for morphology and phenology enabled an acceptable taxonomic classification of the present *Malus* collection and provides useful data for breeding and landscaping.

Indigenous *Malus sylvestris*

About 50 *M. sylvestris* genotypes are known in a 50 km region around Dresden. Generally, one or only a few individuals are found at one site. The authenticity of these *M. sylvestris* has been evaluated *in situ*. There is a wide range from typical forms to hybrids between *M. sylvestris* pollinated by *M.* x *domestica*. The species is endangered by this hybridization and isolated occurrence of single genotypes. Therefore, *ex situ* conservation (39 accessions) and controlled pollination of true types of *M. sylvestris* has been started to ensure preservation of the indigenous genepool. The first offspring obtained have already been distributed to a number of forestry institutes.

Malus sieversii from Kazakhstan

Malus sieversii is the main ancestor of the cultivated apple (*M.* x *domestica*) and is mainly endangered in its centre of diversity in Kazakhstan. Out of the collection material from

[18] The Fruit Genebank Dresden-Pillnitz was transferred to the administrative direction of the Federal Ministry of Agriculture. It has therefore become part of the Institute of Fruit Breeding Dresden-Pillnitz as of 1 January 2003.

Forsline *et al.* (2003), 35 representative offspring with 1089 seedlings were selected for evaluation at the Fruit Genebank in Dresden-Pillnitz. The assessment of the genetic diversity of these seedlings might assist in the conservation of the original habitats and for further collection strategies. Additionally, new sources of genes for resistance and fruit quality are thought to be present within this material and will be available for the apple breeding programme (Luby *et al.* 2001). In the first years after sowing, wide variability within the material has already been observed (Geibel *et al.* 2000). An extensive evaluation programme has been started to characterize the seedlings for morphological, physiological and phenological traits. Symptoms of powdery mildew, apple scab and fire blight are scored over several years to obtain reliable information about resistance to these diseases. The diversity within the material is also shown in the occurrence of diseases (Fig. 1). In parallel with the evaluation work in the field, the DNA will be analyzed to assess the diversity by molecular markers. The results of disease evaluation will be helpful to develop new molecular markers for resistance genes.

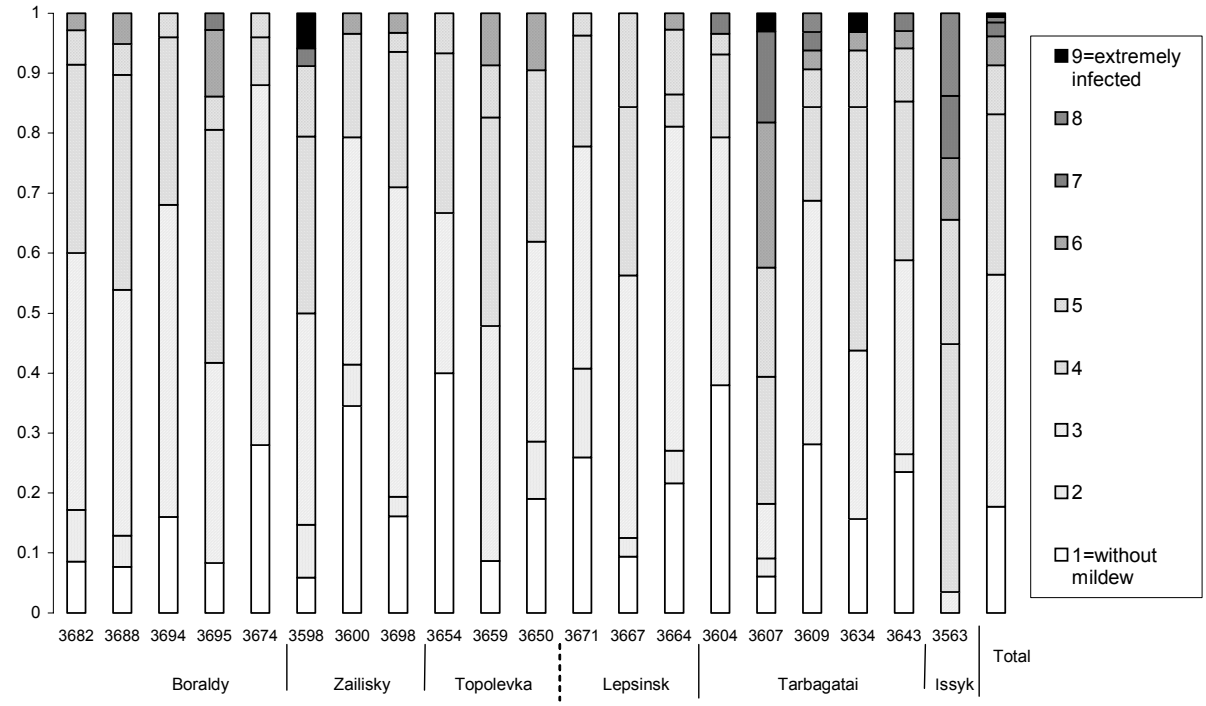

Fig. 1. Distribution of mildew symptoms in *Malus sieversii* seedlings from 1996 (percentage of seedlings in the year 1998 per accession numbers and sites – all natural sites except Issyk = Issy Arboretum).

Other populations

Besides *M. sieversii,* 145 other populations with about 1600 seedlings are grown at the Fruit Genebank in Dresden-Pillnitz and evaluated for different purposes (Table 1).

Table 1. Number of populations under evaluation at the Fruit Genebank in Dresden-Pillnitz

Type of evaluation	No. of populations	No. of seedlings
Malus sieversii	35	1050
Resistance, molecular markers	70	1050
Ornamental value	40	400
Authenticity, diversity	35	150
Total	**180**	**2650**

- **Ornamental hybrids:** about 400 seedlings from 40 crosses between different *Malus* wild species and ornamental forms are evaluated for their ornamental value. The main aim of this project is the combination of ornamental value with disease resistance. Red flowering offspring result from hybrids between *M.* sp. 'Bascatong' and different ornamental and resistant accessions. *Malus* x *domestica* cultivars with columnar habit were crossed with other ornamental wild species accessions.
- **Markers for disease resistance**: resistant accessions from the old collection (see above) were crossed with *M.* x *domestica* to study the inheritance of the resistance and to generate populations suitable for the development of molecular markers. Resistance to scab and mildew is under evaluation.
- **Screening for new accessions**: before genotypes are accepted as new accessions to the collection, seedling populations are compared with descriptors in the literature to decide whether the material is authentic or if the seeds resulted from hybridization between different species. The diversity within these populations is documented.

German-Chinese *Malus* expedition to Sichuan, 2001

Based on a bilateral contract between IPK-Gatersleben and the Southwest Agricultural University Beibei, in 2001 it was possible to collect six wild species (*M. kansuensis, M. toringoides, M. transitoria, M. sieboldii, M. prattii* and *M. hupehensis*) from the centre of diversity in Sichuan and Chongqing, P.R. China. About 7000 seeds from 55 accessions were collected in seven regions. The material may be passed on to third parties for the purposes of research, study, display, training and breeding. Unfortunately, most graftings of scion accessions died due to the inadequate timing and species differences between scion and rootstock. However, the first seedlings are now growing and will be evaluated in the coming years. Hybridization within the seedling material cannot be excluded in all cases because the material was collected near villages where domesticated apples grew or more than one species was present within the region. Wild *Malus* trees near the local settlements are often used as firewood. Populations were between 5 and 50 plants per site. The diversity at the original sites was very high and it is expected that a lot of unexplored material still remains there, including recently described new species. The question still remains whether these are really new species or only hybrids or subspecies of widely spread well-known *Malus* species.

References

Büttner, R., M. Fischer, M. Geibel and P.L. Forsline. 2000a. Genebank work for preservation of the genetic diversity of wild apples. Acta Hort. 538:39-42.

Büttner, R., M. Geibel and C. Fischer. 2000b. The genetic potential of scab and mildew resistance in *Malus* wild species. Acta Hort. 538:67-70.

Berndt, D. 2000. Zierwert von *Malus*-Wildarten und *Malus*-Hybriden [Ornamental value of wild *Malus* species and *Malus* hybrids]. Diploma thesis, Technical University Dresden, Germany.

Forsline, P.L., H.S. Aldwinckle, E.E. Dickson, J.J. Luby and S.C. Hokanson. 2003. Collection, maintenance, characterization, and utilization of wild apples of Central Asia. Pp. 1-61 in Wild apple and fruit trees of Central Asia (J. Janick, ed.). Horticultural Reviews Vol. 29. John Wiley and Sons, Inc., Hoboken, New Jersey.

Geibel, M., K.J. Dehmer and P.L. Forsline. 2000. Biological diversity in *Malus sieversii* populations from Central Asia. Acta Hort. 538:43-49.

Luby, J., P.L. Forsline, H. Aldwinckle, V. Bus and M. Geibel. 2001. Silk Road Apples–Collection, evaluation and utilization of *Malus sieversii* from Central Asia. HortScience 36(2):225-231.

Research

Presentation of a COST proposal on molecular identification of fruit genetic resources

Monica Goerre

Swiss Federal Research Station for Fruit-Growing, Horticulture and Viticulture (FAW)[19]*, Wädenswil, Switzerland*

"Molecular identification of fruit genetic resources and integration of molecular information into a common European database useful for genebank curators and nurserymen"

- **Background and objectives of the proposal**

Accurate cultivar identification in fruit species is essential for the nursery trade, for genebank curators and for those conducting distinctness, uniformity and stability tests (DUS tests) for plant breeders' rights according to UPOV guidelines. Pomological identification of fruit varieties is an old and highly-skilled technique. However, pomological description is becoming less important because experts in this discipline are disappearing more and more and it is not in every case successful. Courses in pomological identification are sometimes offered. Apart from attending courses, continuous use of the learned technique is necessary to be able to identify varieties successfully.

Modern molecular techniques are now becoming available which use leaf samples rather than fruit. They are independent of annual variation and influence of climatic and other factors on fruit samples and therefore usefully supplement traditional methods. However, they require laboratory equipment and each sample has to be prepared for laboratory analyses. The combination of both methods will increase efficiency and exactness of variety identification. Genetic resources may be regarded as "allele collections" where each distinct accession represents a unique combination of alleles.

Many partners interested in this Action have already developed high competence in the search for molecular markers and their utilization for different purposes. This knowledge will be increased by sharing experience and intensive exchange of information.

A joint research action in the molecular field, based on already collected pomological data, between partners of several European countries is promising. This project aims to coordinate the efforts of several European institutes in applying techniques to identify the pool of fruit genetic resources in order to allow for efficient conservation and accurate identification in the nursery trade. The problem of synonyms and therefore duplication of efforts could be largely solved by proper identification. The development of a well-coordinated database will be of great benefit and allow the accumulation of data sets from all partners to enhance the efficiency of the process. Access to the data of all partners will be facilitated and allow for studies of diversity structure in Europe.

The project will be executed together with partners from different countries. Mutual benefits would be a common database, crosswise data control, rapid methodological updates, rapid problem-solving and instructions to partners less familiar with the molecular methodology and, in particular cases, outsourcing of the molecular work to partner institutions. Genetic relations between the genepool of the different partners could be determined. The efficiency in fruit genetic resources conservation could be dramatically

[19] As of 01.01.2004 name changed to "Agroscope FAW Wädenswil".

increased at a European level, complementing the morphological work. Moreover, the nursery trade and DUS testing could benefit from the methods and results.

- **Expected benefits can be summarized as follows:**

- Coordination of the molecular identification of huge numbers of European fruit genetic resources accessions in order to verify trueness-to-type
- Standardization of methods and development of rapid tests for identification of fruit cultivars. This will be of great benefit for nurseries, *in vitro* laboratories, breeding, early error detection in production
- Establishment of a European database containing all relevant molecular information on the accessions and available to curators, nurserymen, breeders and other interested persons
- Linking molecular data to pomological and morphological data in existing ECP/GR databases
- Enhanced security in variety determination and greater efficiency in conservation
- Providing an interesting database for scientific work on the European fruit diversity structure.

History of the proposal and suggestions for its reactivation

In 2001, after a rather short preparation time, the proposal was presented to the Technical Commission of COST, the meeting of the Commission being held by chance in Lausanne. It had been prepared by partners from 10 European countries coordinated by Switzerland, where the first initiative was started. The proposal was rejected at this first attempt, but the Technical Commission stated that the proposal addressed an interesting area of research, especially in the context of the issue of biodiversity. They approved the idea of standardization of methods for identification of fruit varieties and assumed that the results would be of interest to UPOV (Union for the Protection of Plant Varieties) and nurseries, genebank curators and breeders. They suggested that the proposal should be rewritten and that certain points be clarified, such as research work at national and European levels and the interaction between the proposed working groups (WG on pip fruit, WG on stone fruit, WG on database and WG on data dissemination and Internet).

Most of the current partners expressed their desire to continue and improve the proposal and to resubmit it. Some of the partners are also members of either the ECP/GR Working Group on *Malus/Pyrus* or the ECP/GR Working Group on *Prunus*. If it is possible to reactivate the proposal and take up the work again, other interested institutes would also be welcome to join. First it is necessary to find a new coordinator and to decide where the proposal should be submitted—in the COST programme or maybe preferably in the framework of EU-projects. Then the partners should be asked to make suggestions on specific items of the project, such as research topics they want to work on or are already working on, in order to extend the research part in the project. The competence and specific expertise of each participating institution should be better declared as well as the involvement of some of the partners such as genebank curators.

Information source

COST proposal "Molecular identification of fruit genetic resources and integration of molecular information into a common European database useful for genebank curators and nurserymen". 2001. Electronic version of the proposal available from Markus Kellerhals (markus.kellerhals@faw.admin.ch).

APPENDICES

Appendix I. Evaluation descriptors for *Malus*

***Marc Lateur*[1] *and Jan Blazek*[2]**

[1] *Département Lutte Biologique et Ressources Phytogénétiques, Centre de Recherches Agronomiques (CRA), Gembloux, Belgium*

[2] *Research and Breeding Institute of Pomology, Holovousy, Horice, Czech Republic*

Introduction

- We need to define as precisely as possible the materials and methods used: experimental design, number of replicates, average age of the trees, rootstock, control cultivars used, management scheme for fungicide application during at least 5 years preceding the first evaluation year. We also need to provide some important climatic data such as mean rainfall (mm) for each season.
- The descriptors proposed are tools to be used for the evaluation of the accession and which finally will help to make a ranking of the accessions and a relative classification; you can choose which fit the best with your specific situation.
- Do not hesitate to make use of the "Remark" files.

1. Disease susceptibility

- It is very important to study the phytopathological background of each disease before developing the evaluation process, taking into account the following elements:
  - Cycle of the disease (conservation, phases, primary, secondary infections, etc.)
  - Epidemiological factors
  - Interaction between environment, plant physiology, human activity
  - Variability of the symptoms depending on cultivars, plant organs and environment
  - Identity of the pathogen, as revealed from lab tests, to avoid confusion with other causal agents.
- It is important to make sure that the disease is homogeneously spread inside the plot; systematic planting of control cultivars throughout the field helps identifying the occurrence of localized infections.
- It is very important to organize training for the field workers who will perform the evaluation.
- For the validation of the data, it is recommended to check the data reproducibility (difference between data collected on the same object by different observers) and the data repetitiveness (difference between observations made by the same observer at two different times).
- Disease assessment scales follow the general 1-9 scale where 1 = no visible symptom and 9 = extremely high degree of disease intensity (Watkins and Smith 1982).
- Inside Europe, the most widely used assessment keys are based on a global approach for the assessment of the intensity of the disease. The intensity is the sum of two components defined as '*incidence*' and '*severity*'. *Incidence* is based on the qualitative aspect of 'presence' and 'absence' of the symptoms and is defined by the proportion of organs affected by at least one symptom (e.g. percentage of leaves infected by at least one spot). *Severity* is a quantitative approach defined by the proportion of a surface, of a length or a volume of an organ which is infected by the disease.
- In some instances, when more precision is needed on the type of resistance of some cultivars, it can be interesting to evaluate separately the two components as '*incidence*' and '*severity*'.

1.1. Scab (*Venturia inaequalis*)

- At least one observation per year: for fruit scab and for leaf scab at the end of the growing season. If possible, it is recommended to assess leaf scab two or three times in the season in order to be able to evaluate the primary and secondary infections.
- It is much easier to make the assessment when the leaves are dry.

Global assessment scales take into account incidence and severity (Tables 1 and 2). The key for incidence is given in Table 3 and the key for severity is given in Table 4.

Table 1. Global assessment scale for scab infection (*Venturia inaequalis*) on leaves (Lateur and Populer 1996)

Scale	Field observations	Rating (%)	
		Incidence(*)	Severity(**)
1	No visible symptom	0	-
2	A few small scab spots are detectable on close scrutiny of the tree	≤ 1	-
3	Scab immediately apparent, with lesions very thinly scattered over the tree	≤ 5	-
4	X	X	-
5	Infection widespread over the tree, majority of leaves with at least one lesion	≥ 50	≤ 5
6	X	-	X
7	Heavy infection; multiple lesions or more large surfaces covered by scab on most leaves	-	± 25
8	X	-	X
9	Maximum infection; leaves black with scab	-	> 75

X = intermediate rating
(*) Incidence = proportion of infected leaves with at least one lesion
(**) Severity = mean proportion of leaf surface covered by scab

Table 2. Global assessment scale for scab infection (*Venturia inaequalis*) on fruits (Lateur and Populer 1996)

Scale	Field observations	Rating (%)	
		Incidence(*)	Severity(**)
1	No visible symptom	0	-
2	A few small scab spots are detectable on close scrutiny of the tree	≤ 1	-
3	Scab immediately apparent, with lesions very thinly scattered over the tree	≤ 5	-
4	X	X	-
5	Infection widespread over the tree, majority of fruits with at least one lesion	≥ 50	≤ 5
6	X	-	X
7	Heavy infection; multiple lesions or more large surfaces covered by scab on most fruits, some fruits with skin cracks in scabbed lesions	-	± 25
8	X	-	X
9	Maximum infection; fruits black with scab	-	> 75

X = intermediate rating
(*) Incidence = proportion of infected fruits with at least one lesion
(**) Severity = mean proportion of fruit surface covered by scab (based on the most infected half-surface of the fruits)

Table 3. Incidence assessment key for apple scab

Scale	Mean proportion of infected parts (leaves or fruits) (%)
1	0
2	]0-1]
3	]1-5]
4	X
5	~25
6	X
7	~50
8	X
9	>90

X = intermediate rating

Table 4. Severity assessment key for apple scab

Scale	Mean proportion of scab-infected surface (leaves or fruits) (%)
1	0
2	]0-1]
3	]1-5]
4	X
5	~25
6	X
7	~50
8	X
9	>90

X = intermediate rating

1.2. Powdery mildew (*Podosphaera leucotricha*)

- At least one assessment during late summer to take into account primary infections (which are the most damaging) and secondary infections (Table 5). If possible, two assessments, one in spring (for the primary symptoms on shoot tips and on flower clusters) (see incidence scale Table 6) and one during summer (Table 5).

Table 5. Global assessment scale for the evaluation of powdery mildew (*Podosphaera leucotricha)* on apple leaves, top shoots and flower clusters (Lateur 1999)

Scale	Field observation	Mean proportion of infected shoot ends and/or clusters by primary infection (%)
1	No visible macroscopic symptoms	-
2	Very few leaves with secondary infection (0-5%)	0
3	Secondary infections on leaves immediately apparent, infected leaves thinly scattered over the tree (5-25%), no primary infection	0
4	Same as 3 but very few primary infections are visible	]0-5]
5	Widespread secondary infection over the tree, majority of leaves with secondary infections, few twigs or flower clusters with primary infection	]5-10]
6	X	X
7	Heavy infection, about half of the shoots have primary infection	~50
8	X	X
9	Extremely heavy infection, nearly all twigs have primary infection	>90

X = intermediate rating

Table 6. Incidence assessment scale for spring evaluation of primary powdery mildew on top of twigs and flowering clusters

Scale	Field observation of primary mildew symptoms	Mean proportion of affected organs (%)
1	No visible symptom of mildew	0
2	One or very few organs affected, detectable on close scrutiny of the tree	]0-1]
3	Infected organs readily apparent but without important consequences for the tree	]1-5]
4	X	X
5	Primary mildew widespread over the branches, inducing the infection of a substantial part of the crown	± 25
6	X	X
7	Heavy infection; half of the organs are badly affected	± 50
8	X	± 75
9	Crown completely affected, nearly all top of the organs are infected by primary mildew	> 90

X = intermediate rating

1.3. Nectria canker (*Nectria galligena*)

- Nectria canker is normally only **significant** on sites where annual rainfall is around 800 mm or above. Table 7 shows a global assessment scale and Fig. 1 provides illustrations for a more accurate assessment.

Table 7. Global assessment scale for the evaluation of resistance to Nectria canker (Lateur 1999)

Scale	Observation in the orchard	Approximate proportion of branches infected by *Nectria* canker (%)
1	No visible canker symptom	0
2	One or very few small cankers, detectable only on close scrutiny of the tree	]0-1]
3	Directly apparent cankers without important consequences for the tree	]1-5]
4	X	X
5	Cankers widespread over the branches, inducing the death or the ablation of a large part of the crown	± 25
6	X	X
7	Heavy infection; about half of the crown is badly affected with risk of ablation or death	± 50
8	X	X
9	Maximum infection, tree completely affected, nearly dead	> 90

X = intermediate rating

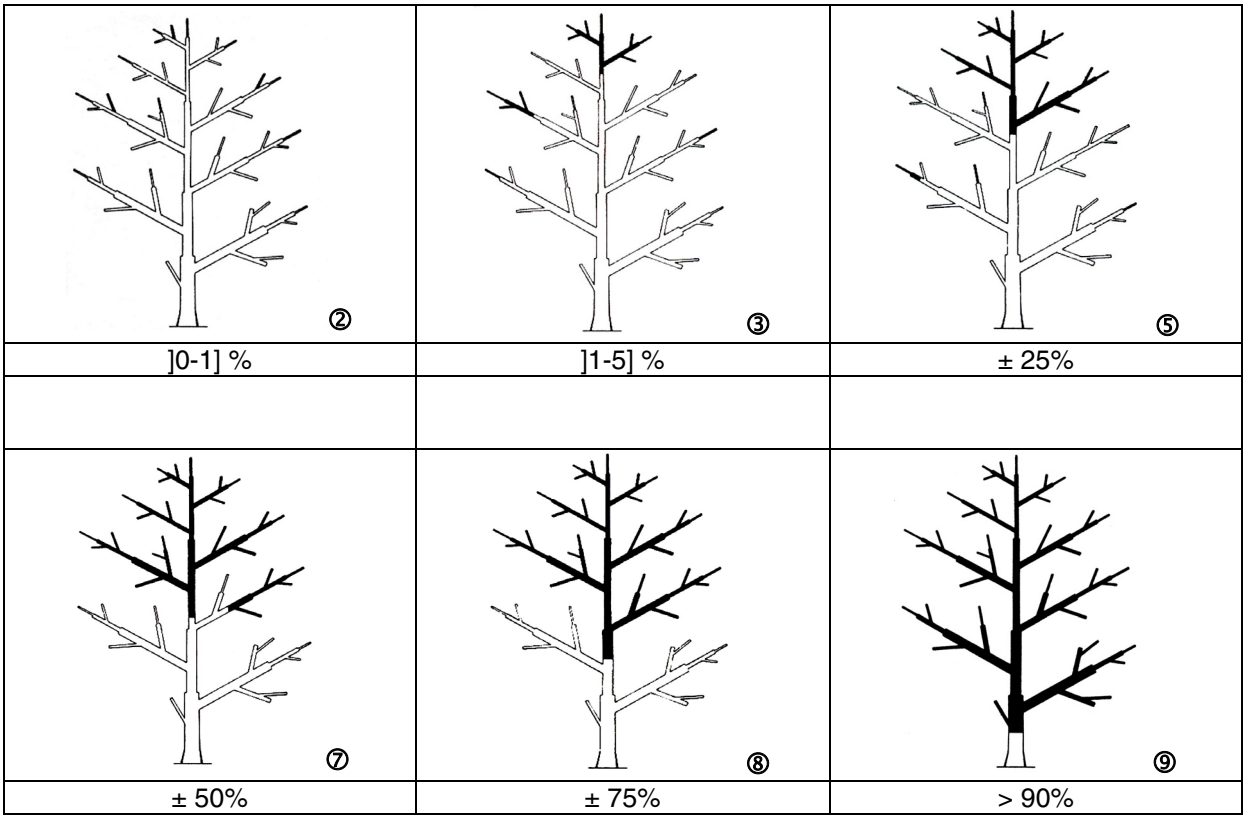

Fig. 1. Illustration of the assessment scale for the evaluation of *Nectria* canker symptoms on apple (Lateur 2001)

2. Fruit quality traits

As first evaluation procedure, sensory analysis is simple and efficient. The use of instrumental measurements is more precise but time-consuming. The choice of the evaluation method depends on priorities set by the curators.

2.1. Fruit firmness assessment

a. Using a penetrometer equipped with a 11 mm probe, following the protocol described on page 36 in Watkins and Smith (1982). It is done, as a minimum, at picking time, on a sample of at least six fruits, making the measurements on both sides of the fruits (facing and opposite the sun). The data are expressed as kg/cm^2.

b. Sensory analysis

Table 8. Key for fruit firmness assessment in apple

Scale	
1	Extremely soft
2	Very soft
3	Soft
4	X
5	Intermediate
6	X
7	Firm
8	Very firm
9	Extremely firm

X = intermediate rating

2.2. Sweetness of the flesh

a. Refractometer method
This is done, as a minimum, at picking time on a sample of at least six fruits and expressed as ° Brix.

b. Sensory analysis

Table 9. Key for flesh sweetness assessment in apple

Scale	
1	No sweetness at all
2	Very low sweetness
3	Low sweetness
4	X
5	Intermediate sweetness
6	X
7	High sweetness
8	Very high sweetness
9	Extremely high sweetness

X = intermediate rating

2.3. Flesh acidity

a. Measurement with a pH meter (optional)
Done as a minimum at picking time on juice from a sample of at least six fruits.

b. Sensory analysis

Table 10. Key for flesh acidity assessment in apple

Scale	
1	No acidity at all
2	Very low acidity
3	Low acidity
4	X
5	Intermediate acidity
6	X
7	High acidity
8	Very high acidity
9	Extremely high acidity

X = intermediate rating

2.4. Flesh juiciness

Table 11. Key for flesh juiciness assessment in apple

Scale	
1	Extremely low juiciness
2	Very low juiciness
3	Low juiciness
4	X
5	Intermediate juiciness
6	Very high juiciness
7	High juiciness
8	X
9	Extremely high juiciness

X = intermediate rating

2.5. Overall taste appreciation

(optional and only as indicative information)

Table 12. Key for the evaluation of flesh overall taste

Scale	
1	Extremely poor
2	Very poor
3	Poor
4	Poor to good
5	Good
6	Good to very good
7	Very good
8	X
9	Extremely good

X = intermediate rating

2.6. Fruit storage capacity

- Representative sample of 20-40 fruits, date of harvesting, fungicide scheme, good description of the storage conditions (cellar, normal cold chamber, average temperature range, average relative humidity, etc.)
- Give the latest month when fruits still retain a good internal and organoleptic flesh quality
- Give the latest month when fruits still exhibit good external quality.

References

Watkins, R. and R.A. Smith, editors. 1982. Descriptor list for Apple (*Malus*). International Board for Plant Genetic Resources, Rome/Commission of European Communities, Brussels.

Lateur, M. 1999. Evaluation et caractérisation des ressources génétiques d'arbres fruitiers [Evaluation and characterization of fruit tree genetic resources]. Pp. 167-177 *in* Le patrimoine fruitier. Hier, aujourd'hui, demain [Fruit patrimony. Yesterday, today, tomorrow] (M. Chauvet, compiler). AFCEV/BRG/INRA, Paris, France.

Lateur, M. 2001. Evaluation de la résistance au chancre européen (*Nectria galligena* Bres.) de ressources génétiques du pommier (*Malus domestica* Borkh.): étude méthodologique [Evaluation of resistance to European canker (*Nectria galligena* Bres.) in apple genetic resources: methodological study]. PhD Thesis, Faculté des Sciences Agronomiques de Gembloux, Belgium. 245pp.

Lateur, M. and C. Populer. 1996. Evaluation and identification methods used for apple genetic resources at the State Plant Pathology Station in Gembloux, Belgium. Pp. 78-87 *in* European *Malus* Germplasm. Proceedings of a workshop, 21-24 June 1995, Wye College, University of London (H.J. Case, ed.). International Plant Genetic Resources Institute, Rome.

Appendix II. Model for a Memorandum of responsibility

MEMORANDUM OF RESPONSIBILITY

The ECP/GR Working Group on *Malus/Pyrus* intends to preserve the most important apple and pear genotypes in Europe.

In accordance with the principles agreed by the Working Group in the "Establishment of a European *Malus/Pyrus* Collection"(*), the institute **<FULL NAME AND ADDRESS OF THE INSTITUTE>** undertakes the responsibility for the conservation of the following accessions:

1. <Accession name and accession number>
2. <Accession name and accession number>
3. <Accession name and accession number>
4. <Accession name and accession number>
5. (etc…)

Name:

Position:

Signature:

Date:

(*) Maggioni, L., M. Fischer, M. Lateur, E.-J. Lamont and E. Lipman, compilers. 2004. Report of a Working Group on *Malus/Pyrus*. Second Meeting, 2-4 May 2002, Dresden-Pillnitz, Germany. International Plant Genetic Resources Institute, Rome, Italy. (Appendix III, pp. 84-85).

Appendix III. Establishment of a European *Malus*/*Pyrus* Collection[20]

Purpose

To coordinate efforts of individual European countries and to conserve and make available *Malus/Pyrus* accessions originating in Europe or otherwise important to European horticulture, silviculture, cultural heritage or science. The availability will be subject to applicable international and national legislation and for the purpose of utilization and conservation for research, breeding and training for food and agriculture.

Composition

The European *Malus* and *Pyrus* Collections should be decentralized and cost-effective *ex situ* collections comprising appropriate accessions held by participating genebanks and available for distribution.

Accessions to be regarded initially as European Collection accessions are those held in various European countries and accepted as European Collection accessions by the ECP/GR Working Group on *Malus/Pyrus*.

- Accessions should be considered for inclusion in the European Collection if they are[21]:
  - (priority 1) – landraces, old cultivars and commercial cultivars or exceptionally certain selections with extraordinary traits raised in Europe should have priority
  - (priority 2) – important accessions from the wild, collected in Europe and representing the diversity present in Europe.
- In addition there may be included:
  - other wild accessions, and exceptionally other cultivars and selections important for horticulture, silviculture, cultural heritage or research in one or more European countries.
- Cultivars protected by Intellectual Property Rights and virus-infected items may be included even if they cannot be distributed freely at present.

Subsequently, if several accessions of the same genotype are held, a limited number may have the European Collection designation confirmed by the ECP/GR Working Group on *Malus/Pyrus*, to reduce duplication of effort.

Implementation of decentralized collection

1. Curators, in accordance with their regional and national coordinators, to offer accessions by sending a list to the Central Database manager.
2. Central Database manager, supported by an *ad hoc* subgroup, coordinates and analyzes the offers and, with agreement of the *Malus/Pyrus* Working Group, notifies the participating genebanks concerned of the accessions that will be regarded as European Collection accessions.

---

[20] Last draft proposal after the "extraordinary meeting" in Angers, France, September 2003.

[21] As an example, the criteria used by Switzerland to define material to be conserved in the national collection are the following:
Definition 1: a variety is of Swiss origin if a) it is/was bred or 'born' (seedling) or found (mutant) in Switzerland; b) it is a local variety from Switzerland, with a local name or locally spread and cannot be proved to originate from another country.
Definition 2: has to be conserved in Switzerland if: a) it is of Swiss origin; b) it is socioculturally related to Switzerland; c) it has extraordinary traits and d) provisionally, if it is not conserved elsewhere, is not available from abroad or its origin and identity are not sure.

3. Central Database Manager identifies European accessions held at only one site that need to be safety-duplicated at a second site and provides the list to the Working Group and the ECP/GR Secretariat for action.

Responsibilities of participating genebanks

- In accordance with regional and national coordinators, to provide a list of the accessions they are offering as European accessions *and if possible a complete list of accessions.* The list should include Institute code, Genebank accession numbers, Genus, Species, Accession name and Code of country of origin (where available), and should be sent to the European *Malus* and *Pyrus* database managers.
- To endeavour to provide the database managers with additional passport data, according to the latest version of the FAO/IPGRI Multicrop descriptors.
- To endeavour to provide the database managers with characterization data in the form agreed upon by the Working Group and to provide the status with respect to quarantine pests and diseases.
- To provide, when available, synonym lists from defined local pomologies or standard pomologies upon request from the database manager.

For accessions accepted into a European *Malus/Pyrus* Collection

- To maintain the genotypes, ideally at least two trees per accession at each of two sites, and give at least two years' notice via the European *Malus* and *Pyrus* Database Managers before grubbing out.
- To endeavour to provide characterization data for the European *Malus* and *Pyrus* Databases in accordance with agreed descriptors.
- To make scion wood available in response to reasonable requests, subject to restraints of Intellectual Property Rights, phytosanitary regulations and the conditions set above.

Responsibilities of European Malus *and* Pyrus *Database Managers*

- To obtain lists of available *Malus/Pyrus* accessions from participating genebanks, together with passport data, and make them available in a computerized version.
- To include synonyms from several referenced literature sources into the databases, in order to avoid duplication of already duplicated accessions.
- To produce a list showing the number and location of accessions of each genotype identified as a potential accession to the European collection.
- To check and to draw attention to genotypes held at only one site (needing safety-duplication).
- To cross-check and confirm with the ECP/GR *Malus/Pyrus* Working Group and the participants which accessions are regarded as European Collection accessions and to indicate this in the European databases.
- To receive and disseminate information about accessions to the European Collection that are threatened by uprooting, with a view to arranging propagation and replanting.
- To seek characterization and evaluation data of accepted accessions in the European Collection.
- To update the database when given information by holders.

Responsibilities of the ECP/GR Working Group

- To determine the composition of the European Collection.
- To regularly re-examine the collection and if needed update or adjust its composition.
- To organize practically the sharing of responsibility between the countries for the sustainable conservation of the accepted accessions in the European Collection.

Appendix IV. Report of an extraordinary meeting of the ECP/GR Working Group on *Malus/Pyrus* held during the EUCARPIA Symposium, 2 September 2003, Angers, France

Compiled by Celia James and Marc Lateur

Members present
János Apostol (Hungary), Enrique Dapena (Spain), Vasiliy Djouvinov (Bulgaria), Bronislovas Gelvonauskis (Lithuania), Zygmunt Grzyb (Poland), Stein Harald Hjeltnes (Nordic countries), Monika Höfer (Germany), Celia James (United Kingdom, on behalf of Mike Jeger), Markus Kellerhals (Switzerland), Marc Lateur (Belgium), François Laurens (France).

Observers
Laurence Feugey (France), Walter Guerra (Italy), Elżbieta Rozpara (Poland).

Three topics were on the agenda:
1. Harmonization of the *Malus/Pyrus* WG with the *Prunus* WG definition on the concept of "Decentralized European Collections"
2. Conservation, evaluation and utilization of genetic resources
3. Funding (application to EU)

Harmonization of the Malus/Pyrus *WG with the* Prunus *WG*

The documents "Establishment of a European *Malus/Pyrus* collection" and "Towards a definition and implementation of a European *Prunus* collection" were compared. Changes to the *Malus/Pyrus* document were discussed and agreed (see Appendix III).

Conservation, evaluation and utilization of genetic resources

It was decided that better use of the *Malus/Pyrus* databases should be made.

The *Pyrus* database was started some years ago. It includes over 9000 accessions from 24 collections. Mis-spelling and synonyms are a problem. Software is being developed by CRA Gembloux to solve this problem. It was estimated that it will take three months' work to encode all the lists from the literature. The list and the research module will be available on the Web and will be integrated in the *Pyrus* DB by the end of 2003.

The next stage will be to include passport data, with the possibility of getting these directly from the European catalogue EURISCO.

Action points

- Marc Lateur to send list of *Pyrus* accessions to all members.

They will fill in all passport data. This will include personal contacts and a network of relevant people. It is crucial to know the country of origin of the cultivars as a tool for defining the "National Collection" lists.

- DNA fingerprinting

The aim is to use common SSR markers to fingerprint accessions at different sites. Members to either:
- collect leaves, extract DNA and do the SSRs themselves,
- or send extracted DNA to François Laurens,
- or send freeze-dried leaves to F. Laurens (fresh leaves must not be sent),
- or send Whatman FTA cards to F. Laurens.

F. Laurens agreed to run the markers this winter (2003-2004).

The aim is to fingerprint the most representative cultivars from each collection. A maximum of 100 samples per collection. The inclusion of common controls was discussed. It was decided to use the following apple cultivars: 'Golden Delicious', 'Fiesta' and 'Prima'.

These, and the samples from the collection, will be screened with 9 of the Swiss (CH) SSR primers, described in Gianfranceschi *et al.* (1998).[22] These were selected by INRA as follows: *CH01D03, CH02C06, CH02C09, CH01H02, CH04C06, CH04E05, COL, CH02C11 and CH02D08*.

It was agreed that it would be understandable that some institutions would prefer to withhold this type of data.

Funding

The first call of the new EU regulation on genetic resources (ex 1467/94) is expected by the end of 2003/early 2004.

Seven to ten million Euros would be available, divided between animals (50%), agricultural crops (40%) and forests (10%) i.e. there would not be much money available. A second call is expected in 2005, for which the 10 new countries joining the EU would be certainly eligible.

Which call to apply for was discussed. It was provisionally decided to try for the first call, then the second call if not successful in the first call, or for additional funding.

The new proposal must be:

- Well focussed on the utilization of genetic resources,
- Taking a basic or fundamental approach, to demonstrate a stepwise and targeted action. It should be applied, but NOT new technology, or a research project.

It was agreed that preparing a common or complementary project with the *Prunus* group was a good idea. The Ma*lus/Pyrus* and *Prunus* groups will exchange information before the call is launched and then decide whether to put in a joint or separate proposal.

It was suggested that an "English person" could coordinate the project and act as chairperson of a small group. Emma-Jane Lamont or Mike Jeger were suggested and will be asked if they would be available. It was agreed that it was very important to find out what the EU wants and what type of actions they will fund.

The deadline of **mid-November 2003** was decided to collect the information; a specific task force coordinated by Marc Lateur will collect the information in collaboration with the *Prunus* WG (Monica Höfer, Stein Harald Hjeltnes and François Laurens).

A list of participants was taken and signed by all attending.

Celia James (Horticulture Research International East Malling, UK) was asked to attend on behalf of Emma-Jane Lamont and Mike Jeger as UK representative, and was asked to write up the minutes.

---

[22] Gianfranceschi, L., N. Seglias, R. Tarchini, M. Komjanc and C. Gessler. 1998. Simple sequence repeats for the genetic analysis of apple. Theoretical and Applied Genetics 96:1069-1076.

Appendix V. Acronyms and abbreviations

AARI	Aegean Agricultural Research Institute, Izmir, Turkey
AFLP	Amplified fragment length polymorphism
BAZ	Bundesanstalt für Züchtungsforschung an Kulturpflanzen (Federal Centre for Breeding Research on Cultivated Plants), Germany
BRG	Bureau des Ressources Génétiques, Paris, France
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CGN	Centre for Genetic Resources, Wageningen, The Netherlands
CHM	Clearing House Mechanism
CIA	Centro de Investigación Agraria de Galicia
CLO-DvP	Centrum voor Landbouwkundig Onderzoek - Departement voor Plantengenetica en – veredeling (Agricultural Research Centre, Department of Plant Genetics and Breeding), Gent, Belgium
CRA	Centre de Recherches Agronomiques, Gembloux, Belgium
CRNFB	Centre de Recherche de la Nature, des Forêts et du Bois (Nature, Forests and Wood Research Centre), Gembloux, Belgium
CSIC	Centro Superior de Investigación y Ciencia, Zaragoza, Spain
ECCDB	European Central Crop Database
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
EPGRIS	European Plant Genetic Resources Information Infrastructure
EU	European Union
EUCARPIA	European Association for Plant Breeding Research
EURISCO	European Internet Search Catalogue (EPGRIS project)
FAO	Food and Agriculture Organization of the United Nations, Rome, Italy
GPA	Global Plan of Action
GRIN	Genetic Resources Information System (USA)
IBW	Instituut voor Bosbouw en Wildbeheer (Institute for Forestry and Game Management), Belgium
INIA	Instituto Nacional de Investigação Agrária (National Institute for Agrarian Research), Portugal
INIA	Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (National Institute for Agriculture and Food Research and Technology), Spain
INRA	Institut national de la recherche agronomique (National Agronomic Research Institute), France
IPK	Institut für Pflanzengenetik und Kulturpflanzenforschung (Institute for Genetics and Plant Breeding), Gatersleben, Germany
ISF	Istituto Sperimentale per la Frutticoltura, Rome, Italy
ISHS	International Society for Horticultural Science
ISSA	Irish Seed Saver Association
KUL	Katholieke Universiteit Leuven (Catholic University of Leuven), Belgium
MCPDs	Multi-crop Passport Descriptors (FAO/IPGRI)
NAGREF	National Agricultural Research Foundation, Greece
NBS	Nationale Boomgaarden Stichting (National Orchard Society), Belgium

NGB	Nordic Gene Bank, Alnarp, Sweden
NGO	Non-governmental organization
PCR	Polymerase chain reaction
PGR	Plant genetic resources
PRI	Plant Research International, Wageningen, the Netherlands
RICP	Research Institute of Crop Production, Prague, Czech Republic
SERIDA	Servicio Regional de Investigación y Desarrollo Agroalimentario del Principado de Asturias, Villaviciosa, Spain
SIA-DGA	Servicio de Investigación Agroalimentaria de la Diputación General de Aragón, Spain
SINGER	System-wide Information Network for Genetic Resources (CGIAR)
SLU	Swedish Agricultural University
SSAP	Sequence-specific amplification polymorphism
UPOV	Union internationale pour la protection des obtentions végétales (Union for the Protection of Plant Varieties), Geneva, Switzerland
USDA	United States Department of Agriculture
VIR	N.I. Vavilov Research Institute of Plant Industry, St. Petersburg, Russian Federation

Appendix VI. Agenda

Second Meeting of the ECP/GR Working Group on Malus/Pyrus
2-4 May 2002, Pillnitz, Dresden, Germany

Wednesday 1 May
Arrival of participants

Thursday 2 May

09:00 – 09:20 **Introduction**

- Opening of the meeting, welcome (*M. Fischer)*
- Briefing on IPGRI and recent international developments (*C. Hoogendoorn, 15 min*)

09:20 – 09:45 **ECP/GR**

- General briefing on ECP/GR *(L. Maggioni, 10 min)*
- Report of the Working Group Chair *(M. Fischer, 10 min)*

Discussion

09:45 – 10:30 **Documentation**

- The European *Malus* Database. Progress and planning *(E.-J. Lamont, 15 min)*
- The European *Pyrus* Database. Progress and planning *(M. Lateur, 15 min)*

Discussion

10:30 – 11.00 *Coffee break*

11:00 – 11:30
- The EPGRIS project and the new Multi-crop passport descriptors *(L. Maggioni, 15 min)*

Discussion

11:30 – 12:30
- Harmonization of minimum descriptors of the *Malus*, *Pyrus* and *Prunus* databases (*M. Lateur and E.-J. Lamont*)
- *Malus* database. Characterization/evaluation data. Protocols for evaluation of canker, scab and mildew resistance, fruit firmness, fruit storage quality, fruit sugar/acid ratio (*discussion introduced by M. Fischer, J. Blazek and E.-J. Lamont*)
- *Pyrus* database. Characterization/evaluation data (*discussion introduced by M. Lateur*)
- Definition of accepted names and synonyms of *Malus* and *Pyrus* accessions (*discussion introduced by M. Lateur and M. Goerre*)

12:30 – 14:00 *Lunch*

14:00 – 15:30 Update on national collections ***(brief updates on the status of national collections – 5-7 minutes each)***
Austria; Belgium; Czech Republic; Estonia; France; Germany; Hungary; Ireland; Israel; Italy; Lithuania; Macedonia FYR;

15:30 – 16:00 *Coffee break*

16:00 – 17:00 Update on national collections (continued)
Nordic countries; Poland; Portugal; Russian Federation; Slovenia; Spain; Switzerland; United Kingdom; F.R. Yugoslavia

End of the first day

Friday 3 May

09:00 – 10:30 **Exchange of apple and pear germplasm in Europe (phytosanitary and legal aspects)** *(discussion introduced by M. Fischer)*

Coffee break

11:00 – 12:30 **Definition of a system for international responsibility for the conservation of apple and pear germplasm in Europe** *(discussion introduced by M. Fischer)*

Background document: "Towards the definition and implementation of a European *Prunus* collection" (Annex I *in* http://www.ecpgr.cgiar.org/publications/fruitncg5.htm)

12:30 – 14:00 *Lunch*

14:00 – 15:30 **Collection, evaluation and use of wild species of *Malus* and *Pyrus*** *(discussion introduced by F. Laurens)*

- Use of fruit genetic resources in Germany for fruit breeding and production *(M. Fischer, 20 min)*
- Research on *Malus* wild species at the Fruit Genebank Dresden-Pillnitz *(M. Geibel, 10 min)*
- Activities in Belgium on wild *Malus (M. Lateur, 10 min)*

15:30 – 16:00 *Coffee break*

16:00 – 17:00 **Research activities**

- A project proposal on molecular identification of fruit genetic resources *(M. Goerre, 10 min)*
- The D.A.R.E. project for durable apple resistance evaluation *(F. Laurens, 10 min)*
- Evaluation of *Malus* and *Pyrus* GR collections for disease resistance *(M. Lateur, 10 min)*
- Development of a Belgian network for *in situ* and on-farm conservation of *Malus* and *Pyrus* genetic resources *(M. Lateur, 10 min)*
- The ISHS Pear Working Group *(F. Grassi, 5 min)*
- Research activities at SERIDA, Spain *(E. Dapena, 10 min)*

End of the second day

Saturday 4 May

9:00 – 10:00 **Visit to the German Fruit Genebank**

10:00 – 10:30 *Coffee break*

10:30 – 17:00 **Excursion to Saxon Switzerland (or City of Dresden) except for the compilers of the draft report**

18:00 – 19:00 **Approval of workplan and recommendations**

19:00 – 19:15 **Selection of a new Chair for the Working Group**
Closing remarks

20:30 *Social dinner*

Sunday 5 May

Departure of participants

Appendix VII. List of participants

Chairperson

Marc Lateur
Département Lutte Biologique et Ressources Phytogénétiques
Centre de Recherches Agronomiques (CRA)
Chemin de Liroux 4
5030 Gembloux
Belgium
Tel: (32-81) 620314
Fax: (32-81) 620349
Email: lateur@cra.wallonie.be

Working Group Members

Siegfried Bernkopf
Austrian Agency for Health and Food Safety Ltd. - AGES Linz
Wieningerstrasse 8
4021 Linz
Austria
Tel: (43-732) 381261/236
Fax: (43-732) 385482
Email: siegfried.bernkopf@ages.at

Jan Blazek
Research and Breeding Institute of Pomology
Holovousy
508 01 Horice
Czech Republic
Tel: (420-49369) 2821/-5
Fax: (420-49369) 2833/2831(direct)
Email: blazek@vsuo.cz

Kalju Kask
Estonian Agricultural University
Polli Horticultural Institute
69104 Polli, PO Karksi-Nuia
Viljandimaa
Estonia
Tel: (372-43) 31841
Fax: (372-43) 31442
Email: kalju.kask@polli.ee

François Laurens
Station d'amélioration des espèces fruitières et ornementales - INRA Angers
Bois l'Abbé - BP 57
49071 Beaucouzé cedex
France
Tel: (33) 241225763
Fax: (33) 241225755
Email: laurens@angers.inra.fr

Manfred Fischer [23]
Genbank Obst Dresden-Pillnitz am IPK Gatersleben
Bergweg 23
01326 Dresden
Germany

Tibor Szabó
(On behalf of János Apostol)
Research and Extension Centre for Fruit Growing
Vadastag 2
4244 Újfehértó
Hungary
Tel: (36-42) 290822
Fax: (36-42) 290822/291359
Email: szaboti@ujfehertokutato.hu

Doug Dudley
(On behalf of Anita Hayes)
Irish Seed Savers Association
Capparoe
Scariff, County Clare
Ireland
Tel: (353-61) 921866
Fax: (353-61) 921693
Email: issa@esatclear.ie

[23] *Address at time of publication:*
Söbrigener Str. 15
01326 Dresden
Germany
Tel./Fax: (49-351) 2618539
Email: manfred.fischer@sz-online.de

Fabrizio Grassi [24]
Istituto Sperimentale per la Frutticoltura (ISF)
Via Fioranello 52
00134 Roma
Italy

Bronislovas Gelvonauskis
Lithuanian Institute of Horticulture
28 Kaunas street
4335 Babtai, Kaunas distr.
Lithuania
Tel: (370-7) 555287
Fax: (370-7) 555176
Email: bronius@lsdi.lt

Bojan Popovski
Faculty of Agriculture - Skopje
Bul. Aleksandar Makedonski, bb
1000 Skopje
Macedonia F.Y.R.
Tel: (38-92) 115277
Fax: (38-92) 130310
Email: bojanp@zf.ukim.edu.mk

Inger Hjalmarsson
(Representing the Nordic countries)
Nordic Gene Bank (NGB)
PO Box 41
230 53 Alnarp
Sweden
Tel: (46-40) 536645
Fax: (46-40) 536650
Email: inger@ngb.se

Stein Harald Hjeltnes
(Representing the Nordic countries)
The Norwegian Crop Research Centre
Division Njøs
PO Box 42
6861 Leikanger
Norway
Tel: (47) 57656063
Fax: (47) 57656061
Email:
stein.harald.hjeltnes@planteforsk.no

Zygmunt Grzyb
Research Institute of Pomology and Floriculture
Str. Pomologiczna 18
96-100 Skierniewice
Poland
Tel: (48-46) 8332021
Fax: (48-46) 8333228
Email: zgrzyb@insad.pl

Eliseu Bettencourt
(On behalf of Alberto Santos)
Estação Agronómica Nacional,
Instituto Nacional de Investigação Agrária (EAN/INIAP)
Quinta do Marquês
2784-505 Oeiras
Portugal
Tel: (351-21) 4403688
Fax: (351-21) 416011
Email: e.bettencourt@meganet.pt

Dušan Gvozdenović
Faculty of Agriculture
Institute for Fruitgrowing and Viticulture
Sq. Dositej Obradović 8
21000 Novi Sad
Yugoslavia, F.R.
Tel: (381-21) 21350366
Fax: (381-21) 450126
Email: dusang@polj.ns.ac.yu

Metka Hudina
(On behalf of Franci Štampar)
Biotechnical Faculty
Department of Agronomy
Jamnikarjeva 101
1000 Ljubljana
Slovenia
Tel: (386-1) 1231 161
Fax: (386-1) 1231 088
Email: metka.hudina@bf.uni-lj.si

Enrique Dapena De La Fuente
Servicio Regional de Investigación y Desarrollo Agroalimentario (SERIDA)
Apdo. 13
33300 Villaviciosa (Asturias)
Spain
Tel: (34-98) 5890066
Fax: (34-98) 5891854
Email: enriquedf@serida.org

[24] † 2003

Monica Goerre [25]
(On behalf of Markus Kellerhals)
Swiss Federal Research Station for Fruit Growing, Viticulture and Horticulture
Postfach 185
8820 Wädenswil
Switzerland

Observers

Martin Geibel [26]
Genbank Obst Dresden-Pillnitz am IPK Gatersleben
Bergweg 23
01326 Dresden
Germany

Monika Höfer [27]
Bundesanstalt für Züchtungsforschung an Kulturpflanzen
Institut für Obstzüchtung
Pillnitzer Platz 3a
01326 Dresden
Germany
Tel: (49-351) 2616222
Fax: (49-351) 2616213
Email: m.hoefer@bafz.de

László Csiszár
Research and Extension Centre for Fruit Growing
Vadastag 2
4244 Ujfeher
Hungary
Tel: (36-42) 290822
Fax: (36-42) 290822
Email: csiszarl@ujfehertokutato.hu

Leonid A. Burmistrov
Department of Fruit Crops
N.I. Vavilov Research Institute of Plant Industry (VIR)
42 Bolshaya Morskaya Street
190000 St. Petersburg
Russian Federation
Tel: (7-812) 3119901
Fax: (7-812) 3118762
Email: l.burmistrov @vir.nw.ru

Emma-Jane Lamont
National Fruit Collections
Imperial College
Brogdale Road
ME13 8XZ Faversham, Kent
United Kingdom
Tel: (44-1795) 590272
Fax: (44-1795) 532271
Email: nfc@imperial.ac.uk

IPGRI

Coosje Hoogendoorn
Deputy Director Programs
International Plant Genetic Resources Institute (IPGRI)
Via dei Tre Denari 472/a
00057 Maccarese (Fiumicino)
Italy
Tel: (39) 066118200
Fax: (39) 0661979661
Email: c.hoogendoorn@cgiar.org

Lorenzo Maggioni
ECP/GR Coordinator
Regional Office for Europe
International Plant Genetic Resources Institute (IPGRI)
Via dei Tre Denari 472/a
00057 Maccarese (Fiumicino)
Italy
Tel: (39) 066118231
Fax: (39) 0661979661
Email: l.maggioni@cgiar.org

---

[25] *Address at time of publication:*
Schlossbergstrasse 14
8820 Wädenswil
Switzerland
Email: ruban.goerre@datacomm.ch

[26] *Address at time of publication:*
Hörnchenweg 4
01328 Dresden-Borsberg
Germany
Tel.: (49-351) 2618498
Email: martingeibel@aol.com

[27] In April 2003 Monika Höfer was nominated Working Group member in replacement of Manfred Fischer, retired.

Unable to attend

Vasiliy Djouvinov
Fruit Growing Institute
12 Ostromila Street
4004 Plovdiv
Bulgaria
Tel: (359-32) 771349/671095
Fax: (359-32) 670808
Email: vcd@valan.net

Athena Della
Agricultural Research Institute (ARI)
PO Box 22016
1516 Nicosia
Cyprus
Tel: (357-2) 403219/403100
Fax: (357-2) 316770
Email: athena.della@arinet.ari.gov.cy

Constantinos Tsipouridis
National Agricultural Research Foundation (NAGREF)
Pomology Institute
S. Stathmos street 38
592 00 Naoussa
Greece
Tel: (30-3320) 43343
Fax: (30-3320) 41178
Email: nagrefpi@alfanet.gr

János Apostol
Research Institute for Fruit Growing and Ornamentals
Park u.2 - PO Box 108
1223 Budapest
Hungary
Tel: (36-1) 3621596
Fax: (36-1) 3621573
Email: apostol.janos@dpg.hu

Anita Hayes
Irish Seed Savers Association
Capparoe, Scariff, County Clare
Ireland
Tel: (353-61) 921866
Fax: (353-61) 921693
Email: issa@esatclear.ie

Moshe A. Flaishman
Department of Fruit Trees
Horticultural Institute
Volcani, ARO, PO Box 6
75210 Bet-Dagan
Israel
Tel: (972-3) 9683394
Fax: (972-3) 9669583
Email: vhmoshea@agri.gov.il

Marica Gatt
Plant Health Department
Plant Biotechnology Centre
Ministry for Agriculture and Fisheries
Annibale Preca Street
BZN 04 Lija
Malta
Tel: (356) 417478/435898
Fax: (356) 433112
Email: marica.gatt@gov.mt

Henk Kemp
Fruit Research Station (FPO)
PO Box 200
6670 AE Zetten
The Netherlands
Tel: (31-488)473700
Fax: (31-488)473717
Email: h.kemp@ppo.dlo.nl

Alberto Santos
Departamento de Fitotecnica
Universidade de Tras-os-Montes e Alto Douro (UTAD)
Quinta de Prados, Apartado 202
5001 Vila Real Codex
Portugal
Tel: (351-259) 350447
Fax: (351-259) 350327
Email: asantos@utad.pt

Nicolae Braniste
Fruit Growing Research Institute Maracineni
Pitesti Maracineni
0312 Pitesti, Judetul Arges
Romania
Tel: (40-48) 278292
Fax: (40-48) 278292
Email: icpp_mar@geostar.ro

Eva Šidová
Research Institute of Fruit and Decorative Trees
Prievidzká 53
972 01 Bojnice
Slovakia
Tel: (421-46) 5430941
Fax: (421-46) 5430314
Email: vuood@pd.psg.sk

Franci Štampar
Biotechnical Faculty
Department of Agronomy
Jamnikarjeva 101
1000 Ljubljana
Slovenia
Tel: (386-1) 1231161
Fax: (386-1) 1231088
Email: franci.stampar@bf.uni-lj.si

Markus Kellerhals
Swiss Federal Research Station for Fruit Growing, Viticulture and Horticulture (FAW) [28]
Postfach 185
8820 Wädenswil
Switzerland
Tel: (41-1) 7836242
Fax: (41-1) 7836265
Email: markus.kellerhals@faw.admin.ch

Necla Ercan
Aegean Agricultural Research Institute (AARI)
PO Box 9, Menemen
35661 Izmir
Turkey
Tel: (90-232) 8461331
Fax: (90-232) 8461107
Email: aari@egenet.com.tr

Members nominated after the meeting

Adriatik Çakalli
Albanian Genebank, National Seed and Seedling Institute
Rr. Siri Kodra
Tirana
Albania
Tel: (355-42) 30324
Fax: (355-43) 62419
Email: adri_cristi@hotmail.com

Walther Faedi
Istituto Sperimentale per la Frutticoltura (ISF), Sezione di Forlì
Via Punta di Ferro 2
47100 Forlì
Italy
Tel: (39) 0543722864
Fax (39) 0543722692
Email: faedi.isf@agraria.it

Mike Jeger
National Fruit Collection
Imperial College at Wye
Brogdale Road
Faversham, Kent ME13 8XZ
United Kingdom
Tel: (44-1233) 812401
Fax: (44-1233) 813017
Email:m.jeger@ic.ac.uk

[28] As of 1 January 2004, name changed to "Agroscope FAW Wädenswil".

INDEX OF AUTHORS

ISBN 92-9043-611-5

Cover photo: courtesy of © Federal Centre of Breeding Research, Institute for Fruit Breeding, Dresden-Pillnitz, Germany.
Malus ioensis (Wood.) Britt.