European Cooperative Programme for Crop Genetic Resources Networks

ECP//GR

Report of a Working Group on Potato

IPGRI

First Meeting 23–25 March 2000, Wageningen, The Netherlands

R. Hoekstra, L. Maggioni and E. Lipman, *compilers*

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The International Plant Genetic Resources Institute (IPGRI) is an autonomous international scientific organization, supported by the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to advance the conservation and use of genetic diversity for the well-being of present and future generations. IPGRI's headquarters is based in Maccarese, near Rome, Italy, with offices in another 19 countries worldwide. The Institute operates through three programmes: (1) the Plant Genetic Resources Programme, (2) the CGIAR Genetic Resources Support Programme and (3) the International Network for the Improvement of Banana and Plantain (INIBAP).

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The European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) is a collaborative programme among most European countries aimed at ensuring the long-term conservation and facilitating the increased utilzation of plant genetic resources in Europe. The Programme, which is entirely funded by the participating countries and is coordinated by IPGRI, is overseen by a Steering Committee (previously Technical Consultative Committee, TCC) composed of National Coordinators nominated by participating countries and a number of relevant international bodies. The Programme operates through ten broadly focused networks in which activites are carried out through a number of permanent working groups or through *ad hoc* actions. The ECP/GR networks deal with either groups of crops (cereals, forages, vegetables, grain legumes, fruit, minor crops, industrial crops and potato) or general themes related to plant genetic resources (documentation and information, *in situ* and on-farm conservation, inter-regional cooperation). Members of the working groups and other scientists from participating countries carry out an agreed workplan for their own resources as inputs in kind to the Programme.

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

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Part I. Discussion and Recommendations

Introduction

The first meeting of the ECP/GR Working Group on Potato was held from 23 to 25 March 2000 at the Centre for Genetic Resources (CGN), Wageningen, the Netherlands. Fifteen ECP/GR Working Group members representing 15 countries attended the meeting, jointly with other delegates from the EU RESGEN-CT95-34/45 project and observers from Russia and Ukraine.

Welcoming address

The participants were welcomed by Loek van Soest on behalf of the Centre for Genetic Resources, the Netherlands (CGN). He pointed out that this meeting was a joint meeting of two groups, the newly established ECP/GR Working Group on Potato and the EU-funded RESGEN-CT95-34/45 project on 'Genetic resources of potato, including conservation, characterization and utilization of secondary potato varieties for ecological production systems in Europe', which was organizing its final meeting. He also said that some of the activities started by the latter project could be continued in the framework of the ECP/GR.

He also conveyed the greetings of Lorenzo Maggioni, ECP/GR Coordinator, wishing the best to the new Group, also on behalf of IPGRI. He then mentioned the presence of observers from Russia and the Ukraine, invited by IPGRI, and acknowledged with pleasure the presence of a representative from ASSINSEL. He informed the Group that FAO had also been invited and had expressed interest in this meeting, although it was not possible for them to send a representative.

He went on to explain that CGN is the national genebank of the Netherlands and operates under the responsibility of the Ministry of Agriculture, Nature Management and Fisheries. The Centre is part of the newly established institute 'Plant Research International' (a recent merger of CPRO-DLO—Centrum voor Plantenveredelingsen Reproduktieonderzoek (Centre for Plant Breeding and Reproduction Research)), IPO-DLO (Instituut voor Planteziektenkundig Onderzoek (Research Institute for Plant Protection)) and parts of AB-DLO (Instituut voor Agrobiologisch en Bodemvruchtbaarheidsonderzoek (Research Institute for Agrobiology and Soil Fertility)), and maintains in its genebank facilities more than 21 000 accessions of 20 horticultural and agricultural crops. CGN participates in several ECP/GR networks and the different working groups under these networks, as well as in a number of RESGEN projects financed by the European Commission and deals with the genetic resources conservation and utilization of several crops.

In the field of potato genetic resources CGN participates in a German–Dutch programme in plant genetic resources, which started in 1974. It is responsible for the management of the joint tuber-bearing Solanaceae collection (potatoes).

Finally L. van Soest wished the participants a fruitful meeting and hoped that the discussion would contribute to a further development of joint activities on potato genetic resources conservation in Europe.

Collaboration with the EU RESGEN-CT95-34/45 project

Roel Hoekstra reminded the Group that collaboration between ECP/GR and the EU-funded project dated back to the second EU project meeting held in Edinburgh, United Kingdom, in 1997. On that occasion, five non-EU member participants from the Czech Republic, Hungary, Poland, Russia and the Ukraine had been invited to attend the meeting with the support of ECP/GR funds. Agreements with these five countries were then consolidated to carry out activities complementary to the EU project aims, the results of which will be presented during this meeting.

The need to continue the regional collaboration for the conservation and use of potato genetic resources, after the end of the 4-year EU project, resulted in a proposal to establish an ECP/GR Working Group on Potato. This proposal was submitted in 1998 to the ECP/GR Steering Committee by R. Hoekstra, EU project coordinator (see full proposal, Appendix II). At its seventh meeting (Braunschweig, Germany, July 1998) the ECP/GR Steering Committee approved the establishment of the Working Group on Potato within the framework of the Industrial Crops and Potato Network.

According to a suggestion received from the ECP/GR Coordinator, R. Hoekstra offered to chair the meeting, in agreement with the Group. He then informed the Group that, at the end of the meeting, a Chairperson and a Vice-Chairperson should be selected to coordinate and monitor the Group's activities until its next meeting.

R. Hoekstra then asked the participants to briefly introduce themselves and the provisional agenda was subsequently adopted by the Group (see page 85).

Information on ECP/GR

On behalf of the ECP/GR Coordinator and on the basis of notes and overheads received from him, R. Hoekstra gave a presentation summarizing the history, scope, objectives and achievements of the Programme, as well as its mode of operation in the current Phase VI.

He explained that the Steering Committee, comprising the member countries' coordinators, has overall responsibility for the Programme; takes decisions regarding the general scope of the Networks and the establishment or continuation of working groups; and approves the Programme's budget. The Steering Committee periodically reviews the overall Programme and progress made by the Networks. The ECP/GR Working Groups are composed of country experts nominated by the respective National Coordinators. The Working Group members are expected to ensure effective links between ECP/GR and the respective stakeholders at the national level. Working Group members and other scientists from participating countries carry out an agreed workplan with their own resources as inputs in-kind to the Programme.

Participation in Working Groups takes place either as 'Attending members', whose participation in the meetings is fully funded, or as 'Corresponding members', who keep a high level of interaction with the Working Group without, however, attending the meetings. This arrangement helps maintain the cost of meetings within budget frames and contributes towards maintaining groups at a size conducive to a dynamic discussion and the efficient elaboration of practical workplans. National coordinators can nominate a defined number of 'Attending members' to the existing Working Groups. This number varies for each country, according to the level of their financial contribution to the Programme.

Although in the previous Phases of ECP/GR the Working Groups used to hold approximately two meetings within a 5-year phase, the strategy for the current Phase VI was modified by increasing the number of Working Groups, but reducing the frequency of their meetings and enhancing the role of the Networks. The establishment of Network Coordinating Groups, composed of Working Group Chairpersons and Vice-Chairpersons or Database managers, was also decided by the Steering Committee. These Groups will work closely with the Secretariat to which they will submit proposals for activities and review progress, achievements and future workplans of the Working Groups.[1] Full Network meetings were also planned as replacements for individual Working Group meetings, while remaining funds could be invested in small technical meetings addressing relevant issues identified within the Networks.

In this way it was hoped that an enhanced internal coordination within the Networks would facilitate better planning and follow-up of the agreed workplans. An increased scope and flexibility of operation was expected as a result of these operational changes.

[1] Report of the Seventh Steering Committee Meeting, Braunschweig, Germany, 29 June and 4-5 July 1998. IPGRI, Rome, Italy.

R. Hoekstra informed the Group that the Industrial Crops and Potato Network Coordinating Group met for the first time at Bury St. Edmunds, United Kingdom, on 11 September 1999 (a report of this meeting is available on the Internet at <http://www.ecpgr.cgiar.org/Publications/IndCrops0999.htm> and was distributed to all Working Group members in advance of the present meeting). On this occasion the Network Coordinating Group (NCG) proposed that the two Working Groups on *Beta* and on Potato should meet independently from each other. The first meeting of the Working Group on Potato was planned for March 2000 and the second meeting of the Working Group on *Beta* was proposed for 2002. These proposals were submitted to the attention of the Steering Committee and no objections were raised to their implementation. Consequently, the present meeting could be organized. No other meetings of the Working Group on Potato are planned during Phase VI; however, it will be possible for the NCG to identify *ad hoc* actions, in consultation with the Secretariat and related to the Industrial Crops and Potato Network. R. Hoekstra concluded by saying that the implementation of the workplan of the Working Group on Potato, to be agreed at the end of this meeting, would need to be the result of the continued coordination offered by the Working Group Chairperson and Vice-Chairperson and of an intense interaction, mainly maintained by correspondence, between all the Working Group members.

National collections

On 24–25 March the statuses of national collections were presented by the participants: Katrin Kotkas (Estonia), Harry W. Kehoe (Ireland), Roel Hoekstra (The Netherlands), Stepan Kiru (Russia), Jerzy Lewosz (Poland), Kvetoslava Forisekova (Slovakia), Zsolt Polgár (Hungary), Jean-Louis Rolot (Belgium), Luigi Frusciante (Italy), Merja Veteläinen (Nordic Gene Bank), Karl Tolstrup (Denmark), Daniel Ellissèche (France), Konrad Schüler (Germany), Stuart F. Carnegie (UK), Enrique Ritter Azpitarte (Spain), Anatoly A. Podgajetskiy (Ukraine), Christoph Schauer (Austria) and Jaroslava Domkárová (Czech Republic). Where provided by the authors, full texts of these presentations are given in Part Two of this report.

Technical discussion and workplan

The technical discussion and the agreed workplan are summarized by topics below.

Data

S. Carnegie stated that SASA (Scottish Agricultural Science Agency, Edinburgh, United Kingdom) would continue to maintain and update the European database of collections of potato varieties and breeding lines. SASA, however, intended to review the form in which data would be received and would e-mail the final format (see Appendix I, Descriptors) to all participants soon after completion of the EU project. It is expected that the data exchange will be in Microsoft Excel® or Access® format.

R. Hoekstra stated that CGN will continue to develop the database on European stocks of wild and primitive potato species. For the time being the complete database will be on the Internet as a downloadable file, and will be made searchable on-line later (see <http://www.plant.wageningen-ur.nl/about/Biodiversity/Cgn/>).

Both databases will be made available on the Internet. The central database of potato varieties will be available on the SASA Web page within 3 months to all sectors of the potato industry (see <http://www.sasa.gov.uk>). EU participants will also be supplied with the database in Excel or Access format. Links will be included from the central database Web sites to the collections of origin, so that readers will have access to the donor of the data. An update of the databases will be conducted at least once a year.

Virus cleaning (clonal stocks), regeneration (wild species)

None of the delegates presented detailed plans for the following years. It was agreed that the chair will request, by email, working plans (where possible) for the coming years.

The central database will, however, be an essential tool in determining the need for virus cleaning/regeneration, because an infected clone in one collection may be available virus-free elsewhere. It is, therefore important that changes in the plant health status of material are notified to the database managers regularly.

Maintenance responsibilities and rationalization of collections

In the framework of the EU potato genetic resources project, an attempt was made to create criteria for designating two institutes to be primary holders of a variety. With the start of the ECP/GR Working Group, however, the number of collections involved has expanded considerably and the criteria may need to be redefined. For example, where a variety has been bred outside of Europe, e.g. in the United States, it may be felt unnecessary to maintain it at two sites in Europe.

Accepting the responsibility for the maintenance of a certain clone means that the institute will maintain it until further notice and will make it available upon request. If an institute at any point does not want to continue the maintenance of a clone, then the ECP/GR Working Group will be informed and another institute would be identified to take over the responsibility. Collections other than the two primary ones may also maintain the clone for different reasons, but are free to remove the clone from their collection. This strategy will ensure that the clone will be maintained at least in two different sites, and gives other holders the opportunity to rationalize their collection on the basis of specific priorities.

It was agreed that all collections will make a list of which clones they would accept responsibility for in the first place, and send this list to SASA. SASA will identify the clones where no one or only one institute offered to accept responsibility for maintenance.

For accessions of wild and primitive species, the collection holding the most original sample of a certain accession will be determined.

Safety-duplication

The central database will identify unique material. Although a number of institutes, e.g. SASA, keep their collections at two sites within a country, it was felt that it would be preferable to maintain each clone in two different countries. However, it may be difficult to find another collection willing to maintain a safety-duplicate sample. As a temporary solution, M. Veteläinen suggested that material may be kept at two sites within a country.

For true seeds of wild and primitive species, safety-duplication can easily be implemented through black box arrangements.[2] The need for additional safety-duplication will be determined.

Characterization/evaluation

None of the delegates presented detailed plans for the following years. It was agreed that the Chairperson will request, by e-mail, working plans (where possible) for the coming years. SCRI is currently developing testing methods for susceptibility to silver scurf (*Helminthosporium solani* Durieu & Mont.) and black dot (*Colletotrichum coccodes* (Wallr.) S.J. Hughes).

[2]Under 'black box' arrangement, the safety-duplicate seed sample is stored in long-term conditions according to international standards; it is not used, tested, regenerated or distributed to a third party.

Other topics

It was agreed that the potato genetic resources should be freely available, but handling costs, for example for packing and sending *in vitro* plantlets, could be requested.[3]

J. Lewosz is looking for cooperation to start a research project on *in vitro* culture of potato clones.

Considering that a core collection includes a maximum of diversity in a limited number of accessions, it is felt relatively easy to determine how to build a core collections for wild species. However, the same exercise seems to be more complicated for potato varieties, since they are genetically closely related. J. Lewosz proposed that a core collection of cultivars should include the most commonly used ones.

Some potato variety names (like 'Gloria') have been used more then once. In such cases, varieties with the same name may have different parents. It is crucial to be able to distinguish them. An Internet site with the available descriptions and pictures of the light sprouts of the varieties may be of help as a reference and may be as effective and as cheap as comparing genotypes with electrophoresis or PCR methods. Furthermore such an approach means that no material needs to cross country borders.

Conclusion

Field excursion

It should be noted that on 24 March the Group had the opportunity to visit Plant Research International in Wageningen, where they were shown the genebank storage facilities of CGN. In that occasion, Dr van der Vossen discussed the changes in the role of the institute in relation to potato breeding and the breeding companies. He explained that the institute is currently committed to the use of molecular technology in breeding and not to traditional pre-breeding by crossing species, etc. The Group also visited the Genomics laboratory where they saw the new equipment for molecular work.

The Group also visited the breeding station of HZPC, a recent merger of the potato breeding companies Hettema and of the cooperative ZPC. There, J. van Loon presented the technical facilities of the breeding station, the tuber samples of a part of the 'potato variety and breeding lines collection' of SSA, the '100 year Hettema' slide show and the Hettema computer program for handling passport, characterization and evaluation data of varieties, breeding lines and their offspring.

Election of the Chairperson and Vice-Chairperson

After some proposals and discussion R. Hoekstra (CGN, the Netherlands) and M. Veteläinen (NGB, Sweden) were unanimously chosen by the ECP/GR delegates as, respectively, Chairperson and Vice-Chairperson of the ECP/GR Working Group on Potato.

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[3] IPGRI's view on 'genebank handling charges':

IPGRI encourages genebanks to find ways of promoting the use of genetic diversity. Handling charges, however small, could run counter to this objective and even discourage requests from potential users. For many countries, the difficulty of obtaining foreign exchange, even for small handling fees, could act as an impediment to requesting material from a genebank. Overall, the cost and effort of setting up a system for recovering handling costs may not be justified and the pros and cons should be examined carefully before setting up such a system. However, it is understood that charges may need to be levied on requests for large quantities of germplasm that would require excessively expensive multiplication and shipping costs.

In considering the possible introduction of handling charges, IPGRI believes that special attention should be given to the possibility of:

- not applying handling charges to requests from developing countries
- not applying handling charges for exchanges with other genebanks (reciprocal free-exchange agreements are often more appropriate)
- waiving handling charges for institutions, including private companies, that agree to make their own breeding products (genetic stocks, advanced lines, etc.) available to the genebank.

Closing remarks

It was proposed that the second meeting of the ECP/GR Working Group on Potato be held in Hamburg in 2002, after the 15th triennial EAPR meeting.

The Group wished to thank CGN for the excellent organization of the meeting. Thanks were also extended to HZPC for their hospitality and the lunch offered to the Group.

Part II. Presented papers

The *in vitro* collection of potato varieties held at the Animal Production and Agricultural Systems Department, Unit of Libramont, Belgium

J.L. Rolot

Département Production animale et Systèmes agricoles, Ministère des Classes moyennes et de l'Agriculture, Centre de recherches agronomiques de Gembloux, Libramont, Belgium

Introduction

The Animal Production and Agricultural Systems Department located in Libramont, in the Ardennes, is a division of the Centre de recherches agronomiques de Gembloux (Agronomical Research Centre in Gembloux), and thus depends on the Belgian Ministry of Agriculture.

The Department was historically involved in potato research. There have been several changes in organizational structure and the word 'potato' does not appear any longer in the name of the department, but an important part of its activities still focuses on potato.

Potato seed production techniques are particularly studied, with emphasis on the production of pre-basis material in the form of *in vitro* or minitubers or acclimatized vitroplants. A technique for soilless production of potato minitubers, allowing an increase of the sanitary quality and economical efficiency, has been developed. Minitubers and acclimatized vitroplants are produced for the seed production sector in Belgium, as well as minitubers and vitrotubers for abroad and particularly Central Africa. The collection contains many specific varieties from Rwanda, Burundi and eastern Congo.

Other major research themes on potatoes are summarized below:

- decision support systems to help take decisions and protect crops or seeds against viral infections or potato crops against late blight
- study of late blight populations in our region
- study of aphids populations
- detection techniques for major potato viruses (ELISA / PCR): the Department manages the national laboratory for viral diseases inspection during potato seed production
- control methods for bacterial diseases and especially Erwinias
- organic potato production
- study of varieties: agronomical value and uses
- analytical evaluation techniques of the varieties' culinary quality or suitability for industrial processing.

The potato collection

Background

When the potato collection was initiated at the Research Unit of Libramont, a great part of the Unit's activities dealt with the creation of new varieties. From the 1950s to the 1970s, tens of varieties were created. They are virtually forgotten nowadays, except for the cultivar 'Gasore', a variety with exceptional resistance to late blight and to potato virus Y.

A collection of genitors and cultivars was kept in the field, encountering various commonly associated problems: viral or fungal infections, storage problems, etc. Many varieties were lost because of degeneration.

In 1993, owing to its activities of *in vitro* pre-basis material production, the Unit was equipped with an *in vitro* production laboratory. Collecting of the most representative cultivars of the seed production sector in Belgium (e.g. 'Bintje', 'Désirée', 'Kennebec', 'Corne de gatte' and 'Heidenière') was then undertaken, in order to be able to supply the production sector with material of high sanitary value. Afterwards we progressively introduced all the varieties multiplied in Belgium, or even those of companies which asked us to control the virus status of their *in vitro* material used as starting material to produce minitubers. We also started working with an amateur interested in maintaining plant biodiversity. In this context we evaluated a collection of 40 old potato varieties in the field after regeneration. Other various collaborations with scientific institutes in other countries led us to collect local varieties (from Bulgaria, Romania, Rwanda and Madagascar).

Although we first aimed at being able to supply the Belgian production sector with *in vitro* pre-basis material of current varieties, we now have a much wider collection of about 300 potato varieties (Table 1).

The maintenance of this *in vitro* collection is a rather heavy work, all the more due to staff reduction, as is the case in many public institutions specialized in scientific research. The laboratory is managed by a half-time technician and a lab assistant in charge of maintaining the collection and the material produced for our customers.

Rules at work

The interest in maintaining an *in vitro* potato collection lies in the capacity of the technique to keep the plant material free from external infections leading to degeneration. The preservation in the laboratory is carried out in a flexible way and is independent of the season. The means required for the maintenance of the material in open fields (fields, manipulations related to plantation, maintenance, harvesting, packaging and storing) are greatly reduced.

However, this technique also involves the following major risks:

– loss of identity of the variety through *in vitro* mutation or by mixing cultivars during manipulation in the lab;
– possibility to keep and multiply an undetected viral or bacterial infection in the laboratory.

It is essential to identify techniques to avoid these problems, especially during manipulation of the material intended for our customers. The main rules observed are presented below.

– During *in vitro* introduction

A. Variety whose tuber has been acknowledged as disease-free after being checked for the presence of common viral diseases

- Checking of varietal identity: electrofocusing of the tuber proteins, comparison of the profile with a well-known tuber;
- testing the regenerated vitroplants for bacteria like *Erwinia, Clavibacter* and *Ralstonia* in collaboration with the Research Centre of Gent (Mr Van Vaerenbergh);
- testing the vitroplants obtained in the lab after being acclimatized in a greenhouse to check again the presence of common viruses;
- entering in the collection register with a code indicating the variety and year of introduction.

B. Variety whose tuber has not been acknowledged as disease-free

- When the variety to introduce is not disease-free and when there are no healthy tubers available elsewhere (e.g. old varieties and sometimes varieties from abroad), it

is purified either as a plant developed from a tuber, or as a vitroplant, after the disease has been identified. Thermotherapy is coupled with meristem culture. After the meristems have regenerated vitroplants, the latter are divided in three batches: one is kept in the laboratory; the second is acclimatized in a greenhouse, observed and tested for viruses; and the third is sent to the lab where bacteria are tested. When all tests prove to be correct, the vitroplants obtained from one of the meristems are selected for preservation. The variety is then entered in the collection with its identification code.

– **During preservation**

- Checking for mutations or accidental mixing: every year, 30% of the collection is transferred to open fields in the form of five minitubers per variety. Observations are made on phenotypes and diseases. The sanitary state is checked for the six major viruses during the minituber production period.
- Varieties are kept *in vitro* in tubes containing 12 specimens per variety. The preservation conditions are as follows: MS medium without growth hormones, average temperature 18-20°C (culture room also used for production), photoperiod 18 h/6 h, renewal of the stump by taking a cutting at least twice a year.

– **During production for a customer**

Identification tests and tests to check the sanitary state of the stump are automatically repeated.

What do we need?

– **Checking the identity of the varieties maintained**

Although their origin is well known, many varieties of our collection have never been checked for varietal identity. It is controlled systematically only when a stump is used for economical purposes or for an exchange with colleagues.

– **Widening the basis of sanitary control**

Most of the varieties of our collection come from Europe. The six major viruses existing in Europe are checked systematically but other less common viruses are not.

Conclusions

The potato collection has never been a priority in our research programmes in the last years. The collection has been built over the years, thanks to passion, curiosity and contacts with foreign colleagues working in the seed production sector or through collaboration in programmes dealing with regeneration and assessment (e.g. old varieties).

In spite of staffing problems, the collection is maintained in a relatively favourable environment since all the necessary equipment is available for sanitary control (ELISA, PCR, etc.), variety control (electrofocusing of the proteins or isoenzymes, observations in open fields), and *in vitro* transfer through suitable facilities (greenhouses). The practical aspect of the utilization of the collection (production for the private sector) allows, through a feedback system, to validate our quality control systems.

Table 1. List of potato varieties held at the Animal Production and Agricultural Systems Department in Libramont

Denomination	Code
1512 (16) (R2)	1512(16)-99
1563-C (14) (R4)	1563-C-(14)-99
3053-18 (R5)	3053-18-99
218-ef (7) (R7)	218-ef-99
2424a (5) (R8)	2424a(5)-99
R9	R9-99
3681ad (1) (R10)	3681ad(1)-99
5008ab(6) (R11)	5008ab(6)-99
501	501-94
85 244 L	85244-96
89-10-97	891097-99
89-15-13N	1513-97
Accosuyto (A)	ACOSU-99
Agatta	AGA-96
Agria	AGRIA-95
Aida	AIDA-98
Aïko	AIKO-95
Ajiba	AJIBA-98
Anosta	ANOSTA-95
Anya	ANYA-96
Arema	AREMA-95
Arinda	ARINDA-95
Arran Banner	ARR BA-97
Arrosett	ARO-94
Artana	ARTA-95
Astérix	ASTE-95
Atlantic	ATL-94
Atsimba	ATSIM-94
Aura	AURA-99
Avalanche	AVAL-97
Avantie	AVAN-99
Axilia	AXIL-95
Aziza	AZIZA-94
Bala	BALA-00
Baraka	BARAKA98
Barsa	BARSA-98
Belle de Fontenay	BEF-98
Belle de Lorraine	BEL-99
Berber	BERBER-99
Berna	BERNA-97
BF 15	BF15-97
Bimonda	BIM-99
Bintje	BTJ-98
Biola	BIOLA-94
Blanchard aux yeux bleus	BLANCH-99
Bleue du Périgord	BP-94
Bonanza	BONA-95
Bondeville	BONDE 00
Bonnotte de Noirmoutier	BON-94
BOR 1340	BOR-134099
Bright	BRIGH-99
Brodick	BRODI-99
C 200	C200-97
C 281	C281-97
C 62	C62-97
Calgary	CALGA-99
Cara	CARA-99
Carlita	CARL-94
Casin	CASIN-96
Catellyna	CATELY-99
Charlotte	CHARL-95
Denomination	**Code**
Ciicero	CICER 00
Cilena	CILEN-98
CIP589002-11	CIP589002-11-00
Claustar	CLAUS-94
Combi	COMBI-99
Commander 1904	COM1904-99
Cordovina (B)	COR B-99
Corne de Chèvre Bretonne	CCB-99
Corne de Gatte	CGA-98
Craigs Royal ®	CRAIGS ROYAL ®-99
Craigs snow white (R1)	CRAIGS SNOW WHITE R1-99
Crebella	CREBE-94
Crispin	CRISP-97
Cruza	CRUZA-94
Cycloon	CYCLO 00
D60	D60-95
Dali	DALI-98
Derby	DERBY 00
Désirée	DES-98
Désitale	DESIT-98
Diamant	DIAM-98
Disco	DISCO-94
Ditta	DITTA-98
Docent	DOCEN-94
Donald	DONALD-97
Doonstar	DOON-95
Dorado	DORADO-98
Dore	DORE-98
Draga	DRAGA-98
Duke of York	DY-94
Eba	EBA-95
Eersteling	EER-98
Electre	ELECT 00
Elles	ELE-94
Erasme	ERASM 00
Ernstestolz	ERN-94
Eschyle	ESCHYL 00
Escort	ESCOR-94
Estima	ESTIM-94
Etoile du Léon	ETO-98
Etoile du Nord	ETN-95
Exempla	EXEM-98
Exquisa	EXQUI-00
Fabula	FABULA-96
Felsina	FELSIN-98
Fianna	FIANA-95
Fin de siècle 1894	FINSI-99
Finlander délice	FINLAN-99
Folva	FOLVA-98
Forelle	FORELLE-98
Franceline	FRA LI N 00
Francine	FRANC-99
Garana	GARANA-99
Gashari	GAH-94
Gasore	GASO-SHB-97
Gasore	GASO-GBX-99
Gasore	GASO-RWA-99
Gasore PVS	GASO PVS-99
Gaumaise	GAUMA-
Gloria	GLORI-98
Denomination	**Code**
Grata	GRATA-95
Guanaja Equateur	GE-94
Hansa	HANSA-99
Heidenière	HEI-94
Hercule 1912	HERCULE1912-99
Herculus	HERCU-95
Hermes	HERMES-99

Table 1 continued.

Homero	HOMERO-95
Imila (A)	IMILA-99
Impala	IMPA-95
Imperia	IMPER-
Indira	INDI-99
Innovator	INNOVA 00
Inova	INOVA-98
Irish Peace	IRP-94
Jacqueline	JACQ LI 00
Jaerla	JAERLA-98
Jamilla	JAMIL-97
Jaune de l'Aveyron	JA-94
Jaune du Perou	JP-94
Joëlle	JOEL-94
Judith	JUDIT-94
Juliette	JULIET 00
Kaptah vandel	KAPTA-97
Kennebec	KENB-98
Kenya	KENYA-94
Keumiske	KEUMI-99
Kirundo	KIRUN-94
Kivu	KIVU-94
Kondor	KONDOR-97
Kuras	KURAS-95
Kuroda	KUROD-99
Lady Claire	LADYCL-98
Lady Rosetta	LROS-94
Lava	LAVA-99
Linzer Délicatesse	LINZERD-98
Lisetta	LISET-95
Lola	LOLA-98
Mabondo	MABON-94
Majestic	MAJES-98
Marco Polo	MARPO-99
Marfona	MARFO-
Mariline	MARIL-97
Maris Bard	MABA-99
Maris Peer	MAPE-95
Maris Piper	MAPI-99
Marjolaine	MARJO-99
Markies	MARKI-99
MC-14 clone 2 T1	MC14CT-97
MC-36 clone 2	MC36C2
MC-40 clone 2	MC40C2-97
MC-6 clone 2	MC6C2-99
MC-8 clone 2	MC8C2-99
Merit	MERIT-99
Milva	MILVA 00
Miova	MIOVA-99
Miriam	MIRIA-95
Mirka	MIRKA-97
Mizero	MIZER-94
Monalisa	MONAL-99
Mondial	MONDIA-99
Moni	MONI-99
Mountain king	MOUKI-99
Muhabura	MUHAB-94
Muresan	MURESA-96
Nadia	NADIA-99
Denomination	**Code**
Nderera	NDERE-94
Nevskij	NEVSKI-01
Nicola	NIC-98
Nikita	NIKIT-99
Noire des Indes	NI-95
Noire du Casset	NC-99
Novaship	NOVA-95
Noylha Papa	NOY-94
Oblongue d'Oléron	OL-99

Oeil de Perdrix	OP-94
Olivia	OLIVI-99
Ostara	OSTA-98
Ovatio	OVATI-99
Paki	PAKI-95
Pamina	PAMINA-98
Patraque d'Auvergne	PAUV-98
Pentland Ace (R3)	PENTLAND ACE (R3)-99
Pentland dell	PEDE-99
Peveloise	PEVE-94
Pitaro	PITARO-99
Pompadour	POMPA-99
Pota	POTA-99
Précoce de Pologne	PREPO-99
Première	PREMI-01
Primreine	PRIMR-99
Primura	PRIMU-01
Prudentia	PRUD-99
Puca	PUCA-94
Quarta	QUAR-95
Radlin	RADLIN-97
Radosa	RADO-98
Raja	RAJA-99
Ratte (Touquet)	RATO-98
Record	RECOR-94
Red Pontiac	REDP-98
Reina	REINA-94
Resonant	RESON-99
Rita	RITA-95
Ritipasissan (A)	RITI
Robinta	ROBIN-99
Roclas	ROCLAS-96
Rode Eersteling	ROEE-98
Rosa	ROSA-00
Rosabelle	ROSAB-99
Roseval	ROSEVA-98
Rouge d'Auvergne	ROA-99
Rouge du Mexique	ROM-94
Rougeor	ROUGE-97
Roxane	ROX-97
Roxane x 522 33	ROX522-94
Roxy	ROXY-98
Rubiastra	RUBIAS-98
Rubinia	RUBI-94
Runica	RUNICA-96
Russet Burbank	RBK-95
Rustic	RUSTIC-96
S. Berthaultii	SBER-97
Sangema	SANGE-94
Santana	SANTA-98
Santé	SANTE-98
Saskia	SASKIA-98
Saturna	SATUR-97
Saucisse de Plougastel	SP-94
Sava	SAVA 00
Serenade	SEREN-99
Seresta	SERES-99

Table 1 continued:

Denomination	**Code**
Shepody	SHEPOD-98
Sibylla	SIBIL-98
Sieglinde D2	SIE-98
Sirco	SIRCO-99
Sirma	SIRMA-97
Sirtema	SIRTE-95
Sokolech	SOKO-97
Solide	SOLID-98
Soltskaïa	SOLTS-98
Sommergold	SOM-99
Spartaan	SPA-95
Spunta	SPUNTA-98
Start	START-97

Stormontenter pen	STORMPE-99
Succevita	SUCEV-96
Superstar	SSTAR-97
Synfonia	SYNFO 00
Tango	TANGO-99
Teo	TEO-96
Teodora	TEODO-98
Tescla	TESCL 00
Timate	TIMAT 00
Titus	TITUS-96
Triptik	TRIPT-99
Tubercule Ardeche	TUARD-99
Turia	TURIA-98
Ukama	UKAM-98
Uram	URAM-99
Van Gogh	VA N GO 00
Vebebe	VEBE-99
Venouska	VENOU-99
Vento	VENTO 00
Victoria	VIC RIA 00
Vieille de Bourges	VIEILBOU-99
Vitelotte Négresse	VN-94
Vroegt op	VROEGT-99
Wilja	WILJA-99
Xantia	XANTIA 00
Yukon Gold	YUGO-96
Yul	YUL-95
Zeemuis	ZEEMUI-99

The potato germplasm collection in the Czech Republic

J. Domká?ová and V. Horá?ková

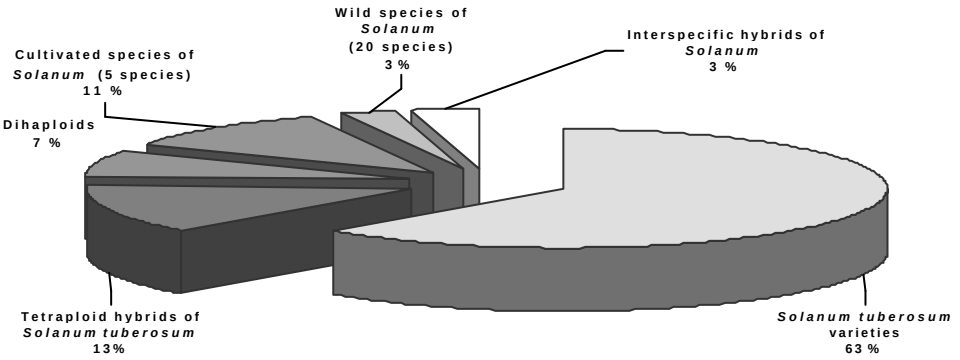
Potato Research Institute (PRI) Havlí?k?v Brod Ltd., Havlí?k?v Brod, Czech Republic

The Potato Research Institute (PRI) Havlí?k?v Brod has been involved in the gathering, study and maintenance of potato genetic resources in the Czech Republic for a long time. In 1952, the 'world potato collection' (collection of potato varieties from different countries, maintained at the Potato Research Institute) was already maintained in a field collection and evaluated. Over 1800 potato varieties have been gathered and evaluated (Domká?ová *et al.* 1993, 1995; Domká?ová 1997, 1999). In the last years, a few research projects have been conducted at PRI on potato genetic resources. Since 1994 potato genetic resources have been studied within the framework of the 'National Programme of Conservation and Utilization of the Plant Genepool' (Dotla?il *et al.* 1995).

The in vitro *genebank*

The maintenance of potato genetic resources via simple transplanting of tuber samples exposed the collection to natural infection pressure every year, and this resulted in a deterioration of the sanitary status and in losses of stocks. For this reason, the conventional technique of vegetative propagation has been gradually replaced by *in vitro* preservation since 1986. A whole series of experiments were carried out with the aim to observe the influence of culture conditions on growth reduction and on the induction of *in vitro* tuberization. Based on these experiments, techniques for long-term *in vitro* preservation have been developed, involving several joint procedures: quarantine planting of newly obtained materials; aseptic transfer to *in vitro* conditions; long-term *in vitro* preservation and subculturing; and *in vitro* eradication of viruses (Horá?ková *et al.* 1999).

Fig. 1. Proportion of individual categories maintained in an *in vitro* genebank

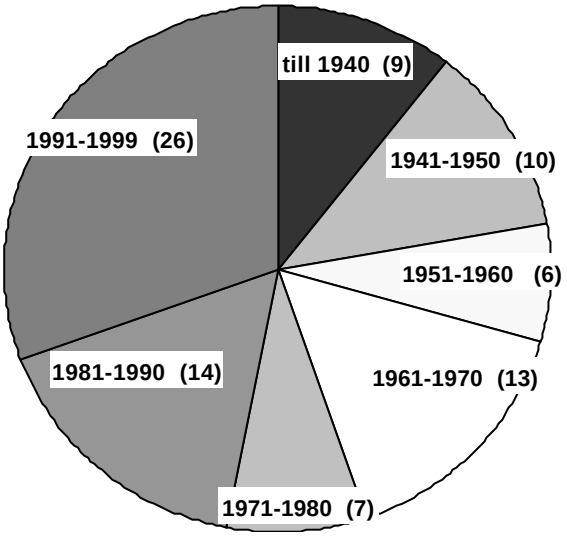


The *in vitro* genebank contains a total of 1627 genotypes, recently divided in six groups: (1) varieties of *Solanum tuberosum*; (2) tetraploid hybrids of *Solanum tuberosum*; (3) dihaploids; (4) cultivated species of the genus *Solanum*; (5) wild species of *Solanum*; and (6) interspecific hybrids of *Solanum*. The varieties of the 'world potato collection' represent the largest group in terms of numbers (Fig. 1).

The collection contains 1018 varieties from 33 countries, including 27 European countries accounting for 95% of the maintained varieties. From the viewpoint of the sanitary status, the collection can be divided in three groups: (i) varieties free from virus infection (47.6%); (ii) varieties infected by PVS (26.0%); and (iii) varieties infected by other viruses (26.4%).

The collection includes original varieties bred in the Czech Republic. Since the beginning of potato breeding activities in the Czech Republic, 102 original varieties were bred (Fig. 2). The genebank maintains 85 of these, including both currently authorized varieties and already restricted varieties.

Fig. 2. Number of varieties of Czech breeding maintained in an *in vitro* genebank, according to years of registrations (Horá?ková *et al.* 1999)



Long-term preservation in the genebank is carried out *in vitro* at low temperatures on media inducing slow growth and microtuber production. Culture conditions are as follows: MS medium with 6% saccharose without growth regulators, temperature 10°C, and 10 hour light period.

Active eradication of viruses involves the utilization of meristem explants. After isolation of the apical meristems of buds containing the virus-free zone, the whole virus-free plants are regenerated from explants. Plants of clones to be cleaned are prepared on MS medium without growth regulators. After 2 weeks of culture, the plants grown in tubes are transferred into a climatized box and subjected to thermotherapy. An alternating regime is utilized: 37°C during a 16 h light period and 25°C during a 8 h dark period. After 6–10 weeks of thermotherapy, the meristems of explants (0.5 mm) are isolated from the axillary buds. Cuttings usually include apical meristems and one or two axillary promeristems. The removed meristems are cultivated on MS medium with an increased content of vitamins, IAA, gibberellic acid and kinetin. The meristems are transferred to tubes containing agar (3 cuttings per tube). After 3 weeks of culture (20°C, 16 h light period), they are transferred to a fresh medium, where shoot regeneration is carried out. The shoots are transferred on a propagation medium containing no growth regulators, and prepared for checking of the sanitary status: this is done by ELISA repeated twice on the *in vitro* material. The length of the cleaning cycle varies widely according to the genotype and to the eliminated virus, and lasts about 1 year. Final evaluation of the efficiency of virus elimination is carried out after

planting the cleaned clones in the greenhouse, by ELISA performed on the growing plants.

An alternative way of virus eradication is chemotherapy. Substances with virostatic effects (e.g. Ribavarin) are added to the nutrient solution. Repeated passages on medium containing selected concentrations of virostatic substances are carried out. It is presupposed that healthy material is obtained after the third passage. A detailed protocol for chemotherapy is currently being elaborated.

Methods used for the evaluation of the potato genepool

Each year, 150–180 genotypes are evaluated in the field collection. The description of morphological traits and the evaluation of the vigour of initial growth, vegetation period, sanitary status, yield and selected economical characters are carried out according to the 'Classificators for the genus *Solanum* L.' (Vidner *et al.* 1987) that use a nine-point evaluation scale.

The following methods are used for the evaluation of these characters:

- testing for viruses: DAS-ELISA method (Clark and Adams 1977) modified according to D?di? and Nohejl (1985)
- tuber resistance to potato wart disease and potato nematode: inoculation experiments in PRI's quarantine station (Kunratice u Šluknova) according to Poto?ek (1987)
- tuber resistance to *Fusarium* dry rot: artificial infection of mechanically damaged tubers by a suspension of *Fusarium* conidia (Horá?ková 1977)
- tuber resistance to potato late blight: artificial infection of mechanically damaged tubers by a suspension of *Phytophthora infestans* conidia (Horá?ková 1996)
- tuber resistance to mechanical damage: evaluation of tuber flesh elasticity by reflexive pendulum according to Zadina and Dobiáš (1975, 1980). A more accurate electronic pendulum MIDAS 88P is now gradually being utilized
- starch content: measured according to Hošpes–Petzold scale and by polarimeter according to Ewers (Davídek 1977)
- dry matter content: by oven-drying at 105°C to constant weight (Štampach and Blecha 1955)
- reducing sugars content: Luff-Schoorl's method (Davídek 1977)
- pollen fertility: iodine staining method (Fr?ek 1988)
- culinary value of the tubers: according to Czech State Standard 46 22 11
- suitability for chips and French fries production: standard methods of the EAPR, chip colour according to the colour scale of IBVL Wageningen, French fries colour according to Munsell Color Company's colour scale.

Information and documentation

The automatized information system EVIGEZ was developed in the Genebank Department of the Research Institute for Plant Production, Praha-Ruzyn?. Passport and description data are entered in databases for documentation and utilization of the whole range of information on agricultural crops germplasm. The system is widely used, including for potato, and will still be considered as the basis for the documentation of the evaluated potato genetic resources. EVIGEZ passport data on plant genetic resources of the Czech Republic (including potato) are available at <http: / / genbank.vurv.cz / genetic / resources / >.

Providing information and samples to users

Requested genotype samples and relevant information on the maintained germplasm are provided to users of the potato genetic resources collection. Individual genotypes are provided as *in vitro* plants, or as tubers obtained from the propagation plot of the field collection (Table 1). Information on the status of potato germplasm is presented annually in special publications as informative reviews (e.g. list of genotypes maintained in the *in vitro*

genebank, yearly results of the evaluation of varieties in the field collection) and varietal descriptions published as a 'Card-index of varieties of the world potato collection'.

Table 1. Number of accessions provided to users of the potato collection, 1990–2000

Years	National breeders	National research stations and colleges (universities)	Foreign users
1990	51	211	52
1991	56	137	15
1992	69	324	0
1993	93	260	0
1994	89	357	13
1995	76	145	5
1996	84	96	8
1997	48	299	39
1998	37	203	32
1999	33	374	30
2000	40	98	3
Total	**676**	**2504**	**197**

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Status of the Danish potato collections

Karl Tolstrup

Landbrugets Kartoffelfond Foraedlingsstationen, Vandel, Denmark

The collection of potatoes for breeding and research purposes has been held at The Danish Potato Breeding Foundation (DPBF) in Vandel since the beginning of the breeding work around 1950. During the last 15 years the field collection has been cleaned from viruses and routinely tested for damaging viruses. At present the collection consists of ca. 580 tetraploid varieties / breeding lines of potatoes and ca. 150 clones of wild species. More than half of the collection is kept *in vitro* as virus- and health-tested plants. Stock multiplication is kept in a netted aphid-proof screenhouse or greenhouse (Figs. 1 and 2).

Fig. 1. Genebank maintenance

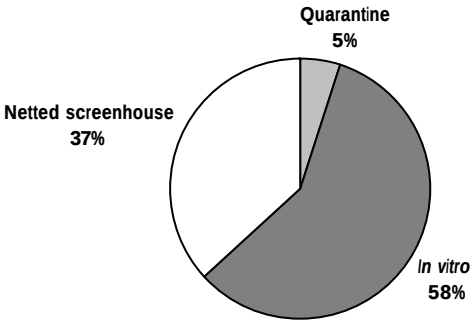
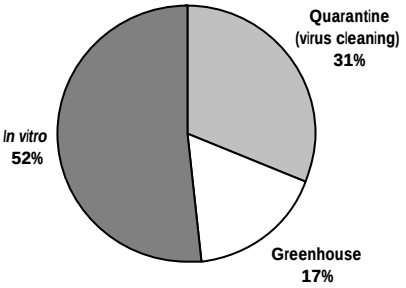


Fig. 2. Wild species genebank



tenance

Every year new material is taken from the netted screenhouse to be multiplied in the field for observation, breeding or scientific purposes. The multiplication stock in the netted screenhouse is routinely tested every year for normally occurring viruses. Virus-diseased plants are discarded and new material is taken from the *in vitro* collection, or meristem cleaning is taken care of.

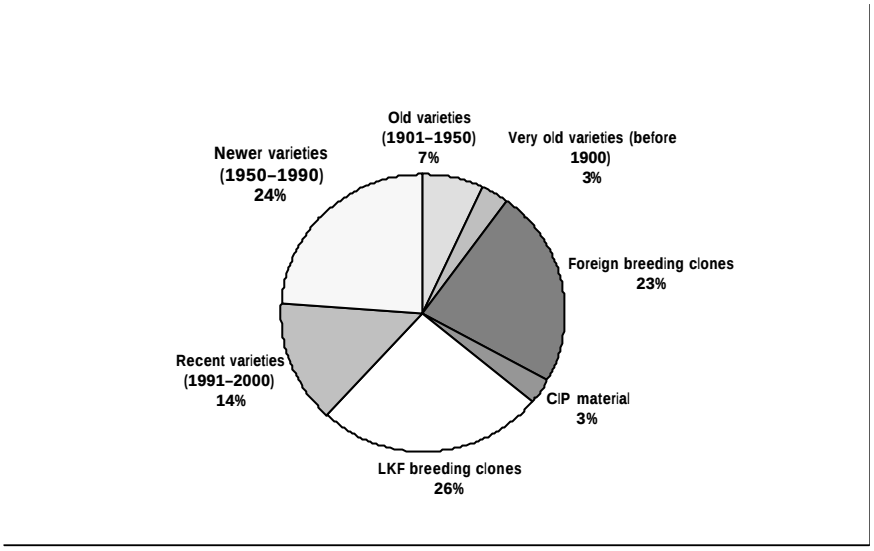
The main collection of potatoes (*Solanum tuberosum*) consists of 65% varieties / lines for consumption, 13% for industry / crisping and 22% for starch.

About 10% of the varieties are old varieties (before 1950), 24% are newer varieties (1950-1990), and 14% are very recently introduced varieties. Half of the collection consists of breeding clones, partly Danish Potato Breeding Foundation's own breeding clones and partly breeding clones of cooperative partners (Fig. 3).

The wild species genebank consists of 150 clones of 69 accessions from 44 different tuber-bearing *Solanum* species kept for their resistances to late blight, cyst nematodes, potato wart disease, viruses, etc., as well as for their special quality traits. The material is used in current Danish projects concerning starch quality, late blight and spraing resistance, in cooperation

with The University of Århus for protoplast fusion and with the Danish Institute of Agricultural Sciences for the use of DNA markers.

Fig. 3. Genebank grouping



The genebank collections are used for the Danish breeding activities, and samples are sent to researchers and breeders elsewhere on request, in conformity with breeder's rights and other breeders' ownership. Material owned by the DPBF is exchanged with cooperating partners under a specific agreement with the receiving party. Free varieties are freely exchanged. The collection is being characterized, although the process is quite slow due to economic reasons. Characterization for late blight resistance has a high priority. DPBF participates in a Nordic project of characterization of the Nordic material. Testing in Denmark is done especially for resistance to potato leaf roll virus and tuber blight.

The genebank work has been supported since 1995 by the Danish Potato Levy Foundation as an ongoing project.

Safety-duplicates of varieties and clones of Nordic relevance are maintained by the Nordic Gene Bank.

Furthermore, the official Danish meristem genebank for potato varieties is held at the Danish Institute of Agricultural Sciences, Flakkebjerg. It contains ca. 70 varieties, which are suitable for growing in Denmark.

Preservation of potato genetic resources in Estonia

Katrin Kotkas

Plant Biotechnological Research Centre EVIKA, Estonian Agricultural University, Harjumaa, Estonia

In 1994 the Estonian Parliament ratified the Convention on Biological Diversity, thereby clearly confirming the importance of preserving plant genetic resources (PGR) and the responsibilities for their maintenance in Estonia. During the period 1994–1997, activities related to plant genetic resources conservation in Estonia were carried out by the relevant institutions, with no real coordination at the national level. Financial support for PGR activities was obtained from different sources: grants from the Estonian Science Foundation, specific programmes, and from the own means of the institutions.

In 1994 the **Nordic and Baltic countries** began to collaborate in a project aiming at better conservation and utilization of those plant genetic resources collections that were of true Baltic origin. Other aims of the project were to describe and extensively document the available germplasm, conduct new collecting missions and repatriate material which had locally been lost in the past, but is still existing in collections abroad.

The initial goal was the transfer of knowledge and technologies. Three genetic resources centres were established, one in each country, to coordinate national conservation activities and long-term storage of seeds. The project started off investigating the composition and status of all working collections. In parallel to the crop-specific working groups of the Nordic Gene Bank, a regional crop network was established to facilitate cooperation and use of resources. An extensive number of researchers, plant breeders and students were offered the possibility to attend relevant courses, conferences and international meetings.

In 1997 a **Committee for Agricultural Crops Genetic Resources** was established in Estonia, lead by the Minister of Agriculture. The Committee has eight members and links all institutes dealing with the conservation and preservation of plant genetic resources for food and agriculture within the Estonian National Network.

A **National Programme** for the period 1998–2003 was approved by the Minister of Agriculture. The most important objectives regarding PGR activities are:

- to develop conservation strategies
- to complete a national inventory of existing collections and publish a summary
- to continue the collection, preservation, identification, evaluation and documentation of accessions of Estonian origin
- to continue preservation and evaluation of accessions of foreign origin that are of interest to plant breeders in Estonia
- to start medium- and long-term preservation and conservation of accessions
- to create a computerized database system for all institutions involved in PGR-related activities.

The priority of the Estonian National Programme is to preserve advanced cultivars, breeding lines and initial material of Estonian origin as well as the most valuable accessions of foreign origin to provide easy access to the germplasm to plant breeders.

The first practical result of the activities of the Committee was the signature of the Agreement with IPGRI, whereby Estonia became a participating member of Phase V of the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR).

According to the National Programme, potato genetic resources are preserved in active collections in two institutions: **Jõgeva Plant Breeding Institute (PBI)** (tubers) and the **Plant Biotechnological Research Center EVIKA** (*in vitro* plantlets). The list of potato varieties, landraces and clones which should be included in the national genebank is now completed.

All available potato cultivars of Estonian origin, as well as the most valuable breeding lines, are preserved *in vitro* (Table 1). EVIKA has the long-term responsibility for the preservation of cultivars produced at the Estonian Plant Breeding Institute, breeding lines with particularly valuable traits, and local landraces. The old foreign varieties which have been cultivated over large areas in Estonia are also included. All the material preserved *in vitro* is also preserved in the form of tubers for safety reasons.

Table 1. Number of accessions preserved at EVIKA and at Jõgeva PBI

	EVIKA	Jõgeva PBI
Cultivars of Estonian origin	40	21
Breeding lines	15	18
Landraces	18	
Old varieties	4	
Valuable mericlones, clones	148	76
Total	**224**	**115**

Action has been taken to obtain **missing cultivars** from other collections worldwide. In 1998 we received the Estonian cultivars 'Brigadir', 'Jõgeva Valge', 'Linda', 'Suvik', 'Sangar' and the breeding line 'Jõgeva 1968-32' as *in vitro* plants (4 per cultivar) and 5 tubers of the cultivar 'Kalev' from the Gross Lüsewitz genebank in Germany. At the same time 17 accessions of old varieties and landraces from our genebank were sent to Gross Lüsewitz. Other potential sources for missing accessions are the collections of breeders and of hobby-growers. However 21 cultivars of Estonian origin are still missing in our national collection.

The **description of accessions** for their identification was started in summer 1998 and will be continued. A first set of 16 botanical characteristics was selected from the UPOV descriptors for potato accessions. A number of characters were selected to describe the whole plant (height, type, growth habit, anthocyanin discoloration, maturity), leaves (size, leaflet size, margin waviness, anthocyanin discoloration), flowers (frequency of flowers, colour, intensity of anthocyanin discoloration) and tubers (shape, skin colour, flesh colour, colour of eye base). The samples from the selected cultivars were analyzed for commercial traits and disease infection.

The **common database** of all potato cultivars (including domestic and foreign) preserved in Estonian collections has been compiled. The database records a total of 604 accessions held in Estonia: 417 at EVIKA and 187 at Jõgeva Plant Breeding Institute, with 79 common to both institutes. A computerized database of 209 accessions has been created and passport, descriptor and evaluation data are available.

The **role of biotechnology** in the conservation of potato genetic resources must be highlighted. Potato is propagated vegetatively and, as such, poses several problems, including difficulties in germplasm storage and transport, and progressive accumulation of viruses. The two major *in vitro* storage strategies for potato genetic resources are slow-growth storage (appropriate for medium-term storage) in the *in vitro* active genebank, and cryopreservation in liquid nitrogen for long-term storage in the base genebank.

During *in vitro* storage the development of culture is inhibited or stopped to a certain stage. **Slow growth** only slows the development and limits the number of necessary subcultures. Storage of nodal cuttings and microtubers is used in several genebank facilities. The advantages of *in vitro* slow-growth germplasm storage are that the collection is maintained under sterile conditions in a controlled environment (free from disease, climatic fluctuations, etc.) and that plantlets can be rapidly propagated from this active genebank when required for use. The disadvantages are that the techniques are relatively expensive, require specialized equipment and facilities, and that the genetic stability of cultures maintained in this way requires further analysis.

Cryopreservation is a viable alternative for the long-term storage of old potato varieties. Major advantages are the reduction of risk factors to a minimum during storage, and the reduction of labour in maintaining the cultures. One disadvantage is that samples are not

readily available, but need to be thawed and regenerated in tissue culture before they can be distributed. For varieties that are frequently requested it would be recommended that plants be stored as *in vitro* cultures and that cryopreservation be used as a safety-deposit.

At EVIKA Research Centre potato cultivars are preserved as *in vitro* plantlets. All accessions preserved *in vitro* are disease-free and are tested several times for virus infection. A technology developed in EVIKA is used for disease eradication. The system consists of three cycles: (1) selection of initial material for eradication, thermotherapy, culture of meristem tips and testing for virus infection; (2) re-eradication and field testing for quality and disease resistance of mericlones; and (3) renewing of the initial material.

Each 2–2.5 months, the collection is renewed by microcuttings. There are currently 417 potato cultivars, breeding lines, landraces and 333 mericlones from 58 varieties in the *in vitro* genebank. There are generally 10–20 plants per accession and they are duplicated in different storage rooms. The oldest plantlets were introduced in 1977. The aims of our research are to study factors and possibilities of increasing the multiplication interval *in vitro* without changes on the plantlet's quality and productivity, and to study the influence of long-term *in vitro* storage on the genetic stability of cultivars. It can be concluded preliminarily that preserving potato cultivars *in vitro* as plantlets for more than 20 years has not influenced the yield and characteristics of cultivars.

The best method to be used for the preservation of potato genetic material has not been decided yet. *In vitro* methods have several advantages compared with preservation in a field collection. The most important criterion to select the preservation technique is the guarantee of genetic stability. However, many problems connected with the *in vitro* preservation of potato genetic resources as plantlets, microtubers or through cryopreservation are currently unsolved. Before deciding which preservation technique to use, it is extremely important to study the influence of the preservation method on the genetic stability of the preserved material.

In the future, potato genetic resources activities will be directed towards:

- long-term preservation of accessions
- field and laboratory studies of accessions of interest both to genebank managers and scientists involved in agricultural research
- establishment of a permanent access to the genebank information through the Internet;
- regional, sub-regional and international cooperation on conservation and documentation for a broad use and exchange of information
- participation in the activities of the Baltic Potato working group.

Potato genetic resources in Finland

Leena Pietila
Boreal Plant Breeding Ltd, Jokioinen, Finland

There is no real potato genebank in Finland. The different kinds of potato collections are presented below.

- **Boreal Plant Breeding** maintains a field collection of ca. 100 potato varieties, landraces and lines. They are mainly for the own use of the institute and research purposes. A meristem collection of 250 dihaploids (DHs) and hybrids (100 DHs and 150 hybrids) is also maintained.
- The **Agricultural Research Centre** (MTT) also has a meristem collection of about 400 DHs and 50 hybrids, and some wild potatoes (DHs and hybrids).
- The **Seed Potato Centre** has a working collection of all the varieties for which they are producing pre-basic seed, that is about 50 varieties and lines. They also have a small meristem collection of the most important old varieties cultivated in Finland (15–20 varieties).
- At least three very interesting field collections of old potato varieties, landraces, etc., are also maintained (ca. 50–100 samples each, but most of them are duplicates, so that the total number is about 100).

Potato genetic resources in France

D. Ellissèche

INRA, Station d'Amélioration de la Pomme de Terre et des Plantes à Bulbes, Ploudaniel, France

Introduction

In France, potato genetic resources are collected, gathered, maintained and evaluated by INRA, Station d'Amélioration de la Pomme de Terre et des Plantes à Bulbes (Potato and Tuber Plants Breeding Station) in Ploudaniel. The collection includes genotypes obtained from INRA research programmes. Ploudaniel is located at 48°N latitude, 4°W longitude, 36 m altitude, with a very typical oceanic climate (windy, 1000 mm average rainfall per year). These conditions are favourable for keeping the germplasm free of virus diseases. All material is maintained as plants and tubers in glasshouse or field collections, and/or as *in vitro* plantlets.

Field collection of Solanum tuberosum *varieties, parental lines and dihaploids*

The field collection is managed under the usual agricultural practices of potato seed production. Visual roguing is complemented by annual ELISA testing of half of the collection for PVS, PVX, PVY and PLRV.

This collection includes:

519 modern and old cultivars
382 parental lines
550 dihaploids.

The parental lines are the result of breeding programmes targeted to improve resistance to late blight or PVX and PVY or of multi-trait selection. The dihaploids have been obtained from 180 varieties.

Collections of interspecific hybrids

About 650 interspecific hybrids are also maintained as a field collection. Most of them have been obtained from crosses between dihaploids of *Solanum tuberosum* and *S. phureja*, *S. stenotomum*, *S. chacoense*, *S. tarijense* or *S. vernei.*

Some 1300 more recently obtained stolon producing interspecific hybrids are kept in pots to prevent irregular proliferation in the field.

Collection of related species

A collection of 463 clones from 14 related species (*Solanum acaule, S. andigena, S. berthaultii, S. bulbocastanum, S. chacoense, S. gourlayi, S. hougasii, S. kurtzianum, S. phureja, S. spegazzinii, S. sparsipilum, S. stenotomum, S. tarijense* and *S. vernei*) is maintained in glasshouse during the winter under natural short day length and 15°C minimum temperature in order to enable their tuberization.

In vitro *collection*

About 1800 genotypes are kept *in vitro* in climatized chambers on Tendille and Lecerf's growth medium (Tendille and Lecerf 1974) under 16 hours of day length. Temperatures are +9°C at night and +12°C during the day. Some of these genotypes are duplicates of the most important genotypes kept in the field collections.

Health status of the French collections

The collections can be considered on average as partially tested (PT). All genotypes are tested for European potato virus and bacterial diseases. Only accessions coming from outside of the European community have been tested for quarantine diseases and pests.

Uses of the collections

The most frequent requests for cultivars come from state organizations, to be used as official references, from researchers, and from breeders, for use as parents in their crossing programmes. Some amateurs ask for old varieties. Parental lines are available for exchange in the frame of scientific programmes.

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Status of potato genetic resources and research in Germany, 2000

Konrad Schüler

Institute of Plant Genetics and Crop Plant Research (IPK), External Station North
Gross Lüsewitz, Germany

Introduction

The different history of both parts of the formerly divided Germany has led to the following current situation:

The former West German Collection, EBS (Erwin Baur Sortiment = Erwin Baur Collection) was merged in 1974 with the former Dutch collection, WAC (Wageningse Aardappel Collectie (Wageningen Potato Collection)) to the Dutch–German potato collection. This collection was first located in Braunschweig, Germany as part of BGRC (Braunschweig Genetic Resources Collection) and was moved in 1995 to Wageningen in the Netherlands, where it is now held under the auspices of CGN (Centre for Genetic Resources the Netherlands). The curator of the Dutch-German Potato Collection is R. Hoekstra.

A collection of *in vitro* or cryopreserved potato varieties and older breeding lines remained in Braunschweig under the responsibility of G. Mix-Wagner (Mix-Wagner and Seidewitz 1991).

In East Germany, the Gross Lüsewitz Potato Collection (GLKS) was established by Rudolf Schick in 1949, shortly after the foundation of the Institute of Plant Breeding in Gross Lüsewitz. Schick collected potatoes himself as he was a collaborator of the 'Kaiser–Wilhelm-Institut für Züchtungsforschung' in Müncheberg / Mark in the beginning of the 1930s, together with E. Baur. In Gross Lüsewitz the main goal was to collect basic material for the institute's own potato breeding activities. But very soon the institute started a worldwide collection of wild and cultivated potato species, accessions from Central and South America, and old and new potato varieties. Dietrich Rothacker contributed significantly to the establishment of the wild potato collection, through his international contacts with other potato researchers.

After the reunification of Germany, the old institute in Gross Lüsewitz was closed. Under the new organizational structure of scientific institutions in East Germany, in 1992 the Potato Collection in Gross Lüsewitz became part of the Genebank of IPK (Institut für Pflanzengenetik und Kulturpflanzenforschung (Institute of Plant Genetics and Crop Plant Research, Gatersleben)), in its External Branch 'North'.

Potato collections in Germany

Potato holdings of the Genebank in Gross Lüsewitz (GLKS) are listed below in Table 1 and those of the Genebank in Braunschweig in Table 2.

Table 1. Potato collection held at the Genebank Gross Lüsewitz (GLKS), March 2001†

	Number	Accessions
Species from Central and South America		
- wild species	138	1255
- cultivated species	8	1650
Total	146	2905
Varieties, old breeding lines		2169
Grand total		**5074**

†Data updated at time of publication of the proceedings.

Table 2. Potato collection held at the Genebank in Braunschweig, March 2001†

	In vitro	Cryopreservation	Total
Varieties, old breeding lines	278	519	797

†Data updated at time of publication of the proceedings.

Activities of the IPK Genebank, External Branch for Potatoes of Gross Lüsewitz

Maintenance of the GLKS

The **wild potato collection** is maintained through production in greenhouse of true seed from generatively propagated species. Some accessions that have resisted sexual propagation are maintained as clones *in vitro*.

Seeds are stored at 4°C in paper bags in jars containing silica gel.

The **collection of varieties** is increasingly maintained through *in vitro* culture, but also still through field cultivation. Field cultivation is used in particular for evaluation, control of the varieties' purity and preparation of tubers for interested users.

Special measures for virus elimination are taken for *in vitro* plants. Viruses have not yet been eliminated from all samples. In field cultivation, the occurrence of latent viruses (PVS, partly PVX) is tolerated. This should be taken in consideration when requesting tubers from the field.

Cryopreservation is used in cooperation with Dr Mix-Wagner in Braunschweig (47 varieties from the GLKS are cryopreserved in Braunschweig) and is carried out in the Research Group *'In vitro* Culture and Cryopreservation' by Dr J. Keller of the IPK Genebank (Table 3). *In vitro* preservation of those varieties that are cryopreserved in Braunschweig has been started in Gross Lüsewitz.

Quarantine regulations and availability

The potato germplasm is systematically tested for quarantine diseases in cooperation with the Plant Protection Office in Rostock and Hannover (Table 3). Only healthy progenies from seeds or tubers are maintained and available upon request.

The quarantine tests of all accessions will require several years. Therefore it may be impossible to deliver some samples immediately.

Table 3. Maintenance and phytosanitary status of the GLKS samples, February 2000

Varieties and breeding lines			
Maintenance	**Samples**	**PSTV-tested**	**Virus-free**
Total	2136	1638	889
Field	702	246	
Field + *in vitro*	218		
In vitro	1434 (2432 lines)	1392	889
of which cryopreserved (in Gatersleben)	187	187	165 (22 only PVS)

Wild and cultivated species			
Maintenance	**Accessions**	**PSTV-tested**	**Test of quarantine viruses**
Total	2913	919	590
Seeds	2823	832	590
In vitro	90	87	

Total *in vitro*	
Varieties and breeding lines	1434 samples with 2432 lines
Wild and cultivated species	90 accessions
CIP-duplicates	370 samples
Total	**2892**

Evaluation

– *Phytophthora infestans*

Tests for tuber blight resistance of accessions of wild and cultivated species were carried out in

cooperation with Dr U. Darsow (Federal Centre for Breeding Research on Cultivated Plants (BAZ), Gross Lüsewitz) using the small tuber assay method developed by Darsow (1992). *Phytophthora* testing has a very long tradition in the GLKS. From 1996 to 1999, 53 accessions of 79 species were tested for tuber blight resistance. During summer 2000 the tuber tests will be completed with the evaluation of late blight on seedling leaves in the greenhouse.

– ***Globodera pallida***
Tests were made in cooperation with J. Kruse (Plant Protection Service in Rostock) using the pot ball method by Stelter (compost infected by *G. pallida*, population 'Chavornay') (Stelter 1955). From 1996 to 1999, 326 accessions of 75 species were tested by this method.

– **Chipping (crisping) quality**
In March, slices of tubers which had been kept at 4°C during winter storage were baked in oil. The colour of chips was determined on a scale 5–1 (5 pale yellow, 4 yellow, 3 pale brown, 2 brown, 1 dark brown). In general, 2-5 genotypes and/or a mixture of genotypes per accession were tested, with at least 5 tubers for each genotype. From 1993-1994 to 1998-1999, 714 accessions belonging to 110 species have been tested.

Research
A small project was started in cooperation with the Research Group 'Molecular Markers' (Dr K. Dehmer) of the IPK Genebank, using PCR-based methods to analyze the genetic stability of accessions from long-term field cultivation and long-term *in vitro* culture.

Documentation of the collection
The documentation of the collection includes passport data and evaluation data for all accessions as well as for *Solanum tuberosum* varieties. Information on the collection is available in the recently published catalogue (Schüler *et al.* 2000) or, for the variety collection, on the Internet at <http://www.dainet.de/genres/eva/kartoffel.htm> (German database for plant genetic resources, PGRDEU).

Distribution of potato material in 1999
The material provided to various users is listed in Table 4, and the exchange of material during the last years is indicated in Table 5.

Table 4. Distribution of potato material in 1999

	Varieties			Species			Total
	Total	**Tubers**	***Vitro***	**Total**	**Tubers**	**Seeds**	
Research institutes							
- Germany	**74**	60	14	**38**	18	20	**112**
- other countries	**20**	–	20	**93**	–	93	**113**
Genebanks Germany	**10**	–	10	**-**	–	–	**10**
Breeders							
- Germany	**14**	14	–	**7**	7	–	**21**
- other countries	**–**	–	–	**32**	–	32	**32**
Within IPK	**10**	10	(10)	**-**	–	–	**10**
Other public institutions							
- Germany	**66**	66	–	**8**	8	–	**74**
- other countries	**41**	31	10	**-**	–	–	**41**
Private people							
- Germany	**210**	210	–	**41**	**5**	36	**251**
- other countries	**26**	26	–	**5**	5	–	**31**

Total	**471**	**417**	**54**	**224**	**43**	**181**	**695**

Table 5. Potato Genebank Gross Lüsewitz (GLKS). Exchange of material 1992–1999

A. Collection of varieties

	Acquisitions			Distribution		
	Foreign countries	Germany	Total	Foreign countries	Germany	Total
1992	14	20	34	4	39	43
1993	55	–	55	35	115	150
1994	47	187	234	38	279	317
1995	61	28	89	85	238	323
1996	21	16	37	81	201	282
1997	9	56	65	140	422	566
1998	47	5	52	90	196	286
1999	5	3	8	87	384	471

B. Wild and cultivated species

	Acquisitions			Distribution		
	Foreign countries	Germany	Total	Foreign countries	Germany	Total
1992	94	–	94	56	136	192
1993	9	–	9	44	29	73
1994	–	–	–	156	62	218
1995	175	–	175	39	74	113
1996	–	–	–	231	151	382
1997	–	–	–	99	68	167
1998	–	–	–	76	128	204
1999	–	–	–	98	108	206

International cooperation

– The IPK Potato Genebank Gross Lüsewitz participated in the EU project RESGEN-CT95-34/45 entitled 'Genetic resources of potato, including conservation, characterization and utilization of secondary potato varieties for ecological production systems in Europe'.

– The IPK Potato Genebank Gross Lüsewitz is a member of the Association of Potato Intergenebank Collaborators (APIC). The principal aim of this cooperation of major potato collections is the establishment of a joint database.

Collecting missions

IPK, Gross Lüsewitz participated in the International Potato Collecting Expeditions in Mexico (1997) and Peru (1999). From 8 March to 25 April 1999, 101 accessions of 35 taxa were collected in the central departments of Peru during a 11 000 km-journey.

Participation in further international collecting activities is planned.

Future activities

An increased use of molecular genetic techniques such as PCR for the identification of varieties and accessions of wild and cultivated species is considered absolutely necessary for further rationalization of the Genebank management. In particular, an efficient tool is needed for a reliable identification of genotypes kept *in vitro* and for the identification of duplicates. Unfortunately, due to limited manpower and funds, this requirement is currently not satisfied.

Selection of potato research and breeding activities conducted in Germany

Given the great importance of potato production in Germany, many research and breeding activities are underway.

Federal centre for Breeding Research for Cultivated Plants (BAZ)

(information provided by U. Darsow)

– Research on potato genetic resources

Virus resistance

S. etuberosum is tested as a source of PVY resistance, connected to *S. tuberosum* through somatic hybridization, and will be introduced via backcrossing into the genome of cultivated potatoes (Thieme *et al.* 1999).

Phytophthora resistance

Potato genetic resources have been progressively utilized in BAZ-Gross Lüsewitz (Darsow 1993). The GLKS germplasm was studied extensively since 1967, especially for tuber blight resistance. As a result, 14 species were introduced in the breeding programme.

Processing suitability

Solanum phureja and *S. cardiophyllum* subsp. *ehrenbergii* have been used in BAZ to improve the processing suitability.

– Workplan for future activities

- Virus-cleaning of seedlings of wild and cultivated species for better use in breeding, especially in protoplast fusions.
- Utilization of evaluated accessions of wild and cultivated species in breeding for resistance to potato cyst nematodes.

– Other research activities considered

- Possible assessment of the resistance to important quarantine diseases such as *Ralstonia* and *Clavibacter* in Europe.
- Development of a method for testing the resistance to silver scurf (*Helminthosporium solani*) and screening of the genebank and breeding material for this disease.

Selected activities in Germany outside of BAZ (Wulfert 1999)

Institution and fields of research	Authors
Federal Biological Research Centre for Agriculture and Forestry; Institut für Pflanzenschutz in Ackerbau und Grünland, Braunschweig	
- Epidemiological and biological research on important fungal *(Phytophthora infestans, Synchytrium endobioticum, Fusarium* sp.) and bacterial microorganisms *(Clavibacter michiganensis* subsp. *sepedonicus, Erwinia* sp., *Ralstonia solanacearum)* of the potato	Schöber-Butin, B.; Stachewicz, H.; Niepold, F.
- Development of methods for testing resistance of potatoes against fungi and bacteria	Schöber-Butin, B.; Niepold, F.
- Development of methods for pathogen diagnosis in diseased potatoes	Niepold, F.
- Official examination of new bred potatoes for the Bundessortenamt (National Variety Office)	Schöber-Butin, B.; Stachewicz, H.
Federal Centre for Breeding Research on Cultivated Plants (BAZ) – Institute of Agricultural Crops Gross Lüsewitz	
- Improvement of quantitative resistance to potato late blight for developing countries. Part: Assessment of late blight resistance, breeding, testing of molecular markers	Darsow, U.
- Healthy, highly productive potatoes by bioengineering - use of new sources of resistance from wild species by symmetric and asymmetric protoplast fusion. Part: Assessment of late blight resistance and other traits and crossing	Darsow, U.
- Breeding of diploid potato basic material with high level of resistance to nematodes and viruses and product quality through somatic hybridization	Darsow, U., Sonntag, K.; Thieme, R.
- Breeding of basic material with resistance to *Phytophthora infestans* (foliage and tubers) using a wide range of *Solanum* species	Darsow, U
- Production and selection of potato genotypes with resistance to viruses and *Phytophthora* using biotechnology	Thieme, R.; Darsow, U., Hackauf, B.
Institut für Pflanzenbiochemie, Universität Tübingen	

- Utilization of wild species for the improvement of resistances of the cultivated potato to *Phytophthora infestans, Erwinia carotovora* and frost. Analysis of the components of resistance by molecular biological and biochemical methods. Role of cytoplasms for the expression of resistance traits	Schilde-Rentschler, L., Ninnemann, H.
ZMBP, Centre for Molecular and Biology of Plants, University Tübingen, Chair of General Genetics	
- Molecular characterization of pathogen resistance characters and molecular evolution and biodiversity of potato	Hemleben, V. and collaborators
Max-Planck-Institut für Züchtungsforschung, Köln	
- Genome analysis: QTL mapping, map-based cloning of disease resistance genes, EST-mapping, function mapping, comparative mapping	Gebhardt, Ch.
- Genetic engineering of potato for stress resistance and modified quality	Rohde, W. and collaborators
BIOPLANT, Biotechnologisches Forschungslabor GmbH	
- New virus resistances in potato	Schuchmann, R.; Tacke, E.
SaKa-Ragis Pflanzenzucht GmbH	
- New resistance to virus diseases in potatoes: development of transgenic potato genotypes with resistance to potato leaf roll virus (PLRV)	Buhr, K.
Bavarian State Research Institute for Soil Science and Plant Production	
- Conventional breeding for better resistances and quality	Hepting, L.
- Dihaploid breeding to accelerate potato breeding	Schwarzfischer, A.; Hepting, L
- Somatic hybridization for direct and fast combination of different resistances and/or quality traits	Schwarzfischer, A.
- Special potato starch or PVY resistant potatoes by gene transfer	Schwarzfischer, A., Müller, M.
Technical University of Munich, Chair of Agronomy and Plant Breeding	
- Molecular markers for fusion combining ability of dihaploid *S.tuberosum*	Frei, U.; Wenzel, G.
- Genetic diversity of dihaploid *S. tuberosum* breeding clones	Frei, U., Mengele, K.
- Molecular markers as a tool for the evaluation of genetic diversity and combining ability in potato breeding	Braun, A., Frei, U.
- Increase in starch content and quality by agronomical measures	Maidl, F.X.; Kunick A.

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Status of the potato collection maintained at the University of Veszprém, Hungary

Sándor Horváth and Zsolt Polgár

University of Veszprém, Georgikon Faculty of Agriculture, Department for Potato Research, Keszthely, Hungary

The potato genetic resources of Hungary are maintained in the collections of one governmental institution and two academic institutions. The Institute for Agrobotany, Tápiószele is the official maintainer of the national plant collections. Its potato collection contains 457 accessions. The other two institutions are the Research Centre, Nyíregyhaza, University of Debrecen, and the Department for Potato Research of the University of Veszprém (former Pannon University of Agricultural Sciences). They maintain 61 and 136 accessions, respectively.

Owing to the difficult financial situation of Hungarian governmental research institutions, the collection of the Institute for Agrobotany is rather under-characterized. The virological status of the collection is uncertain, which makes field comparison and description of accessions unreliable. The collection may contain numerous duplicates and landraces of uncertain origin. The Department for Potato Research, Veszprém started to utilize the resources of this potato collection only during the last year. However, it had established its own collection since 1991. Besides the breeding collection, the Veszprém genebank contains 136 accessions maintained under *in vitro* conditions on slow-growth medium. These include 93 foreign and 37 old Hungarian varieties (part of which was repatriated from the German collection of Gross Lüsewitz), landraces and breeding lines, and 6 wild species (Table 1). Most accessions are well characterized and checked to be true-to-type. All accessions are tested for the six major potato viruses common in Hungary (PVY, PLRV, PVX, PVA, PVM and PVS) and about 50% were successfully cleaned by an *in vitro* combined heat and chemotherapy treatment (Table 2). However, none of the accessions has been tested yet for PSTV, which is not known to occur in the country. The Veszprém genebank is an active working collection and has contacts with the major collections maintained in Germany, the Netherlands, USA and the International Potato Centre (CIP) in Peru. Our Department was offered to participate in the project RESGEN-CT95-34/45 of the EU genetic resources programme 1467/94 as a partner of the Institute for Agrobotany. In the frame of this project, the database was converted according to the descriptor list agreed in the project and additional characterizations and virus cleaning were carried out. The Department for Potato Research and the Institute for Agrobotany worked out a cooperative action to harmonize the maintenance of their respective collections and for virus-cleaning of the collection of the Institute for Agrobotany. This work however proceeds rather slowly due to the high cost of virus-cleaning procedures and the limited financial resources.

Table 1. Number of accessions held at the potato genebank, University of Veszprém

Type of sample						Total number of accessions
Foreign varieties	Foreign breeding lines	Hungarian varieties	Hungarian landraces	Hungarian breeding lines	Wild species	
61	32	23	5	9	6	136

Table 2. Status of accessions

Virus-tested		Virus-free		Characterized	
Number	%	Number	%	Number	%
136	100	66	48.5	90	66.2

Potato genetic resources in Italy

Luigi Frusciante and Domenico Carputo
Department of Agronomy and Plant Genetics, University of Naples, Portici, Italy

Introduction

The introduction of potato cultivation in Italy dates back to Cardano in 1580, who described the plant in '*De Rerum Varietate*' and called it '*Papas*'. Potatoes were first grown in Italy towards the end of the 17th century by the Grand Duke of Tuscany in his gardens. From that moment onwards, the species began to spread throughout Italy under the name '*Patata*'. It had spread throughout southern Italy, probably the most southerly extent of its range in Europe, by the mid-18th century, while large-scale cultivation occurred after the Neapolitan Revolution in 1799. Indeed, to relieve his people from a long period of starvation the Bourbon king, Ferdinando II, ordered the purchase and distribution to his subjects of potato tubers, which met with the immediate approval of the people and dieticians of the time.

The result was so spectacular that farmers began to grow the potato, and the King, in order to teach the farmers agricultural techniques, founded an agricultural school at the Royal Palace of Portici, still today the site of the Agricultural Faculty of the University of Naples. It is remarkable that, among those techniques, there was also the use of what we call now the true seed technique, by which the fruits were harvested, the seed extracted and stored for 7–8 months in a dry environment and sown directly in the field the following spring. The technique involved thinning after emergence to achieve the sowing density required.

Over the years, potato cultivation spread throughout the country, and now it has become a very important crop. Due to favourable climatic conditions, it can be cultivated throughout the year, planting and harvesting dates depending on the specific area of cultivation. One of the limiting factors in the Italian 'potato system' is related to the relatively restricted number of varieties available, many of which were selected several decades ago. From the genetic standpoint this has an important implication, i.e. the genetic potential of the potato has been little used by breeders and only for a limited number of conditions. Thus, breeding programmes based on the exploitation of genetic variability are being developed, with the aim of offering potential for producing new genetic material.

Use of genetic resources in Italian breeding programmes

The genetic resources first used in national breeding programmes were the numerous local varieties grown all around the country. Avanzi (1965) reports that during the first national meeting on potato held in Como in 1935, as many as 177 local varieties were presented. They showed large diversity, were well adapted to the local environments, and displayed very high qualitative standards. However, they often had low yield performances compared to the varieties that were being introduced from northern Europe ('Allerfrüheste Gelbe', 'Majestic', 'Bintje', 'Esterling'). An impulse to use of this genetic diversity was given by the foundation, after World War II, of the Potato Research Centre by the Italian Ministry of Forestry and Agriculture.

Afterwards, the breeding programmes started in the thirties lacked continuity, and the use of foreign varieties became a common practice. As a result, the vast and heterogeneous assortment of local varieties was lost. In recent years, much emphasis is being given in Italy to the use of wild *Solanum* species as source of useful genes and allelic diversity to enlarge the cultivated genepool (for a review see Carputo *et al.* 1998).

The recognition of wild *Solanum* species as primary source of genes led the Italian Ministry of Foreign Affairs, through the Istituto Agronomico per l'Oltremare (Florence), to financially support four germplasm collecting expeditions to Chile, from 1990 to 1995 (Ciampi *et al.* 1999). A scientific team was created for every expedition, involving scientists from Italy (Istituto Agronomico per l'Oltremare and University of Naples), USA (University of Wisconsin), and Chile (University of Valdivia). The main goals of these expeditions were to increase the Chilean Germplasm Bank located in Valdivia (Chile), and to evaluate the material collected for resistance to environmental stresses.

Several Italian institutions have now their own germplasm collection, constituted by various diploid and tetraploid wild *Solanum* species. The main *Solanum* germplasm banks are located at the Istituto Sperimentale per le Colture Industriali (ISCI, Bologna), Centro Ricerche Produzioni Vegetali (CRPV, Imola), Ente Nazionale Energie Alternative (ENEA, Rome), and Department of Agronomy and Plant Genetics of the University of Naples (Fig. 1). The strategies followed in the use of these germplasm collections are similar, involving: a) evaluation of accessions; b) use in conventional and non-conventional breeding strategies; and c) long-term selection and evaluation for desired characters of newly developed material.

Fig. 1. Sites of germplasm collection in Italy

Besides common objectives (high tuber quality, good and stable yield over years and locations, etc.), each programme has specific objectives. The breeding programme carried out at ISCI is mainly focused on resistance to abiotic stresses. Exploitation of new genetic variability for biotic stress resistance and of various crossing schemes is a major goal at the University of Naples, ENEA and CRPV. The exploitation of the available genetic diversity is achieved mainly through sexual and/or somatic hybridization, and chromosome engineering (involving 2*n* gametes).

Table 1 lists the genetic material available at each location. Besides breeding lines developed during specific programmes, each location possesses wild species with various ploidies and EBNs. In addition, various ecotypes and old varieties are also available, with the double scope of avoiding their genetic erosion and exploiting their ability to adapt to sub-optimal conditions.

Table 1. Genetic resources maintained at four locations in Italy

Location	Responsible	Wild species	Cultivar or ecotypes	Breeding clones
ENEA, Rome	Dr A. Sonnino	*S. berthaultii, S. neocardenasii, S pinnatisectum, S. sparsipilum, S. juzepczukii, S. acaule, S. chacoense, S. guerreroense, S. papita, S. stoloniferum, S. verrucosum*	no	yes
Dept. Agronomy and Plant Genetics, Portici	Prof. L. Frusciante	*S. commersonii, S. fendleri, S. bulbocastanum, S. phureja, S. acaule, S. cardiophyllum, S. etuberosum, S. brevidens, S. multidissectum, S. chacoense, S. canasense, S. brachistotrichum, S. tarijense*	yes	yes
CRPV, Imola	Dr L. Lovatti	*S. tarijense, S. microdontum, S. berthaultii, S. stenotomum, S. raphanifolium, S. sparsipilum, S. infundibuliforme, S. demissum, S. vernei, S. phureja, S. spegazzinii, S. chacoense, S. bulbocastanum, S. pinnatisectum*	yes	yes
ISCI, Bologna	Dr Paolo Ranalli	no	yes	yes

In recent years, a big push to preserve, characterize and use *Solanum* genetic resources was given by the Italian Ministry for Agriculture, that funded a national 'Potato breeding' programme. This project is based on the activity of 19 research units, and an important part of this programme is related to the evaluation and exploitation of genetic resources (both wild species and ecotypes). Among the most important results obtained are: 1) the finding of new sources of resistance to nematodes, *Fusarium* and insects (e.g. *S. fendleri, S. cardiophyllum, S. chacoense*); 2) the set-up of appropriate breeding schemes for germplasm introgression; and 3) the characterization of old ecotypes (e.g. 'Viola calabrese'). Details on the research carried out on genetic resources can be found on the Web site of the project (<http://hpimof.imof.na.cnr.it/~andrea/patata>).

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Potato genetic resources in the Netherlands

R. Hoekstra[1] and J.P. van Loon[2]

[1]Plant Research International B.V., Centre for Genetic Resources the Netherlands (CGN), Wageningen, The Netherlands
[2]Stichting Stimulering, Aardappelonderzoek, Zeist, The Netherlands

Introduction

Potato was introduced in the Netherlands around 1680–1700 by Protestants who were expelled from the Pfalz (Germany) and/or France and emigrated to the Netherlands. The crop became popular among poor peasants, who had to pay taxes on their wheat production (Oliemans 1988). The Netherlands have a long history of potato breeding. According to Zingstra (1983), the eldest known variety names date back to 1770 and are called 'Bremer Rooden' and 'Elfringen'. In 1783 Dirk de Vries bred new varieties from true seed. The outbreak of late blight (*Phytophthora infestans*) in 1845 must have stimulated potato breeding, because one year later the Dutch government supplied botanical seeds to interested growers. New varieties were introduced, including 'Schoolmeester' and 'Zeeuwse Blauwe' (1860), 'Fransen' (1870), 'Berlikumer Geeltje' and 'Munstersen' (1890). Famous old varieties are 'Eigenheimer' (breeder: G. Veenhuizen, 1893), 'Rode Star' (G. Veenhuizen, 1909) and 'Bintje' (K.L. de Vries, 1910). Since the beginning of the 20th century, potato breeding was promoted by financial incentives, at first only on an incidental basis. The Institute for Plant Breeding (IvP), founded in 1912 in Wageningen, published the first variety list for agricultural crops in 1924. In the same year a prize was put up for the best potato wart-resistant variety, which stimulated potato breeding. The Dutch General Inspection Service (NAK) was founded in 1932. It reimbursed the breeders according to the amount of certified planting material of their varieties.

In 1938 the COA (Commission for the promotion of breeding and research of new potato varieties) was founded. The number of potato breeders rose particularly in the 1940s, after a legal basis had been created for the reimbursement of breeding costs ('Kwekersbesluit', 1941). It increased from 17 in 1934 to 243 in 1956, then decreasing again to 188 in 1982. In the same period the number of seedlings produced from potato crosses steadily increased from 10 000 to 1.2 million (Zingstra 1983). The COA publications entitled 'Geniteurslijst voor Aardappelrassen' (List of genitors for potato races), with descriptions of many potato varieties, which were published between 1954 and 1991 (Joosten 1991), are widely known by breeders and scientists.

Clonal collections

COA had built up a large reference collection for the Dutch variety list trials. In 1990 the maintenance of the COA collection had to be discontinued by RIVRO (Rijksinstituut van Rassenonderzoek van Cultuurgewassen). About 100 old clones were included in the *in vitro* collection at the Institute of Crop Science (FAL, Braunschweig, Germany). Eight private Dutch potato breeding companies (Agrico, Cebeco, Wolf and Wolf, Hettema, IJsselmeerpolders, Karna, Meijer, Stet Holland and the cooperative ZPC) took over about 600 clones. They share the responsibility of maintaining *in duplo* (= at two different breeding stations) a field collection of old varieties and breeding lines. Overlaps with their own working collections were removed and virus-infected clones discarded. Later on, breeding lines from the former SVP (Stichting voor Plantenveredeling, Wageningen) were included.

The former COA collection consists of old and current cultivars and breeding lines, mainly of Dutch origin (Table 1). It was poorly documented when the EU RESGEN-CT95-34/45 project 'Genetic resources of potato, including conservation, characterization and

utilization of secondary potato varieties for ecological production systems in Europe' started in 1996. The situation improved thanks to the documentation and evaluation activities conducted in the framework of the project. Parts of the collection were evaluated for cyst nematodes (pathotype Ro5), late blight, common scab, powdery scab, and in some cases Fusarium dry rot and soft rot. The passport and evaluation data were supplied to SASA and included in the EU Potato Central Crop Database. In the past, the germplasm collection was not much used by the breeders, but it is expected that it will be used much more when more evaluation results become available.

In the meantime, some of the private companies have merged and one discontinued its potato breeding activities. An overview of the currently active potato exporting companies is available on the Internet at <http://www.nivaa.nl/nivap/exporteurs.html>.

Besides the clones maintained by the breeding companies, a small collection of more than 100 mainly very old cultivars is being conserved by Mr A.S. Heijboer in Kloetinge. The health status of this collection is unclear.

Table 1. Composition of the former COA collection maintained by private breeders

Material type	Number of clones
Breeding lines	26
SVP lines	233
Old varieties	257
More recent varieties	> 400

Botanical seed collection

Table 2. Overview of the Dutch–German Potato Collection: number of accessions per country of origin (number of species in parentheses)

Country of origin	Number of accessions			
	Wild species	Cultivated species	Advanced material	Total
North America				
USA	10 (2)			10 (2)
Central America				
Mexico	194 (22)	7 (1)		201 (23)
Guatemala	35 (5)			35 (5)
Costa Rica	3 (2)			3 (2)
South America				
Colombia	6 (3)	21 (3)		27 (6)
Ecuador	2 (2)	4 (1)		6 (3)
Peru	169 (39)	257 (2)		426 (42)
Bolivia	559 (37)	191 (5)		750 (42)
Chile	11 (5)	38 (2)		49 (7)
Argentina	909 (25)	144 (1)		1053 (26)
Paraguay	2 (1)			2 (1)
Uruguay	1 (1)			1 (1)
Other				
Spain		2 (1)		2 (1)
Unknown	46 (22)	80 (3)	13 (3)	139 (22)
Total	**1956 (119)**	**743 (5)**	**13 (3)**	**2704 (123)**

Introduction

The conservation of plant genetic resources in the Netherlands is globally organized by the Centre for Genetic Resources the Netherlands (CGN), which is part of Plant Research International B.V., a recent merger of CPRO-DLO (Centrum voor Plantenveredelings- en Reproduktieonderzoek (Centre for Plant Breeding and Reproduction Research)), IPO-DLO (Instituut voor Planteziektenkundig Onderzoek (Research Institute for Plant Protection)) and parts of AB-DLO (Instituut voor Agrobiologisch en Bodemvruchtbaarheidsonderzoek (Research Institute for Agrobiology and Soil Fertility)). CGN only maintains (botanical) seed collections of a number of agricultural and horticultural crops. In the case of potato it

maintains the Dutch–German Potato Collection, which contains about 2700 accessions of 118 wild and five primitive (or traditional Andean cultivated) potato species originating from the centre of origin (Table 2). These genetic resources are stored as botanical seeds. Vegetatively propagated potato clones are not included in the collection.

History

In 1974 an agreement was signed between the Federal Minister of Food, Agriculture and Forestry of the Federal Republic of Germany and the Minister of Agriculture and Fisheries of the Netherlands on cooperative activities in the field of potato genetic resources. As a result, a collection was built up at the Institute of Crop Science and Plant Breeding in the FAL, Braunschweig, by assembling both national collections:

- the Erwin-Bauer Sortiment (EBS), maintained at the Max-Planck Institute, Köln; and
- the Wageningse Aardappel Collectie (WAC), maintained at the Department of Plant Breeding of the Agricultural University of Wageningen (Hermsen and Verdenius 1971).

In addition, the collection included 600 samples from the INTA (Instituto Nacional de Tecnología Agropecuaria) collection in Argentina.

Objectives and details of this bilaterally financed cooperation were outlined by Lange (1976). In 1984 it became a project of the German-Dutch Board for Plant Genetic Resources. In the agreement the possibility of the participation of other institutions in Europe is left open. In 1995 the collection was transferred to the Centre for Genetic Resources the Netherlands (CGN) in Wageningen.

For the purpose of safety-duplication about 1300 samples were exchanged in 1981 with the Commonwealth Potato Collection (CPC) (black-box-arrangement).[4] This exchange was discontinued the following year for phytosanitary reasons: the material had to be screened for PSTVd first. Safety-duplication in the partner country of the bilateral cooperation started in 1987.

Collecting expeditions

Twenty-six percent of the collection originates from collecting expeditions with Dutch or German participation, including the Dutch Expedition to Peru (Toxopeus 1956), the German Andes expedition (Ross 1960), the Dutch-English Andes expedition in 1974, expeditions to Bolivia (van Soest *et al.* 1983a; Spooner *et al.* 1994), Guatemala (Spooner *et al.* 1998) and Costa Rica (Spooner *et al.* in press). They have mainly been organized to improve the low representation of the germplasm from these countries. The material collected in Peru in 1999 was transformed into true seed at CIP-Huancayo (Centro Internacional de la Papa, International Potato Centre) (Salas *et al.* in press). Permission for exporting this material will probably not be given by the Peruvian authorities until a new law on genetic resources implementing the 1992 Rio de Janeiro Convention on Biological Diversity (CBD) is passed by the Peruvian parliament.

Rationalization

The following measures are used to control the size of the collection:

- Analysis of the passport data: three different collections (EBS, WAC, INTA) form the basis of the current collection. Since there was already some exchange of material between these collections before the establishment of the Dutch-German Potato Collection, these collections included duplicates. So far, 240 duplicates have been identified.
- Comparison of the parentage: 144 intraspecific hybrids (in particular from *Solanum infundibuliforme* and *S. megistacrolobum*) were excluded from the collection because

[4] Under a 'black box' arrangement, the safety-duplicate seed sample is stored in the long-term conditions according to international standards; it is not used, tested, regenerated or distributed to a third party.

both parents were already present in the collection or represented in other hybrids.

- Molecular methods: two plants from each of the 314 *S. acaule* accessions were analyzed with AFLP primers. Seven percent of these accessions appear to be redundant (McGregor *et al.* in press). Redundant accessions will be excluded or merged when the results have been confirmed after studying a higher number of plants per accession.
- Agreements on responsibilities: overlap with other EU potato collections (CPC and GLKS, Gross Lüsewitz Potato Collection) may be reduced in the future by dividing conservation responsibilities between the genebanks for the individual collecting numbers.

Evaluation of the collection

Table 3. Evaluation results per trait available in the database

Cyst and root-knot nematodes	**VR**	**R**	**M**	**S**	**VS**	**Total**
Globodera rostochiensis: Ro1	1	45	6	514		566
Ro2		8	1	165		174
Ro3		3	2	11		16
Ro5		46	48	205		299
Ro1-5		15	11	56		82
G. pallida: Pa1		30	4	7		41
Pa2		121	118	290		529
Pa3	2	250	76	368	9	705
Pa2/3 (by INRA)		10	6	37		53
Meloidogyne chitwoodi	8	1	1	77		87
M. fallax	8	3	2	72		85
M. hapla		15	11	67		93
Fungal diseases	**VR**	**R**	**M**	**S**	**VS**	**Total**
Late blight field test (*Phytophthora infestans*)	73	158	235	403	817	1686
Late blight lab. Test	103	82	103	120	849	1257
Wart R1 (*Synchytrium endobioticum*)		57	34	122		213
Wart R2		71	52	60		183
Wart R6		94	104	92		290
Wart R8		91	61	84		236
Gangrene (*Phoma exigua* var. *foveata*)		99	121	190		410
Dry rot (*Fusarium coeruleum)*		76	72	304		452
Rhizoctonia solani		3	4	5		12
Common scab (*Streptomyces scabies*)				20		20
Virus diseases		**I**	**IS**	**S**	**VS**	**Total**
PVX		25	43	60	97	225
PVY		2	13	36	184	235
		R	**M**	**S**	**VS**	**Total**
PVM		9	8	190		207
Bacterial diseases	**VR**	**R**	**M**	**S**	**VS**	**Total**
Blackleg (*Erwinia carotovora* var. *atroseptica*)		327	133	67	31	558
Softrot (*E. carotovora* var. *atroseptica*)		3	12	66		81
Other			**Range**			**Total**
Reducing sugar content			35-2838 mg/100g tuber			337
Dry matter content			14 - 44.5 %			348
Starch content			9.2 - 37.1 %			195
Vitamin-C content			32 - 128 ppm			74
		T	**M**	**S**	**VS**	**Total**
Salt tolerance		4	4	28	22	58
Total number of evaluation results				**9807**		

VR = very resistant, R = resistant, M = intermediate, S = susceptible, VS = very susceptible, I = immune, IS = partly immune, T = tolerant.

Potato cultivation faces considerable pests and diseases problems. Systematic evaluation of the collection was started in 1976. Scientists working in several research institutes in the Federal Republic of Germany (BBA, Biologische Bundesanstalt für Land- und Forstwirtschaft; BLBP, Bayerische Landesanstalt für Bodenkultur und Pflanzenbau; and BAGKF, Bundesanstalt für Getreide-, Kartoffel- und Fettforschung) and the Netherlands

(CPRO) have screened the germplasm for resistance to cyst nematodes, fungi, bacteria, viruses and tuber quality traits, in order to identify new sources of resistance for potato breeding. The results were entered into a database, including earlier information obtained from the WAC (Hermsen and Verdenius 1971) and the EBS. Data from literature sources (Elhag 1991; Dziewonska and Ostrowska 1978; Janssen *et al.* 1996; Ross and Huijsman 1969; Rousselle-Bourgeois and Mugniery 1995; Rousselle-Bourgeois and Priou 1995) were also added. Promising sources of disease resistance have been identified and are available for distribution to *bona fide* users all over the world (Table 3). Recently, an evaluation programme in cooperation with the Dutch potato breeders has been initiated. CGN has no own core resources for evaluation activities.

Evaluation results are discussed in more detail in a number of publications on the material maintained in the collection (Dellaert and Hoekstra 1987; Hoekstra and Munzert 1990; Langerfeld and Hoekstra 1992, 1994; van Soest *et al.* 1983b, 1984). The last *Index Seminum* including evaluation data was published in 1987 (Hoekstra and Seidewitz 1987). A new publication is not foreseen, due to the strongly increased importance of on-line access.

Internet

Since 1996 the passport and evaluation data are available on the Internet. They can be downloaded from the Web site at <http://www.plant.wageningen-ur.nl/cgn/potato/>. For those accessions that received a CGN accession number, the passport and evaluation data can be searched on-line. Information on the source of the evaluation data, descriptions of the evaluation methods used, chromosome and EBN numbers, literature references and links to major potato genebanks are also presented on the Web site.

CGN cooperates in the Association of Potato Intergenebank Collaborators (APIC). APIC created a central database of the wild potato holdings of the main potato genebanks in Europe, the USA, Peru and Argentina. The database is searchable at <http://www.potgenebank.org> (Huamán *et al.* 2000).

Phytosanitary requirements

Within the European Union, only material screened for quarantine diseases will receive an EU plant passport (European Commission 1997) and is consequently allowed for distribution. Since 1986 the plants used for rejuvenation are tested for seed-borne diseases to meet the requirements of zero tolerance. The Dutch Plant Protection Service (PD) screens the collection for Potato spindle tuber viroid (PSTVd), using 'return' polyacrylamide gel electrophoresis (return PAGE), and for true seed transmitted viruses, using indicator plants. This procedure includes screening for:

- Andean potato latent virus (APLV)
- Arracacha virus B - oca strain (AVB-O)
- Potato black ringspot virus (PBRSV)
- Potato virus T (PVT)
- Potato yellowing virus (PYV).

If symptoms develop on the indicator plants, the potato plants are re-tested serologically. Indicator plants may also detect unknown viruses.

Material Transfer Agreement

CGN will send a Material Transfer Agreement (MTA) to be signed by the user and the director of CGN. Users are requested to return their evaluation results to CGN. An embargo on the availability of those results for a limited number of years can be agreed upon.

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Potato preservation at the Nordic Gene Bank

Merja Veteläinen
Nordic Gene Bank (NGB), Alnarp, Sweden

Introduction

The Nordic Gene Bank (NGB) has the long-term responsibility for the preservation of Nordic local potato varieties, commercial varieties produced at Nordic plant breeding institutes, and breeding clones with particular valuable traits. Old non-Nordic varieties that have been cultivated over large areas in the Nordic countries are also included in NGB's collection if they are not preserved elsewhere. NGB's work with potatoes was initiated in 1979 and is led by the Working Group where all five Nordic countries are represented.

Criteria for preservation

NGB's Working Group on Potatoes has set the following criteria for preservation:

- The germplasm is not preserved elsewhere
- The germplasm is unique and can be documented
- The germplasm has one or several valuable agronomical, resistance or quality traits
- The germplasm is of cultural historical value.

Nordic and foreign varieties which have been widely cultivated in the Nordic countries are considered for preservation in NGB when they are eliminated from the official lists of varieties. Breeding stocks from Nordic plant breeding institutions may be accepted for preservation in the genebank if the institution responsible for the specific line so requests.

Collection and preservation of the germplasm

Through different channels 180 samples of old local and commercial cultivars were collected in 1982–1983 from all Nordic countries. A number of samples have also been received from private donors each year. The identification of new accessions is based on various morphological characters and electrophoresis. The accepted clones are stored *in vitro* at Svenskt Potatisutsäde AB in Umeå, Sweden, where pathogen elimination and propagation including field production are also carried out.

The present collection

At the moment, 63 clones have been accepted for long-term preservation (Table 1).

Table 1. Distribution of different accession types in Nordic countries

Country	Cultivars	Landraces	Breeding lines	Total
Denmark	7	2	0	**9**
Finland	6	1	0	**7**
Iceland	0	3	0	**3**
Norway	6	7	3	**16**
Sweden	11	13	4	**28**
Total	**30**	**26**	**7**	**63**

Characterization and evaluation of genebank accessions

Characterization and evaluation of genebank accessions is essential in order to make a collection useful and more accessible to users. Therefore, a research project on quality and resistance characters of NGB's potato collection was started in 1993 by the Working Group

on Potato (see box). In addition, several botanical traits have been studied. Descriptions of all accepted potato accessions will be stored in the Nordic Potato Database (NPDB). General information of the collection can be found on the Internet at <http://www.ngb.se/>.

Investigations on NGB's potato material

Botanical characteristics
Tuber
Sprout
Growing plants

Utilization and quality
Dry matter content
Glycoalcaloids (TCA)
Cholorogenic acid (CGA)
Cooking quality
- Disintegration by cooking
- Sogginess
- Taste
- Darkening

Chips quality

Resistance against pest and diseases
Synchytrium endobioticum
Phytopthora infestans
- Foliage
- Tuber

Streptomyces scabies
Phoma exiqua
Fusarium
Potato leaf roll
Potato virus Y
Spraing (TRV)
Mop top (PMTV)

The value of Nordic potato germplasm

The old Nordic potato germplasm probably has a rather narrow genetic base. Many of the cultivars have small tubers, uneven tuber shape and other primitive characteristics. The fact that some of these cultivars have been continuously grown for more than 200 years is a clear indication that certain valuable traits are present in this material.

Most of the old local cultivars have poor resistance against major potato diseases in Scandinavia. However, some of the cultivars have fairly good resistance to some of the storage diseases. Others are notable for their extreme dormancy, which is very important under Nordic conditions. The Nordic breeding lines which will be included in NGB's collection primarily have important resistance genes.

The cultivation history of old local strains indicates that they have a good and stable food quality. Organoleptic tests have also shown that certain older cultivars represent a level of quality which is rarely found in modern varieties. They are undoubtedly a source for quality breeding. There is also evidence that some of the clones among the old germplasm have a high nutritional quality, which may also be valuable in future breeding programmes.

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Status of potato germplasm collections in Poland

J. Lewosz, I. Stypa, E. Turska and E. Sekrecka
Plant Breeding and Acclimatization Institute (IHAR), Division of Bonin, Bonin, Poland

The Polish potato collections include one tetraploid cultivars collection held at IHAR-Bonin and two diploid collections held at IHAR-Mlochow and at the University of Agriculture, Warsaw. These collections are presented below.

Tetraploid cultivars collection

Location: Plant Breeding and Acclimatization Institute (IHAR), Division of Bonin

Curator: Ms Irena Stypa (Ewa Turska)

General description

The collection of potato cultivars and clones has been maintained in Poland for more than 50 years, first as field-grown accessions, and after 1980 also in the *in vitro* genebank. The main collection of potato cultivars is located at the Plant Breeding and Acclimatization Institute (IHAR), Branch Division of Bonin (previously Potato Research Institute). The collection in Bonin includes a total of 1232 accessions gathered over many years and partially evaluated at the same time, according to the methodology recommended by EAPR.

The current status of the collection of potato cultivars held in IHAR-Bonin is shown in Tables 1 and 2.

Table 1. Potato cultivars collection in IHAR-Bonin: origin of accessions and conservation technique

Origin of the cultivars	Number of genotypes	Maintained *in vitro*	Maintained as tubers (field collection)
Polish cvs.	170 (13.8%)	170 (16.7%)	80 (safety-duplicates of accessions conserved *in vitro*)
German cvs.	411 (33.3%)	306 (30.1%)	105 (48.6%)
Dutch cvs.	218 (17.7%)	183 (18%)	35 (16.2%)
Others (20 countries)	433 (35.1%)	357 (35.1%)	76 (35.2%)
Total	**1232 (100%)**	**1016 (82.5%)**	216 (17.5%)

Table 2. Potato cultivars collection in IHAR-Bonin: year of obtainment

Year of obtainment	Number of accessions	Year of obtainment	Number of accessions
1860–1870	2	1930 - 1940	38
1870–1880	1	1940 - 1950	81
1880–1890	5	1950 - 1960	138
1890–1900	6	1960 - 1970	223
1900–1910	9	1970 - 1980	241
1910–1920	12	1980 - 1990	222
1920–1930	20	1990 - 2000	95

Accession numbers, origin and other passport data of all these cultivars have been reported for inclusion in the RESGEN database.

Tuber collection

The main task regarding field-grown plants is to assess their agronomic traits and botanical features under Polish environmental conditions. Agronomic traits such as resistance to various pests and diseases have been evaluated according to a 9-grade score, where 9 is the best. Usually, 20 plants in one repetition have been observed for 2–3 years to evaluate the most important characters. In general about 45 characters were estimated on the basis of the behaviour of the plants and tubers in the field (botanical characters). Some characters were assayed in the laboratory, some were recorded by breeders in the field (e.g. virus resistance).

Field examination served to eliminate the genotypes that behaved below expectation due to different standards and different climatic conditions, as well as to select the most promising and most outstanding genotypes in terms of agronomic traits and resistance to pests and pathogens. Descriptors used for field evaluation are listed in Table 3.

In general, all cultivars that behaved well for a long time, were popular and appreciated in many countries, viable for many years on the field, known as good parental forms, extremely resistant to viruses, nematodes, fungal and bacterial diseases, good starch producers, etc. are maintained in collection.

Table 3. Descriptors used for field evaluation

1	Variety	17	Skin Cl	31	Frying_Cl	50	Stolon_att
2	Parentage	19	Eye Cl	32	Crisping	51	Rust spot
4	Listing	21	Flesh Cl	33	Frying	52	Strep scab
5	Maintenance	22	Eye Depth	34	Enz_Brown	54	Alt solani
10	Maturity	23	Skin tex	36	Starch	57	Phyto folg
11	Habit	24	Dormancy	38	Yield	59	Phyto tubs
12	Cover	25	Ext damage	43	Tuber_Size	60	Rhizo sol
13	Flover FQ	26	Int. bruise	44	Tuber_unif	61	Spongo sub PLRV†
14	Flower Cl	27	Storage	45	Sec_Growth	62	Synch endo PVA†
16	Berry	29	Cooking _ty	46	Hollow_Hrt	63	S end rac PVM†
17	Tuber Sh	30	Cook_black	47	Growt_Crk	66	Erwinia bl PVY†

†From references.

In vitro collection

Severe degeneration of field-grown plants and increased demands for healthy starting material to be used for micropropagation required changes in the methods of preservation of the plants. The construction of a specially designed building with an equipped laboratory at the beginning of the 1980s allowed for efficient transfer of about 80–100 cultivars yearly from the field-grown collection to the *in vitro* collection. Introduction to the *in vitro* collection of almost all accessions has been carried out after examination of the sanitary status, assay on the presence of quarantine pathogens and virus-cleaning.

– **Procedures for virus-cleaning of infected cultivars utilized in the Gene Resources Laboratory, IHAR-Bonin**

A. Three tubers of each genotype were taken as starting material. Meristems were used to test the presence of *Clavibacter michiganensis* subsp. *sepedonicus* in the Quarantine Diseases Laboratory of IHAR in Bydgoszcz. Altogether 90 samples have been assessed by indirect immunofluorescence assay.

B. The remaining parts of the tubers were planted individually into 16 cm-diameter containers filled with compost soil mixture. Emerging plants were examined for the presence of PVX, PVM, PVY, PVS, PLRV, moved to the phytotron and exposed to high temperature (38/34ºC day/night) on a 16/8 hours day/night cycle for 5–6 weeks.

C. Four grams samples of the leaves were taken on the third week of thermotherapy to assay the presence of PSTVd by electrophoretic analysis (RNA) and by a biological test on tomatoes (cv. Rutgers).

D. Meristematic tissues (0.1–0.2 mm diameter) were isolated from each genotype after 6-week thermotherapy. About 90 meristems were taken from each genotype (total 5400) and placed on Murashige-Skoog medium (MS) amended with 0.1 mg GA_3 per litre. About 1200 explants were obtained from the meristems after 8–36 weeks (depending on the cultivar). All these plants were re-examined for viruses presence to

confirm the effectiveness of thermotherapy. Bottom parts of the plants were placed on MS medium amended with 1.25 mg GA_3 per litre and were planted in the glasshouse 3–4 weeks later. After another 3-4 weeks of growth in the glasshouse, plants were assayed 2–3 times by ELISA for the presence of PVS, PVY, PVM, PVX and PLRV. Plants free of viruses, *Clavibacter* and PSTVd that remained as *in vitro* explants were placed on a 'bank medium' for long-term storage. This medium is enriched with saccharose (60 g / l) and abscissic acid (ABA) 1.25 mg / l, vitamins and casein. Explants can be stored on this medium at low temperature (10 / 8° C day / night) under a low light intensity (4 W m^{-2}) for 2–5 years without needing frequent rejuvenation. Vitality and homogeneity of the genotypes stored for several years in the genebank were examined by planting the explants in the glasshouse and subsequent planting of the minitubers obtained in the field. Botanical and molecular characteristics of the plants cultivated in the field were compared with catalogue descriptions.

– Improvement of diagnostic methods

Detection of viruses has been several-fold improved in comparison to regular DAS-ELISA by using a 'cocktail' version and additional amplification of the enzyme reaction by AMPEK and AmpliQ kits produced by DAKO, Glostrup, Denmark. The AmpliQ kit allowed the detection of PLRV in 200-fold diluted sap taken from secondary infected, dormant tubers (Treder and Lewosz 2000).

An extremely low amount of PLRV that was barely detectable by immunoenzymatic methods was easily detected by the immuno-RT-PCR method. The use of this method proved that PLRV may escape the detection by immunoenzymatic methods in the explants during very intensive micropropagation (Treder and Lewosz 1999).

The use of PCR for amplification of bacterial DNA according to the procedure of Schneider *et al.* (1993) or of Firrao and Lozzi (1994) allowed detection of latent infections by *Clavibacter michiganensis* subsp. *sepedonicus* in the aerial part of the stems and in freshly cropped tubers. The limit of the detection was 40 bacterial cells / cm^3 (Pastuszewska *et al.* 2000).

– Fast propagation of the explants

Micropropagation of some recalcitrant cultivars could be improved by the reduction of microelements and macroelements rate in the medium by 50%, while the type of gelling agent (agar or phytagel) or the amount of gibberelic acid had no big influence (Sekrecka 1997) (Table 4).

Table 4. Influence of medium composition on micropropagation and microtuber production from responsive and recalcitrant cultivars

Medium no.	Rate of micro- and macro-elements	Gelling agent	Growth substrate (mg/l)	Developed explants(%) Cultivars		Number of microtubers after planting of the 2- or 4-week old explants	
				Responsive	Recalcitrant	2-week	4-week
1	1	Agar	–	98.5%	77.6%	6.3	9.2
2	½	Agar	–	98.7%	90.8%	6.5	9.4
3	1	Phytagel	–	97.8%	85.9%	5.5	10.2
4	½	Phytagel	–	99.3%	92.5%	6.7	11.1
5	1	Agar	1.0	96.3%	71.0%	6.2	9.7
6	½	Agar	1.0	97.8%	86.8%	6.6	12.2
7	1	Phytagel	1.0	97.8%	89.3%	6	10
8	½	Phytagel	1.0	98.2%	95.8%	6.4	11.2
9	1	Agar	2.5	97.5%	75.1%	5.7	8.3
10	½	Agar	2.5	100.0%	82.5%	6.4	9.7
11	1	Phytagel	2.5	99.2%	85.8%	6	9.4
12	½	Phytagel	2.5	100.0%	90.8%	7	10.4

– Long-term storage of explants

Prolonged storage of the explants became possible by amending the MS medium with 6% sucrose and abscissic acid (ABA). This kind of medium made frequent rejuvenation of the

plants unnecessary. For some cultivars, the storage period has been extended to 5-6 years, while others should be rejuvenated every 6 months (Table 5). Some recalcitrant cultivars ('Mila') behaved much better on the medium composed of 3% sucrose and 4% D-mannitol or 6% sucrose without any addition of growth substances (Sekrecka 1997).

Table 5. Behaviour of several cultivars during long-term storage on 'bank-medium'

Period of rejuvenation	Cultivar
6 months–1 year	Mila—Omulew
2 years	Beata—Balbina—Lotos
3 years	Baszta—Irys—Ruta
4 years	Albina—Bila—Ania—Mors
5 years	Olza—Fanal—Carpatian
6 years	Aba(NL)

– Microtubers

A convenient way of storage, exchange and reproduction of the plants are microtubers produced by planting of the explants in sterile soil in glasshouses or screenhouses. Optimal multiplication rates (above 10) have been obtained when the density of planting was no lower than 24 plants / m^2 and not higher than 38 plants / m^2. Otherwise, a large number of microtubers of undesired diameter have been obtained. Planting 4-week old explants increased the number of microtubers by 50% in comparison to planting 2-week old explants. Growth of the plants on 2-times diluted MS medium improved the yield of microtubers (Sekrecka 1997).

– Cultivar identity and homogeneity

Field-grown plants and sprouting tubers have been thoroughly examined for their consistency with the description of botanical characters according to UPOV guidelines (TG / 23 / 5 from 1986-11-21). Any plant that did not fit was rejected or tested by other molecular methods (Pilecka and Lewosz 2000). Beside botanical features such as shape, colour, flowers, leaves, tubers, sprouts, two additional methods were used for cultivar identification. One of these might be used for the identification of dormant or not heavily sprouted tubers on the basis of the electrophoretic pattern of protease inhibitors isolated from tuber sap by an affinity chromatography on trypsin immobilized on Sepharose matrix. Entrapped protease inhibitors were released by a sudden drop in pH and resolved electrophoretically to display multiple electrophoretic forms specific for each cultivar (Lewosz and Pilecka, unpublished). The second method is intended for the identification of cultivars on the basis of microsatellite DNA amplification by PCR technique, therefore any part of the plant tissue at any physiological stage can be analysed. However, this procedure has been conceived mainly for tuberless explants (Pilecka and Lewosz 1999).

– Current status

Up to now, 1016 accesions have already been introduced in the *in vitro* genebank, 242 accessions are currently maintained both as tubers and as *in vitro* explants, 216 are still maintained exclusively as tuber collection and will be prepared for introduction in the *in vitro* collection in the future, when the most important agronomic characters will be assessed. About 70% of *in vitro* accessions are proved to be PSTVd-free, 85% have been checked for the absence of *Clavibacter* and 100% are totally free from the common viruses occurring in Poland. All accessions introduced in the *in vitro* collection in the last years are completely free of pathogens.

The good quality of *in vitro* accessions makes them a very desired source for the micropropagation of seed materials. In the period 1993–1999, seed reproduction of more than half of the registered cultivars was started from explants stored in this *in vitro* collection (Table 6). This material is also utilized by breeders as a starting material for experimental

purposes.

Table 6. Utilization of genetic resources from the *in vitro* collection for seed reproduction, 1990–1999.

Year	Number of registered cultivars	Number of cultivars utilized for seed propagation
1990	55	17
1991	55	16
1992	55	21
1993	55	44
1994	54	40
1995	53	40
1996	61	31
1997	75	45
1998	80	54
1999	90	63

Activities carried out for project RESGEN-CT95-34

Tables 7 and 8 show the result of the work accomplished within the framework of the RESGEN-CT95-34 project on 'Documentation, characterization and evaluation of potato genetic resources of Poland', as a result of an agreement between IHAR and IPGRI .

Table 7. List of Polish cultivars cleaned from virus infection—Project RESGEN-CT95-34

Cultivar	Cultivar	Cultivar
244020 Aksamitka	245225 Jasia	244819 Orlan
245221 Alicja	244587 Klepa	244987 Rybitwa
245222 Bard	245226 Kuba	244989 Rywal
244119 Barycz	245227 Lord	244996 Salto
244120 Baszta	244708 Mars	245092 Tara
244263 Cykada	244716 Meduza	245113 Tokaj
245223 Danusia	244780 Nimfy	245229 Wawrzyn
245224 Denar	244798 Oda	245230 Wigry
244459 Grom	244804 Oka	245231 Wiking
244460 Gromadzki	244812 Omulew	245232 Wolfram

All listed cultivars were cleaned from viruses X, M, S, Y, L, PSTVd and examined for the absence of bacteria *Clavibacter michiganensis* subsp. *sepedonicus* according to the procedure described above.

Table 8. Evaluation of resistance and quality of 60 Polish accessions

ACCNAME	ACCENUMB	Year of obtainment	Year of cancellation from the official list	PVY	PVM	PLRV	ERWINIA_SR	ERWINIA-BI	PHYTO_FOLG	PHYTO_TUBS	FRYING_CL
ABA	PL 244001	1976	1991	7	7	5	5	6	5	5	4
ALKA	PL 244028	1974	1987	6–7	3	5	4	7	6	3–4	4
AZALIA	PL 244110	1975	1987	5	3–4	4–5	4	7	5	3–4	4
BALTYK	PL 244114	1955	1960	8		4	3		5	3–4	5
BETA II	PL 244135	1955	1968	6		4	4		3	3	5
BOLKO	PL 244160	1966	1982	7	5	2	5		5	6	4
BOMBA	PL 244161	1955	1966	6		4	5		3		2
BRDA /OLD/*	PL 244174	1964*	*	7		6			3	4	
BRYZA	PL 244178	1976		5	5	7		5	5	4	3
CERTA	PL 244201	1976	1997	5		7		6	3	3	4
DALIA	PL 244266	1977	1989	5	3-4	5			6	5	3
DALILA*	PL 244267	1966*	*	6	2	3			3	4	
DELFIN	PL 244283	1955	1957				6			3–4	3
DRYF	PL 244318	1978	1991	6		7		5	6	4	
EPOKA	PL 244349	1955	1981	4	2	3	4		3	3–4	4
EWEREST	PL 244368	1955	1968	8		6	3		6	3–4	3
FIONIA	PL 244392	1969	1980	4	3–2	5–6	5		2–3	2–3	4
FLISAK	PL 244399	1955	1988	5	2	6	4		3	4	4
FLORA	PL 244400	1955	1976	4	3–4	5	3		4	5	4
GRANIT*	PL 244453	1966*	*	5–6	5–6	6–7	3		4	5–6	3
GROMADZKI	PL 244460	1955	1969	4		5			2	3–4	
INA	PL 244509	1977	1986	7		3			5	4	3
IRYS	PL 244 519	1975		7		3			5	4	3
JOWISZ	PL 244536	1963	1969	5		5	5		3	3–4	3
KOLEKTYW	PL 244591	1957	1966	5		6			3	3	
KORA	PL 244597	1975	1980	7	3	4–5			5	6	4
KRAB	PL 244602	1967	1983	6	5	6	4		2-3	3–4	4
KROKUS	PL 244608	1972	1984	7–8	3	5–4	3		2	3	3
LEDA	PL 244 637	1977	1986	5	3–4	5			6	5	4
LIPINSKI WCZESNY	PL 244 656	1961	1972	6		4–5	5		3	2–3	5
LIWIA	PL 244661	1977	1984	5-6		5–6		2	6	4	4
MARS	PL 244 708	1963	1968	7		6					
MAZUR	PL 244714	1963	1968				1			2	4
NAREW	PL 244765	1974	1991	5		3	3	6	6	6	4
NOTEC	PL 244788	1970	1984	5–6	2	3–4	4		3	3	4
NOWA HUTA	PL 244792	1955	1960	6		5	4		3	3	4
NYSA	PL 244794	1968	1982	5–6	2	4	3		6	6	4
ORZEL	PL 244820	1958	1973	7		3	4		2	4	4

ACCNAME	ACCENUMB	Year of obtainment	Year of cancellation from the official list	PVY	PVM	PLRV	ERWINIA_SR	ERWINIA-BI	PHYTO_FOLG	PHYTO_TUBS	FRYING_CL
OSA	PL 244821	1966	1980	7	2	2	3		4	4	3
PALMA†	PL 244830	1950†	†								
PIERWIO-SNEK	PL 244853	1955	1984	6–7		4	4		3	3	3
POLA	PL 244872	1974	1991	7	5	5	4			6	5
POMORSKI	PL 244 876	1955	1960	3			4		3	3	6
POSTEP	PL 244881	1955	1957								
PROSNA	PL 244899	1972	1979	6	2	5	4		7	5	4
RONDA	PL 244965	1974	1994	7	2	7	5				5
RYIS	PL 244988	1974	1984	6		5	4			3–4	4
SMAK	PL 245040	1961	1974	5-6		2	5		3	3	4
SOKÓL	PL 245046	1972	1999	5	3–4	5	4		6	5	3
SOWA	PL 245056	1972	1989	5	3–4	5	3		4	4	5
SPUTNIK†	PL 245063	1960*	†				3				4
TARPAN	PL 245 094	1973	1996	6		6	1			3–4	3
TURYSTA†	PL 245128	1963*	†	6–7	2	3-4	4		3	4	4
UNIKAT	PL 245143	1955	1959	3			4		3	2	4
URAN	PL 245149	1963	1994	6–7	3–4	7	4		4	5	5
WARSZA-WIANKA†	PL 245 186	1949*	†								
WARTA	PL 245187	1966	1976	6	3–4	6	3		4	4	6
WISLA	PL 245204	1955	1980	4	3–4	2			3	2	
WYSZO-BORSKI	PL 245209	1955	1978	5-6	5	5-6	2		4	4	4
ZORZA	PL 245 217	1960	1971	4-5	3	4	4		3	3–4	5
IWITEZ	PL 245 085	1902					5			5	5

†Cultivars refused for registration, however cultivated for some time

All these cultivars are maintained in the genebank as *in vitro* cultures. They have all been cleaned from common potato viruses (PVX,-PVS-PVM-PVY-PLRV).
About 90% have been assayed for the presence of PSTVd and *Clavibacter michiganensis* subsp. *Sepedonicus*:

PHYT_TUBS: assay on tuber slices
ERWINIA_SR: assay on tuber slices inoculated with paper discs soaked with bacteria suspension
PVM, PVY, PLRV: assay as reaction rate

Diploid forms

Plant Breeding and Acclimatization Institute, Division in Mlochow

Curator: Ms Henryka Jakuczun (Ewa Zimnoch-Guzowska).

The collection comprises mainly interspecific hybrids of wild and primitive *Solanum* species that were created as parental lines, outstanding for agricultural traits such as high starch content, good resistance to late blight, viruses and bacteria. This group of genotypes constitutes a source of desired characters for breeders. An additional group is constituted by diploid clones obtained from abroad: USA (16), former Soviet Union (10), The Netherlands (9), former East Germany (9), Mexico (3), Peru (2) and from the collection of the University of Agriculture, Warsaw (5). A total of 382 clones are maintained on field plots in glasshouses and a small part of them is also kept *in vitro* as virus-free accessions.

The evaluation of the clones involved the following descriptors:

Rank number —Name of genotype —Country of the genotype —Country of origin
Year of obtention—Origin (Parents)—Contributing species—Ploidy level
Yielding ability—Mean tuber weight—Starch content
Tuber shape—Regularity of tuber shape—Depth of eyes
Colour of the tuber skin—Colour of the tuber flesh
Blackening of fresh and boiled tuber flesh—Flavour—Cooking type—Colour of chips
Resistance to potato viruses X, Y, M, S, PLRV
Resistance to late blight (leaves and tuber slices)
Resistance of tubers slices to soft rot (Eca, *Erwinia carotovora atroseptica*) and mixed rot (Eca + *Fusarium*)
Resistance to wart, common scab, potato cyst nematodes (Ro_1 and Pa)
Colour of flowers—Blooming intensity
Pollen stainability—Presence of unreduced gametes—Crossability
Seed production in interploid matings—Status (*in vitro* or field)

The characteristics of all these clones are available in a catalogue (Jakuczun *et al.* 1996).

University of Agriculture, Warsaw (SGGW)

Curator: Mr Julian Jakubiec.

According to the 1999 Annual Report (Jakubiec 1999) the collection comprises the following:

a. Seeds from wild species;
b. Hybrid seeds from interspecific crossings;
c. Seeds obtained from open-pollinated clones. Description of the accessions include: number of seeds per population; species; origin; year of obtainment; and laboratory test of germination ability;
d. Clones selected from different interspecific crosses that have been evaluated during a 3-year period at two experimental stations. Every year, 380 clones multiplied are stored as tubers. The evaluated characters of those clones are recorded in tables that include:

Rank number
Code of genotype (ZEL–number) (ZEL: from Zelazna, Experimental Station of SGGW)
Donors—country, institution or own selection
Species and contributing species—Latin names of species or interspecific hybrids
Ploidy level—number of chromosomes or genomes

Compatibility (self-compatible, self-incompatible, male sterile)
Crossability with 2? and 4?—(fertile as female, male or female and male parent)
Gametes—possibility to produce unreduced gametes
Open-pollination—production of fruits and seeds in open-pollination
Colour of flowers –Blooming intensity
Viability of pollen grains—% of grains stainable with acidic lactofuchsin
Shape of hill—Length of stolon
Earliness
Yielding ability—Number of tubers—One tuber weight
Tuber shape—Regularity of tuber shape
Depth of eyes
Colour of tuber skin—Colour of tuber flesh
Starch content – Flavour—Cooking type
Resistance to late blight (foliage and tubers)
Resistance to rot (mixed *Erwinia* + *Fusarium*)
Resistance to viruses X, Y, M, L, S

Wild species and some diploid and tetraploid clones are maintained *in vitro*. To avoid degeneration that may happen by prolonging the propagation of explants on artificial medium, *in vitro* tuberization was accomplished using Life Guard Culture Box (Sigma) filled with tuberization medium. All clones destined to be propagated *in vitro* were examined for the presence of endogenous bacteria using the Bacteria Screening Medium 523.

More details are available from the Centre for Plant Genetic Resources, IHAR Radzików, 05-870 Blonie Poland (Web site: <http://www.IHAR.edu.pl/gene_bank>).

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Potato genetic resources in Romania

***Silvia Strajeru*[1] *and Dumitru Bodea*[2]**

[1]*Genebank of Suceava, Romania*
[2]*Agricultural Research Station of Suceava, Romania*

Importance and utilization

Potato was introduced in Romania in the second half of the 18th century and represents today the second most important crop after wheat, being called 'the Romanian's second bread'. The pedoclimatic conditions of Romania are suitable for potato-growing. The most appropriate areas are located in Harghita, Covasna, Brasov, Sibiu, Neamt and Suceava districts. Locally specialized agricultural systems and certain climatic and soil conditions allow the cultivation of potato for various purposes: extra-early forms, seed production and consumption.

Potato is an important food, fodder and industrial plant. The average annual consumption per inhabitant is about 100 kg.

The evolution of the cultivated areas and production is given in Table 1.

Table 1. Areas cultivated under potato and production since 1989

Year	Area (1000 ha)	Production (kg/ha)
1989-1991	292	10517
1994	249	11836
1995	244	12361
1996	257	13976
1997	255	12572

Source: Morar 1999.

Potato breeding

Potato breeding is carried out at the Research and Production Institute for Potato of Brasov, at the Research and Production Stations for Potato of Tirgu Secuiesc and Miercurea-Ciuc, and at the Agricultural Research Station of Suceava. The breeding programme is directed towards improving yields and increasing resistance to diseases and pests. The specific objectives of Tirgu Secuiesc and Suceava Stations are to create new potato varieties with high starch content and early/semi-early forms respectively. Since 1965, 40 potato cultivars were created in Romania, but the best results in breeding have been achieved after 1991, as shown in Table 2.

Table 2. Number of potato cultivars created in Romania, 1965–1999

Period	Number
1965–1970	4
1971–1980	5
1981–1990	5
1991–1999	26

Source: Chiru *et al.* 1992.

The collections

The collections are currently maintained in a decentralized mode, with the Research and Production Institute for Potato in Brasov acting as coordinating body. The five folllowing institutions are involved in conservation activities:

- Research and Production Institute for Potato of Brasov
- Research and Production Station for Potato of Tirgu Secuiesc
- Research and Production Station for Potato of Miercurea-Ciuc
- Agricultural Research Station of Suceava
- Genebank of Suceava.

The main collection is maintained at the Institute of Brasov as field collection. It consists of

723 accessions, including 35 wild forms belonging to various species and 688 advanced cultivars of *Solanum tuberosum* from different countries of origin. They include 78 accessions of local origin.

All other holders keep only small collections including local genotypes and research materials.

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Status of the VIR Potato Genebank

Stepan Kiru

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

VIR celebrates in 2000 the 75th anniversary of its World Potato Collection.

The first expedition of Russian scientists to South America dates back to 75 years. Under the initiative of N.I. Vavilov, the first Russian scientists to collect the first potato samples in its centre of origin were Drs S. Bukasov in Mexico and S. Juzepchuk in Peru, Bolivia and Chile. N. Vavilov himself visited Mexico, Ecuador and Peru, collecting many new forms of wild and cultivated species. In the following period, the years before and after the Second World War, the VIR Potato Collection was increased with material obtained from about 15 collecting expeditions in Latin America and through exchange of material with the largest potato genebanks in America, Europe and Asia.

As of January 2000 the VIR Potato Genebank contains a total of 8550 accessions, including:

- wild *Solanum* species: 3200 accessions from 130 species,
- cultivated species and indigenous Chilean cultivars: 3330 clones,
- breeding varieties: 1900 clones, and
- hybrids and dihaploids: 120 clones.

The work of VIR's Department of Tuber Crops is based on the project 'Plants genepool'. Its main tasks are the maintenance, conservation and reproduction of the introduced material. The morphogenesis and ontogeny of the potato samples is observed during 3 years. Field trials are conducted to determine productivity, resistance to pathogens and pests, as well as the reaction to climatic conditions and day length. These evaluations are carried out as follows:

- St. Petersburg region (Pushkino town): agricultural commercial traits, horizontal late blight resistance, viral and bacterial diseases;
- Murmansk region (north of Russia, near polar circle): commercial traits, cold and frost tolerance, and maintenance of accessions which are only available in tuber form;
- Chernozem (black soil) region, Ecaterinin research station: resistance to potato viruses and pests (Colorado potato beetle), organic farming, yield;
- Krasnodar (South region): commercial traits, viral, bacterial and fungal diseases and pests;
- Moscow region: commercial traits, late blight and other fungal diseases, potato viruses and pests (Colorado beetle and aphids).

The promising late blight-resistant samples from the above-mentioned regions are further tested in the conditions of Russian Far East on Sakhalin Island, where aggressive fungal races occur naturally, as in Toluca valley in Mexico.

During the past 3 years, VIR's Potato Genebank has participated in three important international cooperative projects on potato genetic resources research:

- EU project RESGEN-CT 95-34 / 45, as part of an agreement with IPGRI
- APIC (Association of Potato Intergenebank Collaborators), and
- CEEM project (Cornell University / Eastern Europe / Mexico late blight research collaboration project).

The directory board of the Institute and all employees of the Department of Tuber Crops, wish to thank IPGRI for its invaluable support to improve the state of VIR's Potato Genebank and the level of investigation carried out in Russia. It is believed that international collaboration promotes an effective utilization of potato genetic resources in potato breeding, which will safeguard the future human food supply.

The Potato Research and Breeding Institute and its Genebank in Vel'ká Lomnica, Slovak Republic

Kvetoslava Forišeková[1], Eva Brutovská[1], Ján Heldák[1] and František Debre[2]

[1]Potato Research and Breeding Institute (PRBI), Vel'ká Lomnica, Slovak Republic

[2]Research Institute of Plant Production (RIPP), Piešťany, Slovak Republic

It is the first time that staff from the Potato Research and Breeding Institute, Vel'ká Lomnica participates in an ECP / GR meeting and have the opportunity to present the current status of potato genetic resources in the Slovak Republic and to introduce the institute and its activities.

As in other European countries, potatoes have a prominent position in Slovakia. They have been an essential component of the diet of the Slovak population for a long time. Before the Second World War, potatoes were grown on more than 100 000 ha in Slovakia. Since then, the cultivated area gradually decreased: in 1995 it was still about 40 000 ha, in 1998 only 28 000 ha and in 1999 even less, 27 000 ha. Slovakia was self-sufficient for potato production, but the considerable decrease of growing areas has caused an important increase of potato imports. At present more than 66% of all potato-growing areas belong to small individual farmers. With the exception of a few skilled farmers, they have been using their own potatoes with low biological value as seed every year, because they do not have enough money to buy new healthy seed. For the same reason, nutrition and protection against pests and diseases are not at a satisfactory level either. Only 30 % of the biological potential of varieties has been used, much less than in the EU countries.

The first Slovak potato breeding station was established in 1946. The breeding station in Vel'l ká Lomnica is located in the centre of the main seed potato area, close to the High Tatras mountains. In the beginning, potato breeding and seed production were the dominant activities of the station. Fundamental changes in the organization of scientific and research activities in Slovakia occurred in 1977. A research department was included into the activities of the breeding station further to the decision of the government to ensure cooperation between research and breeding and seed production. In 1977 the breeding station was renamed Potato Research and Breeding Institute (PRBI) and became the sole institution for research and breeding of potatoes in Slovakia. PRBI is managed directly by the Ministry of Agriculture of the Slovak Republic (MASR). It is a station of the MASR, with competence for the whole country.

Breeding activities resulted in the creation of 20 registered varieties: 'Tatranka' (1958), '? ajka' (1960), 'Jarabina' (1961), 'Lú?nica' (1965), 'Breza' (1965), 'Limba' (1968), 'Lipa' (1973), 'Sosna' (1974), 'Iva' (1979), 'Eta' (1981), 'Rema' (1983), 'Nela' (1985), 'Lipta' (1990), 'Albina' (1991), 'Lomnica' (1992), 'Vila' (1995), 'Patria' (1996), 'Livera' (1996), 'Alva' (1996) and 'Viola' (1999).

Since 1992, activities of PBRI continued within the framework of a National Programme of Cultural Plants Genepool Protection, which was approved by the MASR in that year. This National Programme is coordinated by the Research Institute of Plant Production in Piešťany, in cooperation with other institutes. In the area of plant genetic resources, Slovakia cooperates with IPGRI through the ECP / GR programme.

Potato germplasm can be conserved as an *ex situ* field collection or as an *in vitro* collection. Both methods require significant investments in terms of time and resources. Field maintenance has the advantage that germplasm can be constantly evaluated for the different characters of importance to breeders and end-users. However, this method, more likely than *in vitro* conservation, also results in losses due to diseases, pests, drought, lack of adaptability, frost or flooding. Safe long-term conservation is only partially assured in the

field. Moreover, germplasm distribution and exchange from the field genebank is difficult because of the vegetative nature of the material and the greater risk of disease transfer.

In vitro conservation is safer but may result in somatic mutations, and the cost for long-term storage is quite high. The accessions that are frequently utilized in a breeding programme have usually been maintained in an *ex situ* field genebank for permanent ready access, while the less frequently utilized accessions could be conserved *in vitro*.

Besides collecting the world diversity as well as domestic landraces and promising crosses, it is important to evaluate biological material from the viewpoint of morphological, biological and economical characteristics, to document genetic resources in a database and to provide for their long-term conservation.

Research on potato genepool started in our institute in 1977, when the research department was created. The collection was characterized with morphological characters and duplicates were identified. Morphological traits and economical potential of the collected potato accessions were described only in field collections, intended for utilization in research, breeding and production. Until 1988 there was only a field collection, where 400–500 genotypes were maintained every year. After harvesting, tubers were sampled for virus indexing by an ELISA test. There have been very high levels of re-infection with viruses and many samples had to be excluded and were lost.

In vitro thermotherapy was started in our institute in 1987. After successful thermotherapy and testing for viruses, healthy plants were maintained in the *in vitro* genebank for long-term storage. The *in vitro* collection of potato genotypes for long-term storage has been maintained in test tubes on agar solidified media containing growth-retarding agents. Induction of microtubers by addition of sucrose and coumarin to the medium was also used as a second method for long-term storage, but now cultivation of plants is preferred. Standard culture conditions have been used: temperature 22–24°C/18–20°C; light 16/8 hours; interval between subcultures 3 months; two plants in separate test tubes represent the basic stock and two older plants the spare stock. This is a protection against the loss of genotypes. Every third year genotypes are regenerated in the field and then re-transferred to *in vitro* conditions. Before being maintained *in vitro*, all genotypes have been cleaned from viruses, tested by ELISA and characterized by tuber protein electrophoretic analysis. For some genotypes, RAPD analysis of different somaclones was also carried out and confirmed differences between some of them.

The genetic resources of our *in vitro* genebank are now tested successively in the field, while all genotypes are only maintained in *in vitro* conditions. Healthy plants have been submitted to field trials and evaluated. About 90 traits have been evaluated visually. During the vegetation period, morphological and biological traits have been evaluated at different growing stages according to appropriate guidelines, e.g. leaves shape, pigmentation of the abaxial leaf, petiole pigmentation and length, plant type, etc. Emergence rate, occurrence of virus diseases, resistance to other diseases such as *Phytophthora infestans* and *Rhizoctonia solani*, flowering intensity, flower colour, vegetative period, yield and other characteristics have been evaluated in the field. Economic traits such as the number of tubers per plant, skin and flesh colour, dry matter content and starch have been evaluated on the tubers of 10 plants through mechanical analysis after harvest. Rough protein content, content of reducing sugars, cooking ability and processing ability are evaluated from the viewpoint of technological characteristics.

Data on genetic resources are entered in a database under Excel and genetic resources are stored for conservation in the genebank. The results obtained and the accessible biological material are available to breeders.

Table 1 illustrates the range of our activities in the last ten years. The number of accessions maintained *in vitro* rose rapidly since 1996 and has been relatively constant for the last three years. Table 2 shows the distribution of samples by origin.

Table 1. List of potato genotypes maintained in PRBI in the past 10 years

Year	No. of genotypes maintained in the field/*in vitro*
1990	402
1991	358
1992	292
1993	335
1994	418
1995	352/289
1996	290/636
1997	91/980
1998	185/931
1999	147/926

Table 2. Distribution of accessions of different origin in the *in vitro* genebank

Origin	1995	1996	1997	1998	1999
Slovak varieties	14		20	16	16
Foreign varieties	209	379	423	414	433
Hybrids of Slovak breeding	14		177	188	208
Foreign hybrids	15	201	144	139	110
Cooperation with foreign institutes	–	–	14	12	14
Slovak dihaploids		18	114	115	100
Foreign dihaploids	–	–	43	–	–
Wild species	3	4	15	12	13
Domestic landraces	34	34	30	35	32
Total	**289**	**636**	**980**	**931**	**926**

Research on long-term storage in PRBI has been oriented towards:

– the elaboration of effective methods for long-term storage of genetic resources
– the evaluation of the influence of long-term storage on the stability of potato genotypes
– the collecting and maintenance of the accessions
– the regeneration and evaluation of genotypes' changes in the field after long-term storage *in vitro*
– the reduction of unnecessary duplication of accessions within the genebank
– the improvement and completion of the accessible information in the genebank database.

The range of the tasks planned will depend on the State's financial budget. The transformation of research and breeding institutions, which maintained and used plant genetic resources mainly for the creation of new varieties, leads to many new problems. Given the restriction of the budget allocated for the conservation of plant germplasm, genetic resources collections cannot be maintained at the required level. This is followed by a reduction in manpower and in effective technical equipment for the study of genetic resources. In spite of the difficult situation, our team ensures all the necessary work for the preservation of potato germplasm and it is hoped that working conditions will improve in the future.

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Potato genetic resources in Spain

E. Ritter[1], J.I. Ruiz de Galarreta[1], A. Carrasco[3], R. Ruiz de Arkaute[3], J. Veramendi[2] and A. Mingo-Castel[2]

[1]NEIKER A.B.- Instituto Vasco de Investigación y Desarrollo Agrario, Vitoria, Spain
[2]Instituto de Agrobiotecnología y Recursos Naturales, Universidad Pública de Navarra (UPNA), Pamplona, Spain
[3]APPACALE S.A., Burgos, Spain

Potato collections in Spain

Plant genetic resources activities in Spain are globally organized by the Instituto Nacional de Investigación Agraria (INIA) and in particular by one of its institutes, Centro de Recursos Fitogenéticos (CRF). Collections of beans, maize, cereals and many other crops are maintained, evaluated and characterized in the station at Alcala de Henares near Madrid. However, the situation is different for potato. Germplasm collections of potato are maintained in collaborating institutes or private companies. The largest collection with 604 accessions is held at NEIKER (former CIMA, Centro de Investigación y Mejora Agraria), which has been traditionally, as the Station for potato improvement (Estación de la Mejora de la Patata), the cradle of seed potatoes in Spain. Other remarkable collections are maintained at the Public University of Navarra (UPNA), the Instituto de Agrobiotecnología y Recursos Naturales (116 accessions) and the public enterprise APPACALE (213 accessions), which produces seed potatoes and also performs potato breeding in Spain.

The accessions in these germplasm collections consist of modern and old cultivars from Spain and elsewhere, *Solanum* wild species, tetraploid and diploid breeding clones, as well as somatic hybrids involving in part wild species and some transgenic potato clones (Table 1). Old Spanish potato varieties are also maintained.

The accessions are maintained mainly *in vitro* and as tubers. Some wild species are maintained as seeds at NEIKER, and APPACALE maintains part of its material as microtubers (Table 1).

Table 1. Potato germplasm collections in Spain and their maintenance

	NEIKER	UPNA	APPACALE
Cutivars	288	30	151
Wild species	65	0	22
Clones 4?	50	4	12
Clones 2?	139	5	28
Others	62 (somatic hybrids, transgenics)	77 (transgenics)	–
Total no. of accessions	**604**	**116**	**213**
Maintenance			
In vitro	190	116	194
Tubers	414	0	78
Others	27 (seeds)	0	70 (microtubers)

Characterization and evaluation

Most of the genotypes in NEIKER's collection are characterized and have been evaluated agronomically for several years. The characteristics include common characters such as tuber form, eye depth and flower, sprout, skin and tuber flesh colour. Evaluation criteria for agronomic characters consist of vegetative cycle, yield parameters, resistance to viruses, nematodes and *Phytophthora*. The quality for industrial processing as French fries, chips, or for cooking has also been examined in many accessions. Evaluation at UPNA includes molecular characterization, and at APPACALE accessions are evaluated particularly for processing quality and PVY resistance under local conditions (Table 2).

Table 2. Characterization and evaluation of the collections

NEIKER	UPNA	APPACALE
A. 152 cultivars, Arkaute (Alava) cycle, yield parameters, skin colour, tuber flesh colour, tuber form, dry matter, processing quality (French fries, chips, cooking), resistances (PVYn, *G. pallida* 2/3, *P. infestans*)	**A. 77 transgenics** Molecular characterization	**A. 40 cultivars** Processing quality
B. 65 wild species, Arkaute (Alava) Resistances (PVYn, PLRV, PVS, PVM, *G. pallida* 2/3, *P. infestans)*		**B. 49 accessions** Resistance to PVY
C. 61 diploid clones, Arkaute (Alava) cycle, yield parameters, skin color, tuber flesh colour, tuber form, dry matter, resistances (PVYn, *G. pallida* 2/3, *P. infestans)*		

Documentation

All institutions record characterization and evaluation data of their accessions in databases (Table 3). NEIKER is preparing additional documentation about their germplasm collection on the Internet.

Table 3. Documentation of the collections

NEIKER	UPNA	APPACALE
Databases (Microsoft Excel® /Access®) Internet <http://www.Neiker.net> (in preparation)	Database (Access®)	Database (Excel®)

Interinstitutional cooperation, management and funding of the collections

These institutions work in close collaboration to maintain and exchange germplasm or to avoid duplication of entries. Moreover, collaborative links with the main potato collections worldwide have been established in order to provide information and to exchange plant material.

Management of the potato collections and funding sources are summarized in Table 4.

Table 4. Management of the collections

	NEIKER	UPNA	APPACALE
Cleaning of accessions	yes (thermotherapy, meristem culture)	no	yes (thermotherapy, meristem culture)
Virus testing	yes (ELISA)	no	yes (ELISA)
Safety-duplication	4 duplicates *in vitro*, in 2 different chambers	4 duplicates (vessels with 9 plantlets), in 2 chambers	4 duplicates, as microtubers
Sanitary controls	periodically by visual symptoms	visual controls	periodically by visual symptoms
Funding	Basque Government, INIA	UPNA	APPACALE
Rationalization	no duplications, collaboration with Appacale and UPNA	special media allowing plantlets to grow up to 24 months without regeneration	reduced number of duplicates

Research activities

The germplasm collections are used for several research and development activities mainly related to potato breeding at the tetraploid and diploid level and using, besides classical breeding by crossing, somatic hybridization or genetic transformation techniques. Furthermore, NEIKER intensively applies DNA marker technology for variety identification, linkage mapping and QTL analysis for important traits, while UPNA is interested in the production of pharmacological compounds of interest via transgenic potato plants (Table 5).

Several other institutes in Spain carry out research and development activities on potato.

Table 5. Research and Development activities using germplasm collections

NEIKER	UPNA	APPACALE
1. Evaluation of accessions (resistances, physiological characteristics, agronomic and industrial evaluations)	1. Production of pharmacological compounds of interest in transgenic potato plants	1. Breeding of new varieties
2. Use of *Solanum* wild species for sexual and somatic hybridizations in order to transfer resistances or other characters of agronomic or industrial interest	2. Role of hexokinase as glucose sensor and gene expression regulator in carbohydrate metabolism	2. Complementary studies for the breeding programme
3. Breeding of new cultivars based on characterized germplasm accessions	3. Development of a bioassay for *in vitro* tuberization in order to determine maturity classes of new potato clones	
4. Mapping of resistance genes		
5. Application of molecular markers for germplasm characterization, linkage mapping and QTL analysis		

Potato genetic resources in the United Kingdom

S.F. Carnegie[1] and .G Ramsay[2]

[1]Scottish Agricultural Science Agency (SASA), Edinburgh, United Kingdom
[2]Scottish Crop Research Institute (SCRI), Invergowrie, Dundee, United Kingdom

The potato genetic resources of the United Kingdom are maintained, primarily, at two main centres in Scotland:

– **Scottish Crop Research Institute (SCRI)**
The Commonwealth Potato Collection (CPC) is held by SCRI and consists of 1400 accessions of wild species and cultivated South American landrace material which are stored as true seed. It has been very widely used in potato breeding for the introduction of useful genes, including the *H1* for PCN resistance from CPC 1673. The collection was recently augmented by the introduction of additional material from the Birmingham Potato Collection of Professor Hawkes. During the introduction of this material and during the EU genetic resources project RESGEN-CT95-34/45, quarantine testing at the Scottish Agricultural Science Agency (SASA) has enabled over 600 CPC accessions to become freely available within the EU with Plant Passport status as specified by the EU Plant Health Directive 77/93 (latest inventory: Wilkinson *et al.* 1994. Home page: < http://www.scri.sari.ac.uk/cpc/>).

– **Scottish Agricultural Science Agency (SASA)**
The largest collection of named varieties is held by SASA and contains around 1070 varieties varying from very old to modern, protected varieties. The varietal characteristics of more than 650 of these varieties have been documented by MacDonald (1991). The oldest variety in the collection, 'Lumpers', was known to be grown first in 1806. Wilson (1993) describes the history and origin of old potato varieties in the UK. SASA's role in testing new potato varieties for Plant Breeder's Rights and UK National List Trials means that comprehensive data are held for varieties trialled in the UK since the early 1970s. The data consists of 50 botanical characteristics and evaluations of disease and pest susceptibilities and cooking, processing and tuber quality. The varieties are held largely in two field collections for safety-duplication and an *in vitro* collection (nuclear stock) of ca. 320 varieties is also maintained for seed production in Scotland. Maintenance of this latter collection is charged to the industry. A collection of 850 of the varieties derived from nuclear stock are grown annually at an isolated site near Edinburgh and, therefore, has been fully tested according to the requirements of the EU Plant Health Directive. These varieties, and another 230, are also grown at SASA's Gogarbank Farm at Edinburgh. Approximately 33% of the additional 230 varieties may be virus-infected but it is planned to clean up the entire collection by an ongoing virus elimination programme. Home page of SASA: <http://www.sasa.gov.uk/>.

Private breeding companies, such as Northern Ireland Plant Breeders, Cygnet PB, and Caithness Plant Breeders, as well as SCRI, hold working collections of varieties and breeding lines but these do not contain any unique varieties. SCRI also holds dihaploid and *neo-tuberosum* collections. In addition, there are four private hobby collectors who maintain collections of old and relatively new varieties which may be used to provide small quantities of seed for supply to gardeners. All of these latter collections in Scotland will have been derived from material held in the SASA collection.

References

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Research on potato genetic resources in Ukraine

Anatoly A. Podgajetskiy

Ukrainian Institute for Potato Research, Ukrainian Academy for Agricultural Sciences, Nemishaevo, Borodyanka district, Kiev Region, Ukraine

The potato germplasm collection in Ukraine includes 116 domestic varieties, 732 foreign varieties, 128 intervarietal hybrids, 47 local varieties (forms), 326 accessions of 67 wild species and 180 accessions of cultivated species. In 1998–1999 the collection of varieties from Ukraine, Moldova and Belarus increased by 24 accessions. The collection also includes accessions from other countries (Table 1).

Table 1. Potato genetic resources in Ukraine

	Number of accessions
1. Varieties and hybrids, total	1023
including	
- commercial varieties of Ukraine	116
- varieties of foreign countries	732
- local varieties and forms	47
- hybrids	128
2. Cultivated relatives	180
3. Wild species	326
Total no. of accessions in collection	**1529**
Accessions introduced in 1998–1999	**56**
including	
(a) from Ukraine	16
(b) from the CIS	24
(c) from other countries	16

We consider local potato varieties (forms) to be a very valuable source of improvement of the potato germplasm. The results of our research show that they have a very high adaptive potential, including resistance to stress factors. Local varieties (forms) with very high field resistance to viruses, late blight, drought and/or heat develop according to the local ecological and pathogen complex conditions. In the very dry year 1999, accession numbers 766, 767 and 772 of this material had a much higher yield than the best standard varieties. This material also includes very early-maturing forms.

Some Ukrainian breeders widely use local varieties (forms) in their practical work. For example, the variety 'Carpatskyi', which is unique for its resistance to late blight, dry matter content and yield, was selected from a population of a self-pollinated local form harvested in the Carpathians (Vloh 1985). It has very high general and specific combining abilities for many agronomic characters.

In Ukraine many unique local forms could be used as sources of many useful characters. A collecting expedition should be organized but the Institute is currently unable to finance it.

The material held in the collection is studied and every year selected varieties are recommended for practical use. For example, last year we recommended the following varieties for their high phenotypic expression of:

- yield: 'Kosen-95', 'Povin', 'Svitliachok', 'Volgar', 'Orkhideia', 'Lazurit', 'Doina', 'Yagodka', 'Delphin', 'Slovianka', 'Peresvit', 'Charodey'
- high dry matter content: 'Kosen-95', 'Povin', 'Svitanok Kyivsky', 'Obriy', 'Kupava', 'Lubid', 'Prydesnianska', 'Zarevo'
- early maturity: 'Kosen-95', 'Zov', 'Nezabudka', 'Vorotynskiy ranniy', 'Krasnoiarskaia', 'Lazurit', 'Svitliachok', 'Sprint', 'Yagodka'

- large tuber size: 'Borodianska rozheva', 'Povin', 'Vesnianka', 'Kosen-95', 'Poran', 'Udacha', 'Lazurit', 'Sosnovska', 'Slovianka', 'Mylavytsa'
- late blight resistance: 'Hybridnyi 14', 'Mavka', 'Lvovianka', 'Luhovska'
- resistance to virus diseases: 'Nezabudka', 'Nevsky', 'Lybid', 'Slovianka', 'Poliska rozheva'.

We believe that the effective use of genetic resources should be based on an intensive study of their constituents, including use of artificial contamination methods.

We conduct detailed research on the determination of resistance to late blight in the collected material. Unfortunately, only varieties with partial resistance have been selected. The best variety for this character is 'Hybridnyi 14'. Four accessions of the *S. andigenum* species ('UK 251-64', 'UK 251-66', 'UK 251-122' and 'UK 251-133') have a somewhat higher expression of the character.

Recently much attention is paid to long-term resistance to late blight. We believe that it can be screened by testing the material under the conditions of annual late blight epiphytoty occurring in certain years. Besides assessing accessions grown on artificially contaminated background, we test them under the conditions of the Carpathians, which we find as suitable for this type of research as the Toluka valley in Mexico or the island of Sakhalin in Russia.

Weather conditions in the Carpathians (in particular in N. Vorota, where the research was conducted) favour annual late blight epiphytoty (Table 2). In this area, precipitation is high throughout the vegetation period. It rains more than half of the days from April to July. The average air humidity is rather high, especially at an altitude of 1200 meters above sea level. The air temperature is moderate. Therefore, in the absence of a pesticide treatment, the most resistant varieties are fully affected by the fungus in the middle of the vegetation period. It is thus possible to evaluate potato germplasm for its resistance to late blight.

Table 2. Meteorological data for the vegetation period 1997 (village of N. Vorota)

Meteorological data	Months						
	Apr	May	Jun	Jul	Aug	Sep	Oct
650 m above sea level							
Annual precipitation (mm),1997	73.8	194.6	128.7	172.0	66.6	83.9	82.3
Average 1952–1997	72.0	87.0	128.0	112.0	116.0	92.0	92.0
Number of days with precipitation in 1997	21	17	17	18	11	16	18
Average daily air temperature in 1997	9.0	12.7	15.4	16.0	17.0	10.9	4.9
Average air humidity (%) in 1997	72	75	77	79	74	80	80
Average 1952-1997	73	71	68	69	77	73	69
1200 m above sea level							
Annual precipitation (mm),1997	125.3	203.5	90.3	286.3	75.7	70.0	93.4
Average 1952–1997	85.0	97.0	125.0	116.0	118.0	87.0	92.0
Number of days with precipitation in 1997	17	16	12	18	10	11	16
Average 1952–1997	4.2	3.2	12.4	11.4	12.3	6.8	-5.4
Average daily air temperature in 1997	6.1	10.2	16.4	17.6	16.2	12.3	8.6
Average air humidity (%) in 1997	84	82	82	87	87	91	90
Average 1952–1997	79	80	76	81	78	77	75

The collection of potato wild species is evaluated for resistance to late blight (*Phytophthora infestans* (Mont.) de Bary) using intensive methods of artificial contamination, specifically on sprouts, seedlings, adult plants and tubers. Species that are promising as sources of resistance are selected: for foliage resistance, *S. antipoviczii, S. bulbocastanum, S. cardiophyllum, S. demissum, S. hjertingii, S. fendleri, S. polytrichon, S. polyadenium, S. stoloniferum, S. simplicisolium, S. verrucosum;* and for tuber resistance: *S. bulbocastanum, S. brachycarpum, S. capsicibaccatum, S. cardiophyllum, S. demissum, S. hjertingii* and *S. micboacanum* (Podgajetskiy 1995a; Podgajetskiy 1995b).

To evaluate wild potato species for resistance to *Fusarium sambucinum* Fuck., artificial

contamination of the tubers is carried out. The species with a high average expression of resistance and with high frequency (10% and more) of seedlings split without symptoms of affection are selected. *S. boergeri, S. coriaceifoliolatum, S. demissum, S. gourlai, S. kurtzianum, S. polytrichon, S. sparsipillum, S. vernei* and *S. verrucosum* belong to this group (Podgajetskiy and Koval 1990).

Resistance to virus diseases is an important character in potato. The Ustimovskaia Experimental Station offers optimal conditions for this research. An artificial infection background is prepared there for testing breeding and prebreeding material. Valuable results have been obtained by a post-graduate student on this topic.

Besides the generally adopted classification of potato germplasm (wild and cultivated species, endemic and aboriginal forms, varieties), we also distinguish between starting prebreeding material and starting breeding material.

Involvement of relatives of cultivated species into breeding is a time-consuming and labour-intensive process. We first obtain hybrids from interspecific crosses (primary interspecific hybrids). Subsequently the genetic basis of this material can be widened by involving new species (secondary interspecific hybrids). Backcrossing of the primary and secondary interspecific hybrids is obligatory to obtain cultivated forms. As a rule, single or double backcrosses are inferior to the material from intervarietal crossing for a complex of economic characters. But they have a high / very high expression of one or several characters. These forms correspond to the starting prebreeding material.

During the breeding of varieties by intraspecific hybridization (even with varieties and interspecific hybrids), checking of the hereditary transmission of the main agronomic characters, creation of donors, obtainment of interspecific hybrids with a high degree of backcrossing, etc., the forms that have one or several negative characters and therefore cannot be recognized as varieties, are separated. However they are highly adapted to certain ecological and pathogen conditions and they are able to transmit valuable characters to their progeny. These forms correspond to the starting breeding material (Podgajetskiy 1995c).

A great number of primary and secondary interspecific hybrids have been obtained. Some of them meet the requirements as sources of resistance to late blight or to dry *Fusarium sambucinum* rot. Donors of one or even several characters are selected among the starting breeding material. Many of the created forms surpass standard varieties in yield, starch and protein contents, tuber set and size, as well as resistance to late blight (foliage and tubers), Fusarium dry rot, black leg, ring rot, potato golden or stem nematodes and virus diseases.

The best backcrosses are widely used in breeding.

References

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Appendix I. Descriptors for the European database of potato varieties and breeding lines[5]

Accession name
Either a registered or other formal unique designation given to an accession within a collection.

All entries will be in proper case i.e. first letter of each variety upper case and the rest lower case. If variety names consist of more than one word then first letter of each word will be in upper case.

Variety name must be written in full.

Synonym
Any other name by which the variety is known.

Accession number
This number serves as a unique identifier for accessions and is assigned when an accession is entered into a collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number is still not available for re-use.

Parentage
The mother x father cross from which the accession was derived, or if a mutant, the variety from which it was selected.

The parentage should be denoted as mother x father.

A lower case x should be used between parents.

All entries to be in proper case.

Country of origin
Name of the country in which the variety was originally bred.

Use the ISO 3 letter country codes.

National listing date
Date of national listing.

Only the entry date should be cited.

Plant material maintained as

1 Tuber
2 *In vitro*
3 Cryopreservation
4 Tuber and *in vitro*
5 Tuber and cryopreservation
6 *In vitro* and cryopreservation
7 Tuber, *in vitro* and cryopreservation

Plant health directive EC77/93 requirements

1 Fully tested
2 Part tested
3 Infected
4 Untested

Plant breeders rights

1 Yes
2 No

Data source
Code of the Institute where the accession is maintained or where the information about the accession has come from.

[5] The European database of potato varieties and breeding lines is maintained by the Scottish Agricultural Science Agency (SASA), Edinburgh, United Kingdom.

Breeder

Sample status

1 Wild
2 Weedy
3 Traditional cultivar/landrace
4 Breeder's line
5 Advanced cultivar

Test conditions

1 Organic
2 Non organic

Remarks

Any other information.

PLANT CHARACTERISTICS

Maturity

1 Very late
2 Very late to late
3 Late
4 Late to intermediate
5 Intermediate
6 Intermediate to early
7 Early
8 Early to very early
9 Very early

Growth habit

1 Very erect
2 Very erect to erect
3 Erect
4 Erect to semi erect
5 Semi erect
6 Semi erect to spreading
7 Spreading
8 Spreading to very spreading
9 Very spreading

Foliage cover

1 Sparse
2 Sparse to poor
3 Poor
4 Poor to moderate
5 Moderate
6 Moderate to good
7 Good
8 Good to dense
9 Dense

Flower frequency

1 No flowers
2 Very rare
3 Rare
4 Rare to occasional
5 Occasional
6 Occasional to frequent
7 Frequent
8 Frequent to very frequent
9 Very frequent

Flower colour

1 White
2 Red violet
3 Blue violet
4 Light blue

Pollen fertility

1 Sterile
2 Very low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Berries

1 No berries
2 Very rare
3 Rare
4 Rare to occasional
5 Occasional
6 Occasional to frequent

7 Frequent
8 Frequent to very frequent
9 Very frequent

TUBER CHARACTERISTICS

Tuber shape

1 Round
2 Oval to round
3 Oval
4 Oval to long
5 Long to oval
6 Very long

Tuber skin colour

1 White to yellow
2 Red
3 Blue
4 Part red
5 Part blue

Tuber eye colour

1 Yellow
2 Red
3 Blue

Light sprout colour

Colour when sprouted under prescribed light conditions.

1 Pink
2 Blue
3 Green

Primary tuber flesh colour

Colour of flesh excluding vascular tissue.

1 White
2 Cream
3 Light yellow
4 Yellow
5 Deep yellow
6 Blue
7 Red

Secondary tuber flesh colour

Colour of the vascular tissue.

1 White
2 Cream
3 Light yellow
4 Yellow
5 Deep yellow
6 Blue
7 Red

Tuber eye depth

1 Very deep
2 Very deep to deep
3 Deep
4 Deep to medium
5 Medium
6 Medium to shallow
7 Shallow
8 Shallow to very shallow
9 Very shallow

Tuber skin texture

1 Very russet
2 Russet
3 Rough
4 Rough to intermediate
5 Intermediate
6 Intermediate to smooth
7 Smooth
8 Smooth to very smooth
9 Very smooth

Dormancy period

1 Very short
2 Very short to short
3 Short
4 Short to medium
5 Medium
6 Medium to long
7 Long
8 Long to very long
9 Very long

Resistance to external damage

1 Very susceptible
2 Very susceptible to susceptible
3 Susceptible
4 Susceptible to moderate
5 Moderate
6 Moderate to resistant
7 Resistant
8 Resistant to very resistant
9 Very resistant

Resistance to internal bruising

1 Very susceptible
2 Very susceptible to susceptible
3 Susceptible
4 Susceptible to moderate
5 Moderate
6 Moderate to resistant
7 Resistant
8 Resistant to very resistant
9 Very resistant

Storage ability

1 Very poor
2 Very poor to poor
3 Poor
4 Poor to moderate
5 Moderate
6 Moderate to good
7 Good
8 Good to very good
9 Very good

Tuber glycoalkaloid

1 Very high
2 Very high to high
3 High
4 High to medium
5 Medium
6 Medium to low
7 Low
8 Low to very low
9 Very low

UTILIZATION CHARACTERISTICS

Cooking type

1 Firm (salad type)
2 Fairly firm (multi-purpose type)
3 Mealy (floury type)
4 Very mealy (floury type)
5 Firm (salad type) and fairly firm (multi-purpose type)
6 Fairly firm (multi-purpose type) and mealy (floury type)
7 Mealy (floury type) and very mealy (floury type)

After cooking blackening

1 Severe
2 Severe to some
3 Some
4 Some to little
5 Little
6 Little to trace
7 Trace
8 Trace to none
9 None

Frying colour

1 Very dark
2 Very dark to dark
3 Dark
4 Dark to medium
5 Medium
6 Medium to pale
7 Pale
8 Pale to very pale
9 Very pale

Crisp suitability

1 Very poor
2 Very poor to poor
3 Poor
4 Poor to moderate
5 Moderate
6 Moderate to good
7 Good
8 Good to very good
9 Very good

French fry suitability

1 Very poor
2 Very poor to poor
3 Poor
4 Poor to moderate
5 Moderate
6 Moderate to good
7 Good
8 Good to very good
9 Very good

Enzymic browning

1 Severe
2 Severe to some
3 Some
4 Some to little
5 Little
6 Little to trace
7 Trace
8 Trace to none
9 None

Dry matter content

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Starch content

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Protein content

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Taste

1 Very poor
2 Very poor to poor
3 Poor
4 Poor to moderate
5 Moderate
6 Moderate to good
7 Good
8 Good to excellent
9 Excellent

TUBERING CHARACTERISTICS

Yield potential

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Early harvest yield potential

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Adaptability

1 Very narrow
2 Very narrow to narrow
3 Narrow
4 Narrow to medium
5 Medium
6 Medium to wide
7 Wide
8 Wide to very wide
9 Very wide

Rate of bulking

1 Very slow
2 Very slow to slow
3 Slow
4 Slow to medium
5 Medium
6 Medium to fast
7 Fast
8 Fast to very fast
9 Very fast

Tubers per plant

1 Very few
2 Very few to few
3 Few
4 Few to medium
5 Medium
6 Medium to many
7 Many
8 Many to very many
9 Very many

Tuber size

1 Very small
2 Very small to small
3 Small
4 Small to medium
5 Medium
6 Medium to large
7 Large
8 Large to very large
9 Very large

Tuber shape uniformity

1 Very variable
2 Very variable to variable
3 Variable
4 Variable to medium
5 Medium
6 Medium to uniform
7 Uniform
8 Uniform to very uniform
9 Very uniform

Secondary growth

1 Very high
2 Very high to high
3 High
4 High to medium
5 Medium
6 Medium to low
7 Low
8 Low to very low
9 Very low

Hollow heart tendency

1 Very high
2 Very high to high
3 High
4 High to medium
5 Medium
6 Medium to low
7 Low
8 Low to very low
9 Very low

Growth cracking

1 Very high
2 Very high to high
3 High
4 High to medium
5 Medium
6 Medium to low
7 Low
8 Low to very low
9 Very low

Tuber greening before harvest

1 Very high
2 Very high to high
3 High
4 High to medium
5 Medium
6 Medium to low
7 Low
8 Low to very low
9 Very low

Length of stolons

1 Very long
2 Long to very long
3 Long
4 Medium to long
5 Medium
6 Short to medium
7 Short
8 Very short to short
9 Very short

Attachment of stolons

1 Very strong
2 Very strong to strong
3 Strong
4 Strong to medium
5 Medium
6 Medium to loose
7 Loose
8 Loose to very loose
9 Very loose

Internal rust spot

1 Very frequent
3 Frequent
5 Medium
7 Infrequent
9 Very infrequent

RESISTANCE TO FUNGAL DISEASES

Resistance to common scab (*Streptomyces scabies*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to dry rot (*Fusarium* spp.)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to early blight (*Alternaria solani*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to fusarium wilt (*Fusarium oxysporum*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to gangrene (*Phoma foveata*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to late blight on foliage (*Phytophthora infestans*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Presence of late blight R gene

1 Present
9 Not present

Resistance to late blight on tubers (*Phytophthora infestans*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to stem canker (*Rhizoctonia solani*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to powdery scab (*Spongospora subterranea*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Wart (*Synchytrium endobioticum*)

1 Susceptible
2 Field immune

Field immunity to wart races

Field immunity to wart races where these have been specified. Enter the numerical value corresponding to the race, e.g. 1 for race 1, 2 for race 2, etc.

Susceptibility to wart races

Susceptibility to wart races where these have been specified. Enter the numerical value corresponding to the race, e.g. 1 for race 1, 2 for race 2, etc.

RESISTANCE TO BACTERIAL DISEASES

Resistance to bacterial soft rot (*Erwinia* spp.)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to bacterial wilt (*Pseudomonas solanacearum*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to blackleg (*Erwinia* spp.)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to ring rot (*Corynebacterium sepedonicum*)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

RESISTANCE TO VIRUS DISEASES

Resistance to potato leaf roll virus

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to mop top virus

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to tobacco rattle virus

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to potato virus A

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to potato virus B

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to potato virus C

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to potato virus M

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to potato virus S

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to potato virus X

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to potato virus Y (strain not specified)

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to potato virus Yn

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

RESISTANCE TO PESTS

Resistance to *Globodera rostochiensis* race 1

1 Very low
2 Very low to low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Resistance to *Globodera rostochiensis* race 2

1 Very low
2 Very low to low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Resistance to *Globodera rostochiensis* race 3

1 Very low
2 Very low to low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Resistance to *Globodera rostochiensis* race 4

1 Very low
2 Very low to low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Resistance to *Globodera rostochiensis* race 5

1 Very low
2 Very low to low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Resistance to *Globodera pallida* race 1

1 Very low
2 Very low to low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Resistance to *Globodera pallida* race 2

1 Very low
2 Very low to low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Resistance to *Globodera pallida* race 3

1 Very low
2 Very low to low
3 Low
4 Low to moderate
5 Moderate
6 Moderate to high
7 High
8 High to very high
9 Very high

Resistance to aphids

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to slugs

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Resistance to tuber moth

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

RESISTANCE TO ENVIRONMENTAL STRESS FACTORS

Drought resistance

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Frost resistance

1 Very low
2 Very low to low
3 Low
4 Low to medium
5 Medium
6 Medium to high
7 High
8 High to very high
9 Very high

Appendix II. Proposal to ECP/GR Steering Committee for the establishment of an ECP/GR Working Group on Potato

Wageningen, 19 May 1998.

Ir. R. Hoekstra
(coordinator RESGEN-CT95-34/45)
CPRO-DLO / CGN
P.O. Box 16
NL - 6700 AA Wageningen
Tel: +31-317-477077
Fax: +31-317-418094
Email: r.hoekstra@cpro.dlo.nl

Dear committee members,

Proposal for ECP/GR Steering Committee for the establishment of an ECP/GR potato working group

Background

- The potato is the second most important crop after wheat in Europe and the fourth crop world wide. It exceeds all other crops in annual production of starch, protein, vitamins and several other important nutrients (Niederhauser, 1993). It is vegetatively propagated, which raises particular problems in the genetic resources activities (e.g. EU regulations on quarantine organisms).
- At the sixth meeting of the Technical Consultative Committee of ECP/GR in Nitra on 21-23 September 1995 a network was established entitled: 'Industrial crops and potato network'. However, ECP/GR has not yet established a working group for potato.

EU project on potato genetic resources

Since March 1996 the European Commission is funding a 4 years project in the framework of 1467/94 entitled: 'Genetic Resources of Potato including conservation, characterization and utilization of secondary potato varieties for ecological production systems in Europe'. The 12 contractors are from 7 EU countries (appendix 1).
ECP/GR additionally supports 5 East European institutes (appendix 2) to participate in the annual progress meetings and carry out some research within the goals of the project.

The main issues from the second progress meeting (5/6-3-1998) are:

- the participants reported on rejuvenation, virus cleaning, evaluations etc. NGO's will conduct ecological field trials in the last two years.
- the database on clonal potato stocks (cultivars and breeding lines), developed at SASA (see appendix 1) and the database on wild & primitive species, developed at CGN, are progressing.
- **the participants expressed strong concern about the continuation of the work and its coordination after the project will end in February 2000**.

Proposal

It is proposed to set up in the framework of the ECP/GR Programme a Potato Working Group. As the EU potato genetic resources project is due to end early 2000 it is suggested to use the final meeting of the EU project as the starting point of the proposed ECP/GR working group. The Potato Working Group may include those partners of the EU project who maintain a substantial number of potato accessions, the 5 partners of East European countries (appendix 2) as well as institutions from other European countries holding substantial potato collections (appendix 3).

A positive reaction from ECP/GR Steering Committee would be highly appreciated and would allow the continuation of the coordination of potato genetic resources work, preventing a vacuum at the end of the current EU project.

The goals of the potato working group follow the EU project on coordination and extension of potato genetic resources conservation activities:

Further development of the central databases
Improvement of health status of potato genetic resources
Characterization/evaluation of potential genetic resources for quality traits and resistance against pests and diseases
Rationalization of potato collections included in the network
Diffusion of material and results.

References

Niederhauser, J.S., 1993. International cooperation and the role of the potato in feeding the world. Amer. Potato J. 70: 385-403.
Homepage RESGEN-CT95-34/45 http://www.cpro.dlo.nl/cgn/eupotato/

APPENDIX 1

12 contractors of RESGEN-CT95-34/45

The Netherlands	Centre for Genetic Resources The Netherlands (CPRO-DLO/CGN), Wageningen.
	SSA (= Foundation for the Stimulation of Potato research), Zeist.
France	INRA, Station d'amélioration de la pomme de terre et des plantes à bulbes. Kéraïber, Ploudaniel.
Nordic countries	Nordic Genebank, Alnarp, Sweden (incl. Denmark, Finland, Iceland, Norway).
UK	Scottish Agricultural Science Agency (SASA), East Craigs, Edinburgh.
	Scottish Crop Research Institute (SCRI), Dundee.
	Henry Doubleday Research Association (HDRA), Coventry.
Ireland	Teagasc, Oak Park Research Centre, Carlow.
Germany	Institut für Pflanzengenetik und Kulturpflanzenforschung Gatersleben, - Genbank Außenstelle Nord - Groß Lüsewitz.
	Institut für Pflanzenbau, Bundesforschungsanstalt für Landwirtschaft Braunschweig-Völkenrode (FAL), Braunschweig.
	Landesanstalt für Großschutzgebiete des Landes Brandenburg (LAGS), Eberswalde.
Austria	ARCHE NOAH, Schloß Schiltern.

APPENDIX 2

ECP/GR supported East European partners of RESGEN-CT95-34/45

Czech Republic	Potato Research Institute, Havlíckuv Brod.
Hungary	Pannon Univ. of Agricultural Sciences, Georgikon Faculty, Dept. for Potato Research, Keszthely.
Poland	Potato Research Institute, Mlochów Research Center, Rozalin.
Ukraine	Institute for Potato Research of the Ukrainian Academy of Agricultural Sciences., Nemeshaevo, Kiev region.
Russia	N.I. Vavilov Research Institute, St. Petersburg.

APPENDIX 3

Other European countries/institutions holding substantial potato collections

Bulgaria	Institute of Plant Introduction and genetic resources, Sadovo. Experimental Station for potatoes and flax, Samokov.
Ireland	Dept. of Agriculture, Food and Forestry, The Topps, Raphoe, Donegal.
Italy	Consorzio provinciale per la valorizzazione delle produzioni agricole (CPVPA) 'Mario Neri', Imola.
Latvia	Priekuli State Plant Breeding Station, Priekuli.
Lithuania	Lithuanian Institute of Agriculture, Dotnuva-Akademija.
Romania	Genebank of Suceava.
Slovakia	Potato Research and Breeding Institute, Velká Lomnica.
Slovenia	Agric. Institute of Slovenia, Ljubljana.
Spain	Centro de Investigacion y Mejora Agria (CIMA)- Granja Modelo de Arkaute (Alava), Vitoria-Gasteiz.

Agenda

First meeting of the ECP/GR Working Group on Potato, jointly held with the Final meeting of the EU-funded project on potato genetic resources, RESGEN-CT95-34/45
Wageningen, The Netherlands, 23-25 March 2000

Thursday 23 March

Final meeting of the EU-funded project RESGEN-CT95-34/45

- Welcome address on behalf of Plant Research International / CGN
- Introduction of the participants
- Review of achievements of EU potato project RESGEN-CT95-34 / 45

Friday 24 March

Excursion by bus to visit one or more breeding companies in Emmeloord

- Introduction to ECP / GR (*R. Hoekstra*)

- National collections status reports

Belgium (*J.L. Rolot*)
Czech Republic (*J. Domká?ová*)
Estonia (*K. Kotkas)*
France (*D. Ellissèche*)
Germany (*K. Schüler*)
Hungary *(Z. Polgár)*
Ireland (*H.W. Kehoe*)
Italy (*L. Frusciante*)
The Netherlands (*R. Hoekstra*)
Nordic countries (*M. Veteläinen and K. Tolstrup)*
Poland (*J. Lewosz*)
Russia (*S. Kiru*)
Slovakia (*K. Foresikova*)
Spain (*E. Ritter Azpitarte*)
Ukraine (*A. Podgaetsky*)
United Kingdom (*S. Carnegie*)

Saturday 25 March

- National collections status reports (continued)

- Scientific research on potato genetic resources

- Formulation of workplan
  -database and Internet activities
  -virus cleaning (clonal stocks) and regeneration (wild species)
  -maintenance responsibilities
  -safety-duplication
  -characterization / evaluation
  -rationalization of collections
  -other research activities

- Election of Working Group Chair and Vice-Chair

Acronyms and abbreviations

AFLP	amplified fragment length polymorphism
APIC	Association of Potato Intergenebank Collaborators
APLV	Andean potato latent virus
ASSINSEL	Association internationale des sélectionneurs, Switzerland
AVB-O	Arracacha virus B - oca strain
BAGKF	Bundesanstalt für Getreide-, Kartoffel- und Fettforschung (Federal Centre for Cereal, Potato and Lipid Research), Detmold, Germany
BAZ	Federal Centre for Breeding Research on Cultivated Plants, Germany
BBA	Biologische Bundesanstalt für Land- und Forstwirtschaft, Braunschweig. Germany
BGRC	Braunschweig Genetic Resources Collection, Germany
BLBP	Bayerische Landesanstalt für Bodenkultur und Pflanzenbau, Germany
CBD	Convention on Biological Diversity
CEEM	Cornell University-Eastern Europe-Mexico late blight research collaboration project
CGA	cholorogenic acid
CGN	Centre for Genetic Resources, The Netherlands
CIMA	Centro de Investigación y Mejora Agraria, Spain
CIP	Centro Internacional de la Papa (International Potato Centre), Peru
CIS	Commonwealth of Independent States
COA	Commissie ter bevordering van het kweken en het onderzoek van nieuwe aardappelrassen (Commission for the promotion of breeding and research of new potato varieties), The Netherlands
CPC	Commonwealth Potato Collection
CPRO	Centrum voor Plantenveredelings- en Reproduktieonderzoek (Centre for Plant Breeding and Reproduction Research), The Netherlands
CRF	Centro de Recursos Fitogenéticos, Spain
CRPV	Centro Ricerche Produzioni Vegetali, Imola, Italy
DAS-ELISA	double-antibody sandwich enzyme-linked immunosorbent assay
DHs	dihaploids
DNA	desoxyribonucleic acid
DPBF	Danish Potato Breeding Foundation, Vandel, Denmark
EAPR	European Association for Potato Research
EBN	endosperm balance number
EBS	Erwin Baur Sortiment (Erwin Baur Collection), Germany
ECP/GR	European Cooperative Programme for Crop Genetic Resources Network
ELISA	enzyme-linked immunosorbent assay
ENEA	Ente Nazionale Energie Alternative, Rome, Italy
EU	European Union
EVIKA	Plant Biotechnological Research Centre, Estonian Agricultural University, Harjumaa, Estonia
FAO	Food and Agriculture Organization of the United Nations, Rome, Italy
GA_3	gibberellic acid
GLKS	Gross Lüsewitz Potato Collection
HDRA	Henry Doubleday Research Association, UK
IAA	indole-3-acetic acid

IBVL	Institute for Storage and Processing of Agricultural Produce, Wageningen
IHAR	Plant Breeding and Acclimatization Institute, Poland
INIA	Instituto Nacional de Investigación Agraria, Spain
INRA	Institut national de la recherche agronomique, France
INTA	Instituto Nacional de Tecnología Agropecuaria, Argentina
IPK	Institute of Plant Genetics and Crop Plant Research, Germany
ISCI	Istituto Sperimentale per le Colture Industriali, Bologna, Italy
IvP	Institute for Plant Breeding, The Netherlands
LAGS	Landesanstalt für Großschutzgebiete des Landes Brandeburg, Germany
MS medium	Murashige and Skoog medium
MTA	Material Transfer Agreement
MTT	Agricultural Research Centre, Finland
NAK	Dutch General Inspection Service
NGB	Nordic Gene Bank, Sweden
NPDB	Nordic Potato Database
PBI	Plant Breeding Institute, Jõgeva, Estonia
PBRSV	Potato black ringspot virus
PCN	Potato cyst nematode
PCR	polymerase chain reaction
PGR	plant genetic resources
PLRV	Potato leafroll virus
PMTV	Potato mop-top virus
PRI	Potato Research Institute, Havlí?k?v Brod, Czech Republic
PSTV	Potato spindle tuber viroid
PSTVd	Potato spindle tuber viroid
PVA	Potato virus A
PVM	Potato virus M
PVS	Potato virus S
PVT	Potato virus T
PVX	Potato virus X
PVY	Potato virus Y
PVYn	Potato virus Y, strain n
PYV	Potato yellowing virus
QTL	quantitative trait loci
RAPD	random amplified polymorphic DNA
RIVRO	Rijksinstituut van Rassenonderzoek van Cultuurgewassen, The Netherlands
SASA	Scottish Agricultural Science Agency, Edinburgh, UK
SCRI	Scottish Crop Research Institute, Invergowrie, Dundee, UK
SGGW	Warsaw Agricultural University, Poland
SVP	Stichting voor Plantenveredeling, Wageningen, The Netherlands
TCA	Glycoalcaloids
TRV	Tobacco rattle virus (spraing)
UPNA	University of Navarra, Spain
UPOV	Union pour la protection des obtentions végétales, Switzerland
VIR	N.I. Vavilov Research Institute of Plant Industry, Russia
WAC	Wageningse Aardappel Collectie (Wageningen Potato Collection), The Netherlands

List of Participants

ECP/GR Working Group Members

Jean-Louis Rolot
Agricultural Research Centre of Gembloux
Animal Production and Farming Systems
100, rue de Serpont
6800 Libramont
Belgium
Tel: (32-61) 231016/231010
Fax: (32-61) 231028
Email: rolot@cragx.fgov.be

Jaroslava Domká?ová
Potato Research Institute
Havlí?k?v Brod Ltd.
Dobrovského 2366
580 01 Havlí?k?v Brod
Czech Republic
Tel: (420-451) 466227
Fax: (420-451) 21578
Email: domkarova@vubhb.cz

Karl Tolstrup
Landbrugets Kartoffelfond/LKF
Danish Potato Breeding Foundation
Grindstedvej, 55
7184 Vandel
Denmark
Tel: (45-75) 885533
Fax: (45-75) 885615
Email: kt@lkfvandel.dk

Katrin Kotkas
Plant Biotechnological Research Centre EVIKA
Estonian Agricultural University
Teaduse 6-a
75501 Saku, Harjumaa
Estonia
Tel: (372-2) 721484
Fax: (372-2) 721136
Email:katrin.kotkas.002@mail.ee

Daniel Ellissèche
INRA
Amélioration de la Pomme de terre
Domaine de Keraïber
29260 Ploudaniel
France
Tel: (33) (0)229626311 (personal)/
(0)229626310 (reception)
Fax: (33) (0)229 626330
Email: ellissec@rennes.inra.fr

Konrad Schüler
Institute of Plant Genetics and Crop Plant Research (IPK)
External Station North
Parkweg, 1
18190 Gross Lüsewitz
Germany
Tel: (49-38209) 80525
Fax: (49-38209) 80525
Email: genbank.luesewitz@t-online.de

Zsolt Polgár
(Representing Sandor Horvath)
Regional Potato Research Centre
Georgikon Faculty of Agriculture
University of Veszprém
Festetick Gy. u.7
8360 Keszthely
Hungary
Tel: (36-83) 311290/231
Fax: (36-83) 311231
Email: polg-cz@georgikon.hu

Henry W. Kehoe
Plant Breeding Department, Teagasc
Oak Park Research Centre
Carlow
Ireland
Tel: (353-503) 70224/00
Fax: (353-503) 42423
Email: hkehoe@oakpark.teagasc.ie

Luigi Frusciante
Cattedra di Coltivazioni Erbacee e
Miglioramento Genetico
Università di Portici
Via Università 100
80055 Portici NA
Italy
Tel: (39) 081 7885411
Fax: (39) 081 7753579
Email: fruscian@unina.it

Roel Hoekstra
Plant Research International
Centre for Genetic Resources, the Netherlands
(CGN)
PO Box 16
6700 AA Wageningen
The Netherlands
Tel: (31-317) 477077
Fax: (31-317) 418094
Email: r.hoekstra@plant.wag-ur.nl

Merja Veteläinen
Nordic Gene Bank
PO Box 41
23053 Alnarp
Sweden
Tel: (46-40) 536640/536644 (direct)
Fax: (46-40) 536650
Email: merja@ngb.se

Jerzy Lewosz
IHAR Branch Division – Bonin
IHAR Bonin
76009 Bonin
Poland
Tel: (48-94) 3423031/3426997
Fax: (48-94) 3427028
Email: iziem@man.koszalin.pl

Kvetoslava Forï?eková
(representing Eva Brutovská)
Potato Research and Breeding Institute - VSUZ
Popradská 518
059 52 Ve¢ká Lomnica
Slovakia
Tel: (421-968) 61138/61204
Fax: (421-968) 61254
Email: Forisek@kk.sinet.sk

Enrique Ritter Azpitarte
Neiker Centro Arcaute
Apdo. 46
01080 Vitoria-Gasteiz
Spain
Tel: (34-945) 281422/121381
Fax: (34-945) 281422
Email: eritter@neiker.net

Stuart Carnegie
Scottish Agricultural Science Agency (SASA)
East Craigs
Edinburgh EH12 8NJ
United Kingdom
Tel: (44-131) 2448858
Fax: (44-131) 2448940
Email: stuart.carnegie@sasa.gov.uk

Observers

Christoph Schauer
Arche Noah
Obere Strasse 40
3553 Schloss Schiltern
Austria
Tel: (43-2734) 8626
Fax: (43-2734) 8627
Email: arche.noah@Eunet.at

Holger Junghans
(ASSINSEL)
Norika
Nording Kartoffelzucht- und Vermehrungs
GmbH
Parkweg 4
18190 Gross Lüsewitz
Germany
Tel: (49-38209) 47600
Fax: (49-38209) 47666
Email: info@NORIKA.de

Reinhold Jacobs
Landschaftspflege GmbH Lenzen/E
Bahnhofstrasse
19309 Lenzen/E.
Germany
Tel: (49-38792) 9240
Fax: (49-38792) 92444
Email:val-lenzenelbe@t-online.de

Rudolf Vögel
Landesanstalt für Großschutzgebiete des Landes Brandeburg (LAGS)
Stadtsee 1-4
16225 Eberswalde
Germany
Tel: (49-3334) 5822311
Fax: (49-3334) 582244
Email:
Rudi.Voegel@muur-lags.brandenburg.de

Jan P. van Loon
Stichting Stimulering
Aardappelonderzoek
PO Box 909
3700 AX Zeist
The Netherlands
Tel: (31-527) 635004
Fax: (31-527) 635303
Email: jpv.loon@hettema.nl

Stepan Kiru
N.I. Vavilov Research Institute of Plant Industry (VIR)
44, Bolshaya Morskaya Str.
190000 St. Petersburg
Russian Federation
Tel: (7-812) 3144848
Fax: (7-812) 3118762
Email: s.kiru@vir.nw.ru

Anatoly A. Podgajetskiy
Ukrainian Institute for Potato Research
Ukrainian Academy for Agricultural Sciences
22 Chkalov Str., Nemishaevo
255740 Borodyanka district, Kiev Region
Ukraine
Tel: (380-4477) 41533
Fax: (380-4477) 41542
Email: upri@visti.com

Maureen McCreath
SASA
Potato Section
Scottish Agricultural Science Academy
East Craigs
Edinburgh EH12 8NJ
United Kingdom
Tel: (44-131) 2448938
Fax: (44-131) 2448940
Email: maureen.mccreath@sasa.gov.uk

Richard Manchett
Field Trials Officer
Henry Doubleday Research Association (HDRA)
Ryton Organic Gardens
Ryton on Dunsmore, Coventry CV8 3LG
United Kingdom
Tel: (44-24) 7630 3517
Fax: (44-24) 7663 9229
Email: Rmanchett@hdra.org.uk

Gavin Ramsay
Scottish Crop Research Institute (SCRI)
Invergowrie
Dundee DD2 5DA
United Kingdom
Tel: (44-1382) 562731
Fax: (44-1382) 562426
Email: g.ramsay@scri.sari.ac.uk

ECP/GR Working Group Members unable to attend

Dimitrios Karafyllidis
Agricultural Research Centre Makedonia
Department of Horticultural Crops
Thermi
57001 Thessaloniki
Greece
Tel: (30-31) 471544
Fax: (30-31) 471209

Sándor Horváth
Regional Potato Research Centre
Georgikon Faculty of Agriculture
University of Veszprém
Festetics Gy. u. 7.
8360 Keszthely
Hungary
Tel: (36-83) 311 231
Fax: (36-83) 311 231
Email: hs@georgikon.hu

Juozas Jundulas
Vokes Filialas
Zalioji a.1, Traku voke
4002 Vilnius
Lithuania
Tel: (370-2) 645439
Fax: (370-2) 645439
Email: vokefil@takas.lt

Noel Azzopardi
Block D, Department of Agriculture Research and Development Centre
Ghammieri, Marsa
Malta
Tel: (356) 244350
Fax: (356) 442587
Email: noel.azzopardi@magnet.mt

Dumitru Bodea
Agricultural Research Station of Suceava
B-dul 1 Decembrie, no. 15
5800 Suceava
Romania
Tel: (40-30) 210573
Fax: (40-30) 222879

Eva Brutovská
Potato Research and Breeding Institute—VSUZ
Popradská 518
059 52 Vel'ká Lomnica
Slovakia
Tel: (421-968) 4561133
Fax: (421-968) 4561254
Email: forisek@sinet.sk

Drago Milosevic
ARI SERBIA
Potato Research Center
Albanske spomenice 21
32230 Guca
F.R. Yugoslavia
Tel: (381-32) 854086
Fax: (381-32) 854086

New members (nominated after the meeting)

Beate Koller
ARCHE NOAH,
Gesellschaft zur Erhaltung der Kulturpflanzen & deren Entwicklung
Obere Strasse 40
3553 Schloss Schiltern
Austria
Tel: (43-2734)8626/10
Fax: (43-2734)8627
Email: info@arche-noah.at

Sophocles Gregoriou
Agricultural Research Institute (ARI)
PO Box 2016
1516 Nicosia
Cyprus
Tel: (357-2) 305101
Fax: (357-2) 316770
Email: sophocles@arinet.ari.gov.cy

Peter Dolnicar
Biotehniška fakulteta
Oddelek za agronomijo
Jamnikarjeva 101
1000 Ljubljana
Slovenia
Tel: (386-1) 1375 375
Fax: (386-61) 1375 413
Email: peter.dolnicar@kis-h2.si

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