European Cooperative Programme for Crop Genetic Resources Networks

ECP/GR

Report of a Vegetables Network

IPGRI

Joint Meeting with an *ad hoc* group on Leafy Vegetables, 22–24 May 2003, Skierniewice, Poland

G. Thomas, D. Astley, I. Boukema, M.C. Daunay, A. Del Greco, M.J. Díez, W. van Dooijeweert, J. Keller, T. Kotlińska, A. Lebeda, E. Lipman, L. Maggioni and E. Rosa, *compilers*

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

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The International Plant Genetic Resources Institute (IPGRI) is an independent international scientific organization that seeks to improve the well-being of present and future generations of people by enhancing conservation and the deployment of agricultural biodiversity on farms and in forests. It is one of 15 Future Harvest Centres supported by the Consultative Group on International Agricultural Research (CGIAR), an association of public and private members who support efforts to mobilize cutting-edge science to reduce hunger and poverty, improve human nutrition and health, and protect the environment. IPGRI has its headquarters in Maccarese, near Rome, Italy, with offices in more than 20 other countries worldwide. The Institute operates through four programmes: Diversity for Livelihoods, Understanding and Managing Biodiversity, Global Partnerships, and Improving Livelihoods in Commodity-based Systems.

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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 facilitating the long-term conservation and the increased utilization of plant genetic resources in Europe. The Programme, which is entirely financed by the member countries and is coordinated by IPGRI, is overseen by a Steering Committee composed of National Coordinators nominated by the participating countries and a number of relevant international bodies. The Programme operates through nine networks in which activities 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; fruit; oil and protein crops; sugar, starch and fibre crops; vegetables, medicinal and aromatic plants) 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 with their own resources as inputs in kind to the Programme.

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INTRODUCTION

Opening and welcome

The Vegetables Network meeting was organized by IPGRI with the collaboration of Dr Teresa Kotlińska, from the Plant Genetic Resources Laboratory of the Research Institute for Vegetable Crops (RIVC) in Skierniewice, Poland.

Prof. Stanislaw Kaniszewski, Director RIVC, welcomed all the participants. He expressed his pleasure in hosting representatives of so many countries and hoped for valuable results from the Vegetables Network Meeting.

Dr Elzbieta Kozik, Head of the Department of Plant Genetics, Breeding and Biotechnology at RIVC also welcomed the participants. She presented Skierniewice as an important and historical centre for horticulture research and cultivation in Poland.

In his welcome address, Dr Wiesław Podyma, Head of the National Centre of Plant Genetic Resources, pointed out that the meeting was starting on the 22nd of May, the international day of biodiversity.

Recommendations of the ECP/GR Steering Committee and future priorities

Introduction

The ECP/GR Coordinator welcomed the participants to the Vegetables Network meeting and explained that this was the first time that all the Working Groups of an ECP/GR Network were meeting at the same time. According to the decisions of the ECP/GR Steering Committee, a Network meeting is intended to review progress made, to increase integration of activities and make plans for the future at the Network level. All attending members of the Working Groups on *Allium*, *Brassica*, Umbellifer crops and Solanaceae were invited to participate together with a few experts on leafy vegetables and the focal person on Cucurbit genetic resources. Altogether, 42 participants were representing 27 countries, including observers from Azerbaijan, the Russian Federation and Ukraine. Invitations were also sent to FAO and the International Seed Federation and these organizations expressed their interest in the meeting but were not able to send any delegates.

Progress of the Vegetables Network during Phase VI

During Phase VI of ECP/GR (1999–2003) activities were promoted by the Network Coordinating Group, who met in Rome, Italy in September 1999 and in Vila Real, Portugal, in May 2000. At this time, the decision was made to expand the scope of the Network beyond the existing Working Groups (*Allium*, *Brassica* and Umbellifer crops). Therefore, focal persons were identified to promote activities on genetic resources of Solanaceae (tomato, pepper and eggplant), Cucurbits (all crops) and leafy vegetables (lettuce, chicory and spinach). Several vegetable genetic resources projects, funded by the EU under Regulation (EC) N° 1467/94, offered the opportunity to organize joint meetings with ECP/GR. These were held in 2001 for the Umbellifer crops (Edinburgh, UK) and Solanaceae (Nijmegen, The Netherlands) and in 2002 for Cucurbits (Adana, Turkey) and *Brassica* (Vila Real, Portugal). An *ad hoc* meeting on vegetatively propagated *Allium* was also held in Gatersleben, Germany in 2001. The opportunity for the leafy vegetable experts to meet would be offered by the present meeting, in which a specific separate session is dedicated to this purpose.

The progress made by the ECP/GR Central Crop Databases (CCDBs) in the last five years was pointed out as the most visible achievement of the Network, with the initiation of new databases for tomato, eggplant, pepper, *Cyphomandra* and *Physalis*, cucurbits and *Lactuca*. Also a substantial increase of characterization and evaluation data and the definition of core collections of *Brassica* crops were possible, owing mainly to the input of the EU-funded projects. As an example of successful network cooperation, the example was quoted of an emergency regeneration of about 200 old carrot accessions for the Vavilov Institute (VIR, St. Petersburg), which was carried out by institutes in France, Italy, Poland and the UK between 1998 and 2003.

Recommendation of the Steering Committee

A brief account was given of the outcomes of the Mid-term meeting of the ECP/GR Steering Committee held in St. Petersburg, Russian Federation, 14-17 October 2001. On that occasion, the request to formalize the establishment of the Solanaceae Working Group was accepted and it was recommended that the Vegetables Network Coordinating Group prepare proposals for the establishment of two new Working Groups on Cucurbits and Leafy Vegetables, to be considered by the Ninth Steering Committee meeting to be held in October 2003.[1]

In order to develop a strategy for the next Phase (VII), a task force composed of a few Steering Committee members was established to propose future priorities and mode of operation of ECP/GR, to be discussed and approved during the Ninth Steering Committee meeting. The list of five priorities for the future, as drafted by this task force was presented:[2]

1. Documentation
2. Application and use of high technology (molecular markers, genomics)
3. Task sharing
4. Characterization and evaluation
5. *In situ* and on-farm conservation.

Funding opportunities from the European Commission

A brief account was given of the expected launching of the new proposal for a Council Regulation for a Community programme on the conservation, characterization, collection and utilization of genetic resources in agriculture and repealing Regulation (EC) N° 1467/94. The first call for proposals is expected for the end of 2003 or early 2004 with a budget of 7-10 million Euros for 3 years (2003-2006), which are expected to be dedicated to animal (approximately 50%), crop (40%) and forest (10%) genetic resources projects. Only the Community countries would be eligible to receive financial contributions. Third countries could participate without grant of funds. The 10 countries that will be joining the EU in 2004 (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia) will be eligible for the second call for proposals expected for 2005.[3]

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[1] The proposals are included in this volume as Appendices I (Cucurbits) and II (Leafy vegetables). The establishment of both Working Groups was endorsed by the Steering Committee (see Report of the Ninth Steering Committee Meeting, Menemen, Izmir, Turkey, 22-25 October 2003 - http://www.ecpgr.cgiar.org/SteeringCommittee/Outcome_SC9/SC9Report_nocover.pdf).

[2] Four main issues were eventually endorsed by the Steering Committee as future ECP/GR priorities: 1) Characterization and evaluation (including use of modern technologies); 2) Task sharing; 3) *In situ* and on-farm conservation; 4) Documentation and Information.

[3] Due to a delayed launching of Regulation 870/2004, the 10 new EU countries became eligible to participate as project partners also for the first call.

According to the draft text of the new Regulation, the objective is to help ensure and improve conservation, characterization, documentation, evaluation, collection and utilization of plant, microbial and animal genetic resources which are or could be of use in agriculture in the Community. All actions shall take into account relevant international processes, such as programmes implemented by ECP/GR, EUFORGEN, etc. Eligible actions should concern genetic resources occurring within the territory of the Community, with priority given to species that are economically significant (today or in the future) in agriculture, horticulture or forestry and with a view to increasing the use of a broad spectrum of genetic resources. Preference would be given to the use of genetic resources for:

- Diversification of production
- Improved product quality
- Sustainable management and use
- Better care for the environment.

Theoretical studies, testing of hypotheses, improvement of tools or techniques, and all other research activities would be not eligible. In the current draft form, actions aimed at *ex situ* and *in situ* conservation should seek added value (spreading knowledge, increasing use, improving methodologies). Participation of NGOs would be encouraged, particularly in the field of *in situ*/on-farm conservation.

A stepwise approach would be requested for targeted actions that would be funded to 50% of their cost:

- Step 1. Establishment of a workplan
- Step 2. Characterization of the collections
- Step 3. Evaluation and secondary characterization
- Step 4. Sorting of the collections and establishment of a core collection
- Step 5. Rationalization of the collections
- Step 6. Acquisition or collection of genetic resources.

INTEGRATED NETWORK SESSION

Introduction

The Vegetables Network Coordinating Group (VNCG) welcomed all members of the Network and proposed two-stage work aimed at building a more integrated Vegetables Network as an objective of this meeting.

In a first phase (first day) the specific Working Groups (WGs) and the Leafy Vegetables *ad hoc* group would work in parallel sessions in order to:

1. review their activities and identify the main achievements to prepare a workplan for the coming years and discuss the objectives of their activities;
2. identify priorities for the future, focusing on the recommendations of the Steering Committee for Phase VII of ECP/GR. The WGs were asked to comment on these recommendations, taking into consideration their own contribution and the range of crops within their scope; and
3. examine the feasibility of and build the framework for proposals for funding regarding the new EU Regulation (2004-2005).

In a second phase, the whole Network would meet and work at an integrated level on the three main issues cited above. It was proposed to discuss one by one the activities of the different WGs (point 1) in order to identify common proposals for future activities at Network level.

Actions and proposals of the Working Groups

The review of WG actions and proposals for each relevant activity was presented by each Chairperson and discussed at the Network level. G. Thomas coordinated the presentation and the discussion. This review is synthesized in Table 1.

Table 1. Actions and proposals of the Working Groups

Group	Documentation	Characterization	Evaluation	Tracing duplicates	Regeneration	Safety-duplication	Wild relatives
Allium	WG partners will make sure that national *Allium* data are incorporated into national inventories for inclusion into EURISCO. The EADB will be created from EURISCO for use by the group.	Characterization will be conducted mainly on vegetatively propagated material to support the rationalization, duplicate tracing and formation of core collections.	Because of the need to use input of labour, evaluation can only be performed within scientific investigations in universities, other institutions or experimental trials with interested breeding companies on the basis funded projects or other forms of collaboration.	Regeneration will be focused on vegetatively propagated material under the stepwise approach of developing a working division within an intended Conservation Consortium between the participants.	Tracing of duplicates is especially important for vegetatively propagated material because of its big impact on labour use and funding.	Methods of high technology such as *in vitro* storage and cryopreservation are a high priority for the group and should be included explicitly in the safety-duplication actions of the Task Force on the vegetatively propagated material with especially high labour requirements and no possibility of a “black box” approach.	The wild species genepool will be structured according to the relevance of the species for utilization and breeding of the crop species.
Brassica	Integrate information on existing characterization and evaluation data in the *Brassica* EDB.	Recommend use of GENRES descriptors to stimulate characterization actions.	Help prioritization of evaluation by defining major characters through the establishment of a common list of priorities (questionnaire consultation).	Establish a process to define priorities and responsibilities when duplicates are traced. Stimulate passport data use for tracing.	(ongoing)	Establish and circulate a list of safety-duplication facility offers to stimulate action.	Prepare questionnaire on availability of wild species (n=9) in the collections.
Cucurbits	Development of the European Cucurbits Central Database is in progress at the Polytechnic University of Valencia (UPV, Spain).	Establishment of Minimum descriptor list for melon, cucumber, watermelon, pumpkin and minor cucurbits is in progress. Responsibility is shared between the members.	Not yet planned. At national level evaluation for resistance to diseases is carried out.	No activity until the database is more advanced.	Regeneration activities have not been planned until the Cucurbits database is more advanced. Common protocols should be agreed by the WG.	The level of safety-duplication, long-term conservation facilities and availability to host black boxes was stated by each Institution during the first meeting. Partners will be encouraged to plan safety-duplication.	Management of wild relatives presently not considered.

Table 1 (cont.). Actions and proposals of the Working Groups

Group	Documentation	Characterization	Evaluation	Tracing duplicates	Regeneration	Safety-duplication	Wild relatives
Leafy Vegetables	Development of spinach and *Cichorium* databases.	Characterize collections of lettuce, spinach and *Cichorium* according to minimum descriptors.	Screening wild relatives of lettuce for new diseases and pests. Screening of collections of spinach and *Cichorium* for diseases and pests.	Identification of MOS in wild *Lactuca* spp.	Status of regeneration of some important collections is unknown.	Status of safety-duplicates of some important collections is unknown. Organize safety-duplications for minor vegetable crops.	Focus on availability of wild relatives of spinach and *Cichorium* in collections.
Solanaceae	Integration of missing data.	Establish a list of 10 descriptors per crop.	Not considered as a priority for the time being.	Not discussed yet by the group.	Will be done once the documentation is complete.	Not discussed by the group - to be discussed at next meeting.	Apply the official taxonomy to the wild species of each crop.
Umbellifers	Collection of passport data, usage information and an ecogeographical survey will provide the basis to direct other areas of the workplan.	Crop subgroups will develop minimum characterization descriptors for *Anethum, Apium, Carum, Chaerophyllum, Coriandrum, Foeniculum, Pastinaca* and *Petroselinum*.	The group will collaborate with research in national programmes, where possible, and utilize results to increase the efficiency of conservation and collection management.	Objective to identify the most original samples for all wild taxa.	Emergency regeneration of threatened carrot in progress. Need to assess the requirement for regeneration in the *Anethum, Apium, Carum, Chaerophyllum, Coriandrum, Foeniculum, Pastinaca* and *Petroselinum* collections.	Identified as an absolute priority within the workplan - need to promote at the level of the Steering Committee.	An ecogeographic survey of wild taxa will promote both the collecting of wild taxa and their conservation *in situ*.

Discussion and recommendations at Network level

The discussion of each genetic resource management activity at WG level allowed identifying actions that are relevant for the future work of the whole Network.

All these common priorities should be considered as the workplan of the Vegetables Network and it will be responsibility of each WG Chair to incorporate these into the individual Working Group activities. The VNCG will be responsible for reviewing the progress of the WGs and revising the workplan at the Network level.

Documentation / Databases

- It is necessary to clarify the risks of a double approach whereby accession data are incorporated into the EURISCO catalogue and/or into the Central Crop Databases (CCDBs). The importance of the CCDBs should be emphasized, considering that these databases are focused on the WG needs and will contain more detailed and complete documentation. The level of integration between the CCDBs and the EURISCO data, obtained through the national inventories, will also have to be monitored.
- The Network intends to make use of the ECP/GR Web pages to publicize specific highlights of WG activities, especially when these need to be discussed at Network level in order to define the best way to proceed.
- The reinforcement of the role of national WG members is a concern of the Network. The situation could be improved by assigning them the responsibility and coordination of transfer of data sets (or missing data) and information from their national collections to the respective WG CCDB manager.

Regeneration

Based on the model of the Umbellifer WG experience (collaborative regeneration of VIR accessions), establish a system to deal with emergency regeneration requests.

Tracing duplicates

The *Brassica* WG proposed to start a process to define a methodology to be used by WG members in order to trace duplicate accessions in the European collections, starting with an analysis of the passport data. This should also lead to the definition of a procedure to identify priorities among the duplicate holders for regeneration and conservation tasks.

The Network agreed to adopt this task as a common action, using literature and available expertise, *inter alia* from other ECP/GR Networks.

Safety-duplication

This action will be carried out at Network level, as follows:

- Identifying offers of storage of black boxes at Network level,
- Identifying lack of safety-duplicate arrangements among WG members,
- Encouraging each member to improve the level of safety-duplication during the next phase of ECP/GR.

Wild species management

The initiative of the *Allium* WG to study the wild genepool taxonomy and structure (see p. 17) was endorsed by the Network. In particular, a clarification of the relationship between genomes of wild relatives and cultivated species should be documented in relation with breeding and use of genetic resources.

A recommendation is made by the Network to European universities and training institutions to stress the alarming decline in the number of taxonomy experts and to increase the offer of graduate studies in this field.

In situ *and on-farm conservation*

On-farm conservation and expertise from the eastern and southern European countries, which are increasingly involved in the WG, is planned to be incorporated into the Network activities, starting with collecting information on ongoing national initiatives, also in cooperation with the ECP/GR *In situ* and on-farm conservation Network.

The same approach should be adopted for *in situ* actions, considering the richness of wild relatives growing *in situ* in the above-mentioned countries for most vegetable crops.

International legislation on access and benefit sharing of plant genetic resources

L. Maggioni presented the status of the International Treaty on PGRFA (Plant Genetic Resources for Food and Agriculture). On 3 November 2001, the renegotiation of the FAO International Undertaking came to an end. The revised text, adopted through a vote, is called "International Treaty on Plant Genetic Resources for Food and Agriculture" (http://www.fao.org/AG/cgrfa/itpgr.htm). This new legally binding international agreement will enter into force when ratified by at least 40 states.[4] The Treaty establishes a Multilateral System ensuring facilitated access to PGRFA. The system covers a specific list of crops, also including carrot, eggplant and the *Brassica* complex, but excluding tomato, pepper, the cucurbits, *Allium* and the leafy vegetables apart from *Asparagus*. Access and benefit sharing for all crops not included in the Multilateral System would be regulated through the Convention on Biodiversity. The appropriate reference in this case is given by the Bonn guidelines on access to genetic resources and the fair and equitable sharing of the benefits arising from their utilization (http://www.biodiv.org/programmes/socio-eco/benefit/bonn.asp).

The presentation was mailed by ECP/GR Secretariat to all Vegetables Network members after the meeting.

Planning a collaboration between national PGR holders and the private sector

The ECP/GR Secretariat presented a "Proposal for collaboration for conservation and use of genetic resources between genebanks and the private sector".

This proposal is in line with the ECP/GR objectives for Phase VI (facilitate increased use of PGR and encourage cooperation between all stakeholders, including NGOs and private breeders) and the 6th Priority Activity of the Global Plan of Action (June 1996, Leipzig, Germany), recommending the regeneration of threatened *ex situ* accessions.

The proposal consists of the finalization of a multilateral initiative, based on the principles of the International Treaty (ftp://ext-ftp.fao.org/ag/cgrfa/it/ITPGRe.pdf), involving genebanks requiring emergency regeneration of vegetable accessions and breeders who could be available and are interested in multiplying vegetable genetic material. The overall process could be coordinated and monitored by the ECP/GR Secretariat at IPGRI in Rome.

The initiative would not involve monetary exchange, but would be based on reciprocal benefit, i.e.:

- the genebanks would make available genetic material to be regenerated and would receive back the multiplied seed
- breeders would have the chance to use unknown material in their field trials and to keep some seed samples.

Similar examples of collaboration are known to already operate in France and in the Netherlands in collaboration with the national plant genetic resources programmes. This

[4] The International Treaty entered into force on 29 June 2004 (see http://www.fao.org/Legal/TREATIES/033s-e.htm).

initiative would be intended to create additional links, possibly involving east European genebanks and west European breeders, or vice-versa. Expressions of interest for such an initiative were already shown by a few companies, following the meeting on Solanaceae in Nijmegen (September 2001).

The ECP/GR Secretariat offered to help, in collaboration with the Vegetables Network representatives, to:

- identify genebanks and material to be regenerated
- identify breeders and material they wish to test.

A possible arrangement for the whole process could include the signature of the following agreements:

- Letter of Agreement between the breeder and IPGRI, to ensure proper regeneration standards and return of multiplied material to genebanks;
- Standard Material Transfer Agreement between breeders and genebanks, to ensure breeders the possibility to use material, according to the principles in line with the International Treaty.

The Vegetables Network welcomed the idea of the ECP/GR Secretariat being the focal point of the initiative.

In the case of the Netherlands, I. Boukema confirmed interest expressed by Dutch breeders to regenerate leafy vegetable material through the Centre for Genetic Resources, the Netherlands (CGN, Wageningen), as an intermediary.

J. Keller welcomed the initiative as a possible opportunity to receive help for the regeneration of wild species of *Allium* conserved in Gatersleben, Germany. These require a great deal of effort for isolation of the accessions to avoid unwanted crossing. Most of them are outbreeders and, because of the high accession number, it is not possible to isolate a sufficient number for true seed production.

Offers to help in the identification of breeders in their respective countries were made by V. Cadot and M.C. Daunay (France), F. Branca (Italy), A. Lebeda (Czech Republic) and M.J. Díez (Spain).

Special attention should be placed on the exploitation of existing interpersonal relations between genebanks and breeders to build the agreements.

A task force was established to advise the Secretariat on the best way to proceed for the preparation of appropriate agreements. The task force will interact by correspondence with the ECP/GR Secretariat, in order to define, before October 2003, the further details of the overall arrangement and to launch the initiative before the next spring planting.

Members of the task force are: D. Astley, I. Boukema, F. Branca, V. Cadot, M.C. Daunay, M.J. Díez, J. Keller, T. Kotlińska, A. Lebeda, G. Poulsen and W. van Dooijeweert.[5]

Priorities for the future

After having reviewed the activities of the Working Groups, the WGs were asked to stress priorities among their actions, according to the five priority areas identified and proposed by the Steering Committee task force for Phase VII, i.e.:

1. Documentation
2. Application and use of high technology
3. Task sharing
4. Characterization and evaluation
5. *In situ* and on-farm conservation.

[5] Progress made by this initiative at the time of publication is reported in Appendix III.

At the Network level, the five priorities were recognized as relevant for the activities of the Vegetables Network WGs. A specific request to formalize safety-duplication actions in Priority area 3 is made at Network level.

The review of the WG priorities is summarized in Table 2.

Table 2. Main priorities identified by the Working Groups

Group	Documentation	Application and use of high technology	Task sharing	Characterization and evaluation	*In situ* and on-farm conservation
Allium		X	X	X	
Brassica	X		X	X	
Cucurbits	X		X		
Leafy Vegetables	X		X	X	
Solanaceae	X		X		X
Umbellifers	X		X		X

Upcoming EU Regulation on genetic resources – Proposals for projects

Allium

GENRES proposal agreed by the *Allium* Working Group representatives in the Vegetables Network (VEGNET) meeting at Skierniewice, May 2003

Considering the much higher labour requirements of vegetatively propagated germplasm in comparison to seed samples, the group decided to focus further activities on this part of the germplasm, which consists of:

- seed sterile material (garlic, some parts of the leek genepool s.l., selected important hybrids),
- traditionally vegetatively bred varieties (shallot), and
- many wild species with low seed sets or high labour requirement because of the isolation measures needed to obtain true seeds.

The objectives of this possible project are:

- to rationalize the European collections by concentrating the germplasm in several competent centres and organizing targeted safety-duplication between these centres, supporting the ongoing process to form a Vegetatively Propagated *Allium* Consortium under the umbrella of ECP/GR,
- to use high technology methods to further rationalize the collections and to improve their sustainable use and conservation,
- to promote the use and secure the conservation of selected wild species of higher priority.

The main tasks of this project are:

- material exchange, definition of partners for safety-duplication and final concentration of the *Allium* groups according to the proposal in the *Allium* Working Group meetings;
- development, application and refinement of in vitro slow-growth methods for the storage of material of defined higher priority;

- use of meristem culture, thermo- and chemotherapy to clean material of defined higher priority from viruses to create a virus-free core collection of garlic, shallot and other vegetative material of special importance;
- activities for implementation of the proposed phytosanitary standards (especially for virus diseases) for vegetatively propagated material of defined higher priority;
- introduction of the already established garlic core collection into virus-free cryopreservation and establishment of core collections of other vegetatively propagated material;
- promotion of the characterization of material for morphological traits and, where possible, by available molecular markers such as AFLP and microsatellites;
- removal of undesired redundancy of germplasm after its determination by means of passport data comparison, morphological and molecular markers;
- promotion of conservation and characterization of wild species of defined higher priority ("candidate species"), exploration of their diversity and creation of small core collections for these candidate species;
- delivery of the data obtained and collected in the project for common use in EURISCO.

Brassica

The group agreed that it would be necessary to define actions in quite different directions (vs. the previous GENRES project) in order to apply for new EU Regulation funding.

It was decided that the WG would be the core structure for brainstorming about a new *Brassica* proposal concerning wild species. This could be targeted on availability, *in situ* and *ex situ* conservation, reintroduction and evaluation of wild *Brassica* in relation to public awareness and use.

The questionnaire on the inventory of wild species organized by the WG will, in this framework, be the necessary basis of discussion.

Cucurbits

The group is interested in principle in developing a proposal to be submitted to the EU for funding and further discussion will have to take place in the next few months.

Leafy Vegetables

The Leafy Vegetables *ad hoc* group expressed interest in presenting a project proposal on leafy vegetables in the framework of the new EU Genetic Resources Programme. This proposal would include the three most important crops (lettuce, spinach and *Cichorium*) and is based on the following elements:

1. Lettuce, spinach and *Cichorium* are native to the whole of Europe; wild relatives originate from many parts of Europe.
2. All these crops are economically very important in Europe.
3. In Europe there are intensive private and institutional breeding activities on these crops.
4. Availability of germplasm in spinach and *Cichorium* collections is insufficient.
5. No international databases are available for spinach and *Cichorium.*
6. More complete characterization of spinach and *Cichorium* collections is needed.
7. New important pests and diseases and new races/strains of existing diseases and pests are being found.
8. Breeders showed interest to cooperate in regeneration to broaden access of germplasm material for screening important characters.
9. The steps mentioned in the Council Regulation fit exactly with the workplan of the Leafy Vegetables group.

Solanaceae

The submission of a project on Solanaceae genetic resources to the next EU call for proposals is considered very important. But due to the facts that (i) in Europe there are many collections hosting an important number of accessions for one or the other of the Solanaceae crops, and (ii) they are scattered in many countries, including non-EU countries, it will unfortunately not be possible to include all the relevant countries in the project.

Umbellifers

Proposal for new GENRES project for the Working Group on Umbellifers

The group proposed preparation for the development of an Umbellifer project under the new GENRES project. The group identified the collection of high quality passport, utilization and ecogeographic data for all the umbellifer genera. The proposal intends to provide the baseline data in order to fill gaps in the collections for wild and cultivated material, identify protected areas of potential value for *in situ* conservation, and develop a proposal for regional on-farm projects in the context of socioeconomic development alongside landrace conservation.

At the Vegetables Network level

E. Rosa presented an integrated proposal based on several vegetables to be submitted to the EU 6th Framework for funding.

The value of vegetable genetic resources for human health and environment (VEGEREN)

Taking into consideration the diversity of potato, tomato, *Brassica*, *Allium* and carrot genetic resources, this project would aim at defining the value of these crops as anti-oxidants for human health as well as their potential for use in environmentally-friendly agriculture, thanks to existing resistance to pests and diseases and to their suitability for organic production. The main steps of the project would include:

1. Identification of different accessions;
2. Provision of seed to be planted by different partners in parallel trials;
3. Analysis of freeze-dried material for assessment of the content of phenolic compounds, glucosinolates, other sulphur compounds, vitamins A, C and E and selenium;
4. Evaluation of flavour by evaluation panels and by electronic noses;
5. Data analysis and final assessment of anti-oxidant capacity of each accession (quality assessment) and potential health effects;
6. Field test of the best material to evaluate the environmental performance in environmental friendly systems and in organic farming, including under different stresses and conditions (salt, drought, frost, pests and diseases and inter-cropping);
7. Evaluation of the biocidal effect of this material;
8. Multiplication of the best material for public use and inclusion of information into database.

WORKING GROUP SESSION ON *ALLIUM*

Joachim Keller and Dave Astley

In the discussion, 6 members attended: Dave Astley (United Kingdom), Gitte Kjeldsen Bjørn (Nordic Gene Bank), Rina Kamenetsky (Israel), Joachim Keller (Germany), Helena Stavělíková (Czech Republic), Birūta Karpavičienė (Lithuania) and an observer (Rana Geydarova, Azerbaijan).

In the preparation phase of the meeting, D. Astley sent a questionnaire to the Working Group members requesting an update on the activities of the national programme. We received 4 direct answers, and 5 contributions were delivered before or during the meeting in the form of a country report.

During the discussion, 5 national reports about activities for *Allium* work were presented: Czech Republic, Germany, Israel, Lithuania and the Nordic Gene Bank. Additional papers were provided by the representatives of Belgium and Poland (see below, *Presentations and Papers*, pp. 19-44).

Review of the workplan

Objectives for the Allium *Working Group* [6]

- Make European collections better available to users through provision of information (European *Allium* Database, EADB) and collection management, including revision of data management in line with development of EURISCO.
- Improve conservation and safety-duplication of collections, maximizing network efficiency and reducing duplication of inputs.
- Develop European strategy and programme for the maintenance of vegetatively propagated collections, including rationalization based on morphological and molecular information.

Discussion of workplan actions

The workplan discussions followed the topics documented in the Report of the sixth meeting of the *Allium* Working Group[7]:

1. The European *Allium* Database (EADB) is accessible on-line – assess accessions of wild taxa for uniqueness to identify "most original sample" and duplicates. Provide the resulting information to the DB manager.
2. Provide for safety-duplication of all accessions using specific bilateral "black box".
3. Inform EADB manager (D. Astley) about the nature and volume of available characterization data for material in the EADB.
4. Clarify taxonomic status of wild material in collections - P. Havránek, T. Kotlińska and J. Keller.
5. Contribute to the preparation of the IPGRI *Allium* descriptors (published 2001).

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6 Annex IV of the Task Force Document "Priorities for Phase VII" (12 July 2002) (unpublished background document prepared by M. Smith for the ECP/GR Steering Committee).

7 Maggioni, L., D. Astley, H. Rabinowitch, J. Keller and E. Lipman, compilers. 1999. Report of a Working Group on *Allium*. Sixth meeting, 23-25 October 1997, Plovdiv, Bulgaria. International Plant Genetic Resources Institute, Rome, Italy.

1. On-line accessibility of EADB – Identification of MOS in wild taxa

The EADB was revised continuously between 1998 and 2002; there are significant contributions from the large *Allium* collections, but there are also gaps where national programmes have not provided data even after repeated calls for information.

The main discussion focused on the relations between crop-specific databases and the future of EURISCO, which will function as a European centralized database. Further development of the central crop databases is expected to continue until EURISCO is fully functional. The long-term sustainability of the EURISCO database was discussed; this question was clarified by L. Maggioni in the plenary VEGNET session. In the transition phase of EURISCO, it was agreed that it is sensible to stop further data collection in order not to duplicate these activities for collection curators. As for the German example, all relevant data have been delivered to the preliminary EURISCO database. J. Keller suggested the need to assign responsibility for the data delivery not only at the country level (national inventory focal person), but also at the crop level by a crop specialist, who could give advice on the need to correct botanical names, etc. This specialist could be the crop-specific database manager. An example was discussed for wild *Allium* species, where all three synonyms of a species have been used in the same list, which is confusing for those not familiar with the specific crop.

The determination of the most original sample (MOS) of an accession of a wild species is in the initial phase. It was agreed by consensus that most of the samples of the wild species collection of IPK (Institut für Pflanzengenetik und Kulturpflanzenforschung, Gatersleben, Germany) represent MOS status for the major part of the continental (cold-requiring) accessions held in the genebanks. After a previous rationalization phase, IPK is focusing on the maintenance of material collected directly from the location of origin. Thus, 71% of the wild species collection represents MOS samples. A descriptor for the status of originality is included in the IPK *Allium* database managed by R. Fritsch. It may be transferred to the data sets of the future EURISCO database.

Another situation exists for the so-called "tender" species of Mediterranean or Atlantic origins, which are not so well represented in IPK because of the climatic requirements of the species. The Mediterranean members should review their collections and produce their determination of MOS and duplicates. The following countries should be involved in this action: Israel, Italy, Greece, Spain, Portugal, Turkey and UK. The *Allium* specialist of IPK, R. Fritsch might be able to offer assistance in particular problematic cases.

So far, no data relating to MOS status have been included in the EADB. Updating of the MOS information should be done within the national inventories for inclusion in EURISCO.

2. Safety-duplication

There is a clear difference between the management of seed samples and the vegetatively propagated accessions. Therefore the discussion considered the two aspects separately.

- **Seed samples**

Black box arrangements have been well established between UK and the Netherlands (the latter sent 100% of the collection to UK for safety-duplication; UK sent 50% of their collection to the Netherlands). Other cases (without concrete figures or crop specification) have been reported in the Austrian questionnaire response, where a number of samples from Austria are duplicated in Germany, other material is duplicated in the Netherlands and *vice versa*. The Memorandum of Understanding between NGB and Latvia was discussed as an example of cooperation for safety-duplication. A proposal was agreed to distribute the paper to all Working Group members again as an example how to formulate such agreements. The

recommendation concluded that national programmes not yet involved in safety-duplication should emulate the UK/Netherlands model for this important work.

- **Vegetative material**

The fundamental drawback has been stressed that no black box arrangements are possible for vegetatively propagated material. All the germplasm must be cultivated and managed in the same manner as the genebank's "own" material. This situation leads to a much higher labour requirement for this material and is the main reason to strengthen collaboration for rationalization of the vegetative collections. Safety-duplications have been established between the following genebanks: Czech Republic/NGB; Czech Republic/Poland; Czech Republic/Germany (IPK); Poland/Germany (IPK); and Spain/Germany (IPK). With the present level of funding, only very limited offers could be made by the group participants to extend their commitment to this safety-duplication. IPK offered to host 50 garlic accessions to be defined by the members as being of special value. The Czech Genebank, which has sent 105 safety-duplicates to IPK, agreed to accept 30 accessions from IPK in a reciprocal agreement to the former action. A Consortium for the maintenance of vegetatively propagated *Allium* collections has been proposed repeatedly by the group culminating in the proposals of the *ad hoc* meeting at Gatersleben in 2001.[8]

Thus far no duplication data were included in the EADB. The group emphasized that some national programmes that will join the EU next year will be potential partners for the maintenance of safety-duplicates. Training in the standard protocols for this work can be provided.

3. Characterization data for EADB

It was stressed that there is an evident concentration of the characterization measures within the various project activities. Most characterization data have been collected within the *Allium* EU GENRES project (1996-2000) and the EU research projects (FAIR 1996-2001; "Garlic and Health" 1998-2003). Recent contributions to the characterization and evaluation of garlic were presented by Teresa Kotlińska (Poland) in her PhD thesis. The data for these projects have been reported in the various document reports to the EU. The problem of unifying the data in a common database was considered to involve a high level of subjectivity and the dependence of data scores on the location of the genebanks. Furthermore, especially in large collections, it is difficult to obtain complete data sets even for minimum descriptors because of labour requirements for such work. The data will be completed step by step only slowly, i.e. limited numbers of accessions within a long time frame. The conclusion in the discussion was to concentrate data collection on characterization data rather than on passport data. The most important factor in determining the rapid and complete recording of data is funding for genetic resources projects, whether at the national programme level or the EU.

Furthermore, the group discussed the value of molecular and evaluation data. As for the morphological characterization, the molecular and evaluation data have been mainly collected in EU-funded projects and for special publications. The main activities have been carried out in the FAIR project for onion (molecular data, sulphur compounds and carbohydrates), GENRES (Plant Research International (PRI), Wageningen, the Netherlands – disease resistance for *Peronospora* and thrips), and the "Garlic and Health" project (sulphur compounds).

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[8] Maggioni, L., J. Keller and D. Astley, compilers. 2002. European collections of vegetatively propagated *Allium*. Report of a Workshop, 21-22 May 2001, Gatersleben, Germany. International Plant Genetic Resources Institute, Rome, Italy.

The importance of molecular data as an objective tool providing additional characters that are less dependent on local conditions and for tracing duplicates has been stressed. However, the high costs of molecular markers so far hinder the broader application of these methods in genebanks. This has been demonstrated in an example to obtain molecular data for duplicate search in European garlic and shallot collections (proposal made by D. Astley, C. Kik and J. Keller, in order to identify duplicates and reduce the costs of conservation). However, no funding sources were identified for this expensive project (see p. 14 in Maggioni *et al.* 2002 – citation in footnote 8).

4. Clarify taxonomic status of wild material in collections

Wild material is present in many of the collections to a different extent. Taxonomic expertise was offered in the past by the Czech Republic (P. Havránek) and by the Polish (T. Kotlińska) and German (R. Fritsch) genebanks. A major action has been undertaken by R. Fritsch to determine wild material in the Czech genebank (80 accessions). Smaller determination activities were carried out in IPK for CIFA (Centro de Investigación y Formación Agroalimentaria)-Córdoba (Spain) to determine wild leek relatives (4 accessions). Missions for the study of indigenous taxa have been undertaken to Central Asia by IPK. Several international agreements between IPK (Germany) and Central Asia Republics (Tajikistan, Uzbekistan) have been established to validate the taxonomic identity of their wild species material. A project funded by the Volkswagen foundation and a project funded by the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF) will contribute to the characterization of wild material. The Polish genebank reported on missions to collect wild species together with the *Allium* crops. Problems are recognized in the determination of wild material because of the increasing limitation of botanical expertise. Taxonomic determination in the near future is offered at a modest level by R. Fritsch. The group wished to give the important wild species collection of IPK Gatersleben (340 *Allium* species and 24 species of related genera in a total of 1920 accessions) a higher "mandatory status" to acknowledge the significance of the collection for the whole of ECP/GR (beyond the level of the German national programme) and thus to strengthen the existence of this collection for the far future.

A proposal has been made to structure the wild species genepool, which currently totals more than 700 species. Only a part of the genus is of immediate value for direct use and breeding. Thus, a number of candidate species have been selected based on the knowledge accumulated during collecting missions and prebreeding trials (see below, paper by J. Keller, pp. 25-28).

5. Contribution to the IPGRI *Allium* descriptors

The IPGRI *Allium* descriptor list was published in 2001. Much of it was based on the improvements made to the original IBPGR *Allium* descriptors by the partners collaborating in the EU GENRES *Allium* project and collaborating ECP/GR partners, particularly the German, Czech, Polish and Spanish genebanks for garlic; the Czech genebank and NGB for shallot and chives; and all partners for onion and leek. The specific definition of garlic characters was enhanced by graphic representation of character states produced by the Spanish and German genebanks. The crop-specific descriptor lists are recommended for broader use in the genebanks of the ECP/GR countries. For garlic, 13 descriptors were identified as of special importance during the *ad hoc* meeting on vegetatively propagated *Allium*. The group discussed this proposal again and updated the priorities. Where possible, 16 characters should be used.

Additional activities

Further to the activities of the workplan, the following topics were discussed that do not directly fall within the scope of the workplan:

- **Rationalization measures for reduction of redundancy** (internal duplication within the collection) have been undertaken by CGN (the Netherlands) in onion and leek in the course of the GENRES project.

- There was discussion of the urgent **need to develop a Conservation Consortium for Vegetatively Propagated *Allium* Germplasm** as a consequence of the safety-duplicate discussion in point 2.

The following division of the activities has been proposed, which is an update of the proposal given in the report of the *ad hoc* meeting for vegetatively propagated *Allium* in Gatersleben, 2001 (countries in italics have been added as a consequence of the present discussion).

Long-day garlic	Czech Republic, Germany, Poland, Spain
Short-day garlic	Israel, *Spain, France*
Shallot	Czech Republic, NGB, *Lithuania*
Vegetative leek + Mediterranean (Atlantic) wild species	Greece, Israel, Netherlands, Spain, UK, *Italy*
Continental wild species, cold requiring	Czech Republic, Germany, *Lithuania, Ukraine*
Chives and Chinese chives	Netherlands, NGB, United Kingdom

Recognizing the need of funds to implement such a complex, but urgently needed activity, the following statement has been proposed for communication to the Steering Committee:

Statement for the Vegetatively Propagated *Allium* Consortium

"A significant problem exists in the secure maintenance of vegetatively propagated *Allium* taxa. The Vegetatively Propagated *Allium* workshop[9] recommended the development of a European Network for Vegetatively Propagated *Allium*. The group reiterates this proposal, which includes the establishment of a system for the maintenance of safety-duplicates within this network.

The group proposes the development of a costed proposal for security duplicate maintenance based on national programmes for presentation to the Steering Committee. The group recognizes that such a proposal will require inputs in kind from the national programmes in order to achieve the security of this material. The group will attempt to identify national programmes with the knowledge and facilities to join this network initiative. The group is conscious that without the support of the inputs in kind from the national programmes, the material will exist without this essential backup safety net system. In addition, the recommendation from the Working Group included in the report of the Vegetatively Propagated *Allium* workshop and accepted in the objectives of the Task Force for the ECP/GR questionnaire 2002 cannot be achieved."

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[9] Maggioni, L., J. Keller and D. Astley, compilers. 2002. European collections of vegetatively propagated *Allium*. Report of a Workshop, 21-22 May 2001, Gatersleben, Germany. International Plant Genetic Resources Institute, Rome, Italy.

- The group discussed the **report of the Vegetatively propagated *Allium* workshop** held in 2001 in Gatersleben with respect to the importance of the following subjects
  - Phytosanitary standards and recommendations,
  - Impact of *in vitro* culture for preservation of vegetative germplasm, and
  - Increasing relevance of cryopreservation, mainly for garlic, in future years.

  The formulations of the recommendations can be found on pp. 8-13 of the above report. All recommendations received the full support of the Working Group members.

Presentations and papers

Status of Allium *collections in Belgium – Update 2003*

Hervé De Clercq
Departement voor Plantengenetica en –veredeling (DvP-CLO), Melle, Belgium

Conservatoire Botanique de Ressources Génétiques de Wallonie

1 rue Fievez, 1470 Genappe, Belgium
Curator L.A. Dutilleux
Tel/Fax: +32 2633 2025

This living plant collection has increased over the last years and now contains 81 non-edible, vegetatively propagated flowering *Allium* species, as listed below:

Allium aflatunense B. Tedtach
Allium albidum Fischer
Allium albopilosum Becker
Allium altaicum Pall.
Allium ampeloprasum L.
Allium angulosum L.
Allium atropurpureum Waldst.
Allium backhousianum Regel
Allium baeticum Boiss.
Allium beesianum W.W. Sm.
Allium bulgaricum Regel
Allium caesium Schrenk
Allium cardiostemon Fisch. et Mey.
Allium carinatum L. subsp. *pulchellum* (Bonn. et Lay.)
Allium carolinianum D.C.
Allium cepa Alice
Allium cepa L. *viviparum* Alef.
Allium cepa proliferum L.
Allium cepa var. *ascalonicum* Backer[10]
Allium cilicicum Boiss.
Allium condensatum Vavilov
Allium cristophii Trauv.
Allium cyaneum Regel
Allium cyathophorum Bur. et Franch.
Allium darwasicum Vavilov
Allium drbovii Zovo
Allium ebusitanum Sanchez
Allium ericetorum Corbeld
Allium falcifolium J.D. Hook
Allium hirtifolium Boiss.
Allium hymenorrhizum Turkman
Allium iliense Regel
Allium insubricum Boiss. et Reuter
Allium kansuense Regel
Allium karataviense Regel
Allium kunthii Wol.
Allium ledebourianum Schult.
Allium longicuspis Regel
Allium lusitanicum Lam.
Allium macranthum Baker
Allium moly L.
Allium montanum F.W. Schmidt
Allium narcissiflorum Vill.
Allium neapolitanum (Cyr.)
Allium nigrum L.
Allium ochotense Prokh.
Allium ochroleucum Waldst. et Kit.
Allium oleraceum L.
Allium oreophilum A. Gray
Allium paczoskianum Fuzs
Allium przewalskianum Regel
Allium pskemense B. Fedtsch
Allium pulchellum Meyer
Allium ramosum L.
Allium rosenbachianum Regel
Allium roseum Favios
Allium sativum ophioscorodon L.
Allium scabriscapum Boiss.
Allium schubertii Zucc.
Allium scorzonerifolium L.
Allium senescens L. subsp. *montanum* Fries
Allium sibiricum L.
Allium sikkimense Baker
Allium sphaerocephalon L.
Allium stipitatum Regel
Allium strictum Serach
Allium suaveolens Jacq.
Allium suworowii Regel
Allium textile L.
Allium tricoccum Feldt
Allium triquetrum L.
Allium tuberosum odorum L.
Allium tuberosum Rottl.
Allium ursinum L.
Allium victorialis L.
Allium victorialis L. var. *platyphyllum* Mahino
Allium vineale L.
Allium wallichii Kunth.
Allium x *proliferum* (Moench) Schrad.
Allium yunnanense Diek
Allium zebdanense Boiss. et Noë

[10] The standard used for this taxon in the European *Allium* Database is *A. cepa* Aggregatum Group.

National Botanic Garden of Belgium

Domein van Bouchout, 1860 Meise, Belgium
Director J. Rammeloo
Tel: +32 2 2693905; Fax: +32 2 2701567
Web site: www.br.fgov.be

The Living Plant Collections Database (LIVCOL) is searchable on-line (http://www.br.fgov.be/RESEARCH/COLLECTIONS/LIVING/LIVCOL/index.html). The *Allium* collection currently contains 32 accessions.

Faculté Universitaire des Sciences Agronomiques de Gembloux

Jardin Botanique, 2 avenue de la Faculté, 5030 Gembloux, Belgium
Prof. Bodson
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A small living plant collection (about 10 species) is maintained as teaching material.

Departement voor Plantengenetica en -veredeling (DvP-CLO)

Caritasstraat 21, 9090 Melle, Belgium
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The working collection of seeds contains about 200 varieties of leek (*Allium ampeloprasum* var. *porrum*). About 25 of them are Belgian landraces of leek. Future activities will be the regeneration of the accessions and safety-duplication.

UG Plantentuin

Ledeganckstraat 35, 9000 Gent, Belgium
Prof. P. Goedgebuur
Tel: +32 9264 5056
Contact person: Chantal Dugardin
Tel: +32 9264 5073

There are 15 species of *Allium* in the garden: *A. aflatunense, A. cernuum, A. ampeloprasum* var. *barbington, A. galanthum, A. ramosum, A. sphaerocephalum, A. splendens, A. flavum, A. ericetorum, A. angulosum, A. macranthum, A. neapolitanum, A. pulchellum, A. karataviense* and *A. tuberosum.*

Kruidtuin Leuven

Capucijnenvoer 30, 3000 Leuven, Belgium
Contact person: Paul Uyttebroeck, Tel: +32 1623 2400.

This city garden contains 10 species of *Allium: A. schoenoprasum, A. cepa, A. fistulosum, A. porrum, A. sativum, A. ursinum, A. tuberosum, A. platycaule, A. cyathophorum* and *A. moly.*

Current status of the long-day Allium *collection in the Czech Republic*

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[2] *Research Institute of Crop Production Prague-Ruzyne (RICP), Czech Republic*

The Olomouc Station of the Research Institute of Crop Production in Prague-Ruzyne (RICP) holds the extensive collection of genetic resources of long-day *Allium* species. The largest part of this collection is in the international field genebank for vegetatively propagated long-day *Allium* spp., established in Olomouc in 1951. The basis of the *Allium* collection was created in the former Research Institute of Vegetable Growing and Breeding (RIVGB) which was founded in Olomouc in 1951 and abolished in 1994. The establishment of this collection resulted from the decision taken at the Second Meeting of the ECP/GR Working Group on *Allium* held in Olomouc in 1986. Since 1994 the group working with plant genetic resources has been affiliated to the RICP.

The *Allium* collection in the RICP Gene Bank located at Olomouc (RICP-GB Olomouc) is made up of three parts: garlic (*Allium sativum* L.), shallot (*A. cepa* var. *ascalonicum* Backer[11]), and onion (*Allium cepa* L.). Their current status (May 2003) is presented below.

The garlic collection

The collection of garlic consists of 643 accessions, including 23 accessions which are maintained virus-free. The contents of the collection are listed by country of origin in Table 1.

An important part of the collection represents old garlic landraces collected in the Bile Karpaty Mountains and in southern Moravia, as well as advanced Czech varieties. Wild species and primitive forms of garlic were collected during international expeditions in Central Asia (1988) and West Siberia (1990).

The collection is divided into three parts, according to the ability of plants to produce a scape:

- Group of accessions forming scapes: 303 accessions
- Group of accessions without scapes: 208 accessions
- Group of accessions which bear the topset (bulbil) in different parts of the pseudostem: 109 accessions.

Table 1. Structure of the garlic collection in RICP-GB Olomouc according to the country of origin

Country of origin	No. of accessions
Former Soviet Union	151
Czech Republic	128
Bulgaria	60
Poland	43
Slovakia	38
Spain	27
Austria	26
Romania	26
Hungary	22
Portugal	22
Other	77
Total	**620**

[11] The standard used for this taxon in the European *Allium* Database is *A. cepa* Aggregatum Group.

The shallot collection

The collection of shallots contains 121 accessions. The countries of origin are shown in Table 2.

Table 2. Structure of the shallot collection in RICP-GB Olomouc according to the country of origin

Country of origin	No. of accessions
Finland	33
Czech Republic	24
Norway	16
India	11
Former Soviet Union	11
Germany	7
France	4
Australia	4
Other	11
Total	121

The onion collection

We started to reconstruct the onion collection in 2001. Initially, we made a survey of old and current Czech varieties, in close collaboration with genebanks in Wellesbourne, UK (Dr D. Astley), Gatersleben, Germany (Dr J. Keller) and CGN, Wageningen, the Netherlands (Dr I. Boukema). These genebanks provided us with seed of the old Czech varieties; the seeds of the contemporary Czech varieties were provided by the Czech seed companies SEVA-FLORA, SEMPRA and SEMO. Currently the collection consists of 10 accessions and it will be further extended.

Documentation status

Since 2002, all collections are regularly documented and evaluated according to the *Descriptors for* Allium (IPGRI, ECP/GR, AVRDC 2001). We use 17 characters for garlic, 17 characters for shallot and 12 characters for onion.

Evaluation status

We determined dry matter content in storage organs of all above-mentioned species (garlic, onion and shallot). The following specific chemical substances were also analyzed in the collections of individual species:

- **Garlic:** quantitative detection and qualitative measurement of sulphur compounds (in hexane extract) in selected accessions. The accessions were selected using morphological data; the two-year results are now available and continued evaluation is planned.
- **Shallot:** a similar kind of analysis was carried out in the garlic collection to detect accessions with desirable contents of glucose, fructose and sucrose (in comparison to onion).
- **Onion:** evaluation for pyruvic acid content.

Maintenance of the collections

- **Garlic**: the collection is maintained as a field collection. Within the collection 23 accessions were stabilized in a virus–free state and they are being grown in technical isolation cages in the field.
- **Shallot**: the collection is maintained as a field collection in special isolation cages.
- **Onion**: the onion accessions are grown in the field in the first year, and replanted into isolation cages in the subsequent year.

Availability of accessions

- **Garlic:** 90% of the accessions are available for distribution (depending on the health status of the material) during the period between harvesting and planting (July–October).
- **Shallot:** about 90% of the accessions are available for distribution (depending on their health condition and multiplication status) in the period between harvesting and planting (July–April).
- **Onion:** 80% of the accessions are available for distribution.

Documentation of collections

Passport data of all collections are fully recorded and computerized and they are available in EVIGEZ (Documentation System on Plant Genetic Resources in the Czech Republic – http://genbank.vurv.cz/genetic/resources/). The passport data were also transferred to the ECP/GR *Allium* Database **(**http://www.hri.ac.uk/site2/research/PGB/ecpgr/ecpgr.htm).

Safety-duplication

Arranging for the safe duplication of collections is considered very important, especially in vegetatively propagated species (garlic, shallot). For example, hazards such as flooding and frosts have occurred in Olomouc in the last decade. Therefore, cryoconservation is being developed for safer conservation. Beside securing materials against the hazards of weather, this technology can also improve plant health status and its maintenance.

Cryopreservation

The methods of *Allium* cryopreservation are based on vitrification procedures, dehydration encapsulation or using cryprotectant solutions (PVS2 Sakai). We investigated the various steps needed for these methods with the aim of improving them. The experiments with dynamic dehydration studies demonstrated the necessity for meristem encapsulation. The encapsulation of shoot-tips prolonged the dehydration period. Differential scanning calorimetry was used to determine the temperature of "glass transition". We found two glass transition temperatures during heating of the cryopreserved material. The first glass transition temperature range appeared between -70°C and -60°C and was independent of the water content. The second glass transition temperature range was between -20°C and -10°C and it was dependent on the dehydration level of the shoot-tips.

Future experiments will focus on the changes of the vitrification temperature to higher temperatures with the aim to enhance the regeneration ability of *Allium* shoot-tips. At first we are starting to improve the cryoprotocol in clones of Czech origin. All samples will be stored in liquid nitrogen at a guaranteed temperature of -196°C. The Czech Crop Cryobank will operate as a safety-duplicate store for the repositories of germplasm kept in the field or in *in vitro* conditions. The Czech Crop Cryobank will be a part of the Gene Bank for plant germplasm storage in Prague-Ruzyne.

Conclusion

In the near future, more precise description and evaluation of collections is planned, including continued chemical analysis and genetic characterization. Data obtained will be processed and put into the EVIGEZ evaluation database. The creation of safety-duplicates is also considered a priority.

Reference

IPGRI, ECP/GR, AVRDC. 2001. Descriptors for *Allium* (*Allium* spp.). International Plant Genetic Resources Institute, Rome, Italy; European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR); Asian Vegetable Research and Development Center, Taiwan.

Current status of the Allium *collections at IPK-Gatersleben, Germany*

E.R. Joachim Keller and Reinhard M. Fritsch*Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK) – Genbank, Gatersleben, Germany*

The Genebank Department

The collection of the Genebank Department includes the main *Allium* crop species. It amounts to 1570 accessions (June 2003). In the course of pre-breeding activities, some wild parent species accessions as well as hybrid material were also included in the genebank collection. Outbreeding species (onion and leek) are in a two-year reproduction cycle. The shallots are replanted in the field and kept in dry in-house storage over winter every year. Garlic and other vegetative material are cultivated in the field in a five-year rotation. The last transfer was carried out in 2002. Table 1 gives a survey of the field cultivation plan followed since 2000.

Table 1. Development of the cultivation in the field and in isolation cages since the last meeting of the *Allium* Working Group

Year	*A. cepa* L. (*)			*A. porrum* L.	Vegetative material		Total
	Seedling plantlets (year 1)	Mother plants (year 2)	Total		Crop species	Others (including 115 hybrids)	
2000	29	38	67	-	801	309	1177
2001	42	34	76	-	812	332	1220
2002	34	23	57	-	847	336	1240
2003	41	34	75	11	840	337	1263

(*) Onion seed production is a bi-annual cycle. In the first year, the seedlings are grown to small bulblets, which are stored over winter and re-planted the following year as mother bulbs for seed production. Thus, each accession has to be planted and to be counted twice.

We have started to rationalize the top onion collection (152 accessions) after recently running an analysis by means of molecular markers, because a relatively high level of undesired duplication was suspected.

In course of the *Allium* GENRES project (1996-2000), a core collection of garlic was selected ("European Garlic Core Collection, Northern Part") and characterized in detail. Twenty-two of the 25 accessions of the core collection are also present as virus-free samples in *in vitro* culture. The field part of this collection, together with some other priority material, was maintained by the staff of the Working Group on "*In vitro* Maintenance and Cryopreservation" until summer 2002. Since then, the gardening services of the IPK continue to maintain this collection (54 accessions) in an annual cultivation cycle.

Safety-duplication of vegetatively propagated material is one of the tasks of the IPK genebank (Table 2). Most of the work was done during an emergency mission in 1994. Other material has been exchanged within the *Allium* GENRES project.

Table 2. Safety-duplication activities on *Allium* in the IPK genebank

Crop	No. of accessions	Genebank	Remarks
Garlic	78	Czech Republic	62 also *in vitro*
	42	Spain	2 also *in vitro*
	20	Poland	1 also *in vitro*
Shallot	24	Czech Republic	
	7	Austria (NGO)	*in vitro* only
Great-headed garlic	2	Spain	1 also *in vitro*
Hybrids	4	Czech Republic	
Total	**177**		**73 *in vitro***

In vitro storage and cryopreservation are tasks of a special Working Group within the IPK genebank (Keller and Senula 2001). They are mainly aimed at rationalizing the labour-intensive conservation of vegetatively propagated material. Slow growth storage (Table 3) is done in culture rooms (cycles of cold storage for 1-1.5 years at 2°C and warm multiplication phases at 20-25°C). One sample consists of a maximum of two independent sets each of 18 plantlets per accession.

Table 3. Slow growth storage using *in vitro* cultures

Crop	No. of accessions	
	Total	Virus-free
Garlic	132	95
Shallot	40	26
Hybrids	73	
A. chinense	4	
A. hookeri	2	
Others	127	
Total	**378**	**121**

Cryopreservation started to be used for the first time as a routine measure at the beginning of 2003. Seventeen garlic accessions (of which 10 were virus-free) were introduced into the cryo-tanks. For safety reasons, several sets per accessions have been frozen: the total is 42 sets, i.e. 2.5 sets per accession on average (120 explants/accession).

In 2001, the Genebank Working Group "*In vitro* Maintenance and Cryopreservation" participated in the organization of an *ad hoc* meeting on vegetatively propagated alliums at Gatersleben (Maggioni *et al.* 2002) under the auspices of the ECP/GR Vegetables Network.

The Taxonomy Department

The taxonomic reference collection is supervised by R. Fritsch and maintained by a special contract gardening service. It amounts to 2067 accessions with 1600 taxa finally determined (July 2003). In the collection, 340 *Allium* species and 24 species of related genera are represented. The number of original samples is 1469. They were either collected by the IPK staff or obtained from botanic gardens. They are regarded as MOS (most original samples) because of their origins.

The following missions to study indigenous material have been carried out in the last three years: one in 2001 (Uzbekistan), three in 2002 (Turkmenistan, Georgia, Armenia and Turkey) and two in 2003 (Tajikistan and Uzbekistan).

Based on recent research results, a new *Allium* classification proposal has been published (Fritsch 2001; Fritsch and Friesen 2002). Research revealed that three main evolutionary lines exist in this genus, differing from the former subgenera. This finding should also have consequences for any future breeding and crossing strategies.

Structuring the wild species genepool – List of "candidate species"

Exploration of the worldwide use of *Allium* crop species, research and pre-breeding activities have allowed us to accumulate knowledge about the different potential usefulness of the species within the genus *Allium*. A small part of this genus, apart from the main species onion/shallot, leek, garlic, bunching onion, chives and Chinese chives, comes into focus in this respect. These species form a secondary genepool, which deserves more active preservation in genebanks. We call this list the "candidate species", which are likely to become more important in future for further breeding and development. They may be arranged in three groups, as follows:

Group 1. Species already reported to be cultivated and used (Fritsch and Friesen 2002)

A. altaicum Pall.
A. canadense L.
A. chinense G. Don
A. consanguineum Kunth
A. hookeri Thw.
A. kunthii G. Don
A. macrostemon Bge.
A. neapolitanum Cyr.
A. nutans L.
A. obliquum L.
A. oschaninii O. Fedt.
A. pskemense B. Fedt.
A. rotundum L.
A. ursinum L.
A. victorialis L.
A. wallichii Kunth.

Group 2. Species of the onion alliance with possibilities for being crossed with onion (for example, see Keller *et al.* 1996)

A. albidum Fisch. ex Bieb.
A. altyncolicum Friesen
A. angulosum L.
A. carolinianum DC.
A. chevsuricum Tscholok.
A. globosum M. Bieb. ex Ried.
A. hymenorrhizum Ldb.
A. karelinii Poljak.
A. lineare L.
A. lusitanicum Lam.
A. oreoprasum Schrenk
A. roylei Stearn
A. rubens Schrad. ex Willd.
A. saxatile M. Bieb.
A. senescens L.

Group 3. Species of the leek alliance with possibilities for being crossed with leek (according to Mathew 1996)

A. acutiflorum Loisel.
A. ampeloprasum L. (s.l.)
A. asirense B. Mathew
A. atroviolaceum Boiss.
A. bourgeaui Rech. fil.
A. cappadocicum Boiss.
A. commutatum Guss.
A. gramineum C. Koch.
A. iranicum Wendelbo
A. leucanthum C. Koch
A. macrochaetum Boiss. & Hausskn.
A. oltense Grossh.
A. pardoi Loscos
A. polyanthum Schultes & Schultes fil.
A. pseudoampeloprasum Miscz. ex Grossh.
A. pseudophanerantherum Rech. fil.
A. pyrenaicum Costa & Vayreda
A. rollovii Grossh.
A. sandrasicum Kollmann, N. Özathay & Bothmer
A. scaberrimum Serres
A. talijevii Klokov
A. talyschense Miscz. ex Grossh.
A. truncatum (Feinbr.) Kollmann & D. Zohary
A. tuncelianum (Kollmann) N. Özhatay, B. Mathew & Siraneci

The groups are based on experience acquired so far and may be expanded or modified in accordance with any new evidence in future.

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Allium *genetic resources activities in Israel*

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Current status of the field collection of short-day alliums

The collection is maintained by Haim D. Rabinowitch of The Hebrew University of Jerusalem, at the experimental farm of the Faculty of Agricultural, Food and Environmental Quality Sciences, Rehovot Campus, and is partially supported by the Israeli Gene Bank (IGB). The collection was started in 1983 and currently contains about 500 entries of garlic, great-headed garlic (elephant garlic, *A. ampeloprasum*), tropical and subtropical shallot, *A. tuberosum* and *Allium* species growing wild in Israel (Table 1).

The collection includes plant material from Southeast Asia, Africa, Central and South America and Israel. A few accessions from southern Europe and the USA are maintained in the collection as well.

Table 1. *Allium* accessions preserved in the Israeli field collection of short-day vegetatively propagated *Allium* species (Rehovot, Israel)

Botanical name	Horticultural name	No. of accessions
Allium sativum	Garlic	320
A. ampeloprasum	Elephant garlic	15
A. cepa Aggregatum Group	Shallot	70
A. tuberosum	Chinese chives	15
Wild species from Israeli flora	-	80*

* Duplicated samples from various geographical zones in Israel

Allium species with ornamental potential, as well as fertile garlic accessions, are maintained by Rina Kamenetsky at the Volcani Center in Bet Dagan. Vegetatively propagated plants are grown in a shaded screenhouse. Evaluation of the species for their value as new ornamentals and to study their florogenesis and flowering physiology was supported by a binational Dutch-Israeli Agricultural Research Program (DIARP) and private funds for limited periods.

Table 2. *Allium* accessions with ornamental potential preserved in the Israeli field collection at the Volcani Center, Bet Dagan

No.	Genus / species	Hardiness	No.	Genus / species	Hardiness
1	*A. moly*	Tender	12	*A. giganteum*	Hardy
2	*A. triquetrum*	Tender	13	*A. nevskianum*	Hardy
3	*A. zebdanense*	Tender	14	*A. stipitatum*	Hardy
4	*A. platicaule*	Tender	15	*A. oreophilum*	Hardy
5	*A. amethystinum*	Tender	16	*A. regelii*	Hardy
6	*A. neapolitanum*	Tender	17	*A. rubellum*	Hardy
7	*A. roseum*	Tender	18	*A. cristophii*	Hardy
8	*A. altissimum*	Hardy	19	*A. caspium*	Hardy
9	*A. sarawschanicum*	Hardy	20	*A. borszczowiii*	Hardy
10	*A. suworowii*	Hardy	21	*A. nigrum*	Tender
11	*A. aschersonianum*	Tender	22	*Nothoscordum siculum*	Tender

The majority of the new acquisitions were obtained in a number of collecting missions to Kazakhstan, Uzbekistan and other former Soviet Republics in Central Asia. These collections were carried out in collaboration with local scientists, and were supported by private funds for limited periods.

About 800 entries from the vegetatively propagated collections at the Volcani Center and the Faculty of Agricultural, Food and Environmental Quality Sciences in Rehovot are included in the European *Allium* Database (EADB) (Astley 1999).

Collecting missions and research activities

- **Project "Expansion and conservation of *Allium* collection from Kazakhstan and neighbouring areas and its evaluation for ornamental, edible, and medicinal traits"**

Supported by a private fund, 1996-1999.

R. Kamenetsky and H.D. Rabinowitch (Israel) and I.O. Baitulin, G. Agafonova and A.A. Ivashenko (Kazakhstan).

Central Asia is the principal centre of genetic diversity of the genus *Allium*. About 230 of the 700 *Allium* species grow wild in this region, and over 100 are endemic to the area. The aim of the project was to collect, document, preserve and initiate the evaluation of representative samples of the *Allium* flora from Kazakhstan and neighbouring areas. Eight long-range and ten short-range collecting missions explored regions in the south, south-west and east of Kazakhstan, Uzbekistan, Kyrgyzia and Turkmenistan. Information on the distribution of wild *Allium* populations was recorded and about 200 accessions of wild *Allium* species and of edible alliaceous landraces were collected. Samples were sorted out, classified, documented and planted in Almaty (in the reconstructed *Allium* plot of the National Botanical Gardens) and in Israel (Bet Dagan collection: ornamentals and wild species; Rehovot collection: edible plants). Florogenesis, developmental morphology and the effect of cold storage on water status in bulb tissues of the ornamental species were investigated (Baitulin *et al.* 2000; Kamenetsky 2002).

- **Project "Development of high quality *Allium* species for cut flower production"**

Supported by the Dutch-Israeli Agricultural Research Program (DIARP), 1996-1999.

R. Kamenetsky and H.D. Rabinowitch (Israel) and C. Kik (The Netherlands).

This project had two lines of research: one was focused on the study of florogenesis and flowering physiology (R. Kamenetsky and H.D. Rabinowitch, Israel) and the other on disease resistance, especially white rot resistance (Chris Kik, CPRO-DLO). Pre- and postharvest morphological and physiological changes occurring during floral development have been studied for two ornamental *Allium* species from the subgenus *Melanocrommyum: Allium aflatunense* and *A. stipitatum,* under fully controlled conditions. Scanning electron microscopy (SEM) and Magnetic Resonance Imaging (MRI) have been used to study monocarpic shoot development and florogenesis, in connection with the annual life cycle. Cold storage treatment of the *Allium* species considerably affects floral stem elongation. When growing in temperatures of 20/12°C (day and night, respectively) and a photoperiod of 10 hours, the fastest stalk elongation was recorded after treatment at a temperature of 4°C for 16 weeks in *A. aflatunense*, and after treatment at a temperature of 2°C for 12 weeks in *A. stipitatum*. Growth temperatures affect leaf and floral stem elongation. Maximal stalk length was achieved in both species cultivated at 17/9°C (day and night, respectively). Relatively high growth temperatures depressed stalk elongation and vegetative reproduction (Kamenetsky 1997; Zemah *et al.* 1999, 2001; Kamenetsky and Fritsch 2002).

- **Project "Collection and conservation of *Allium* species from Uzbekistan and their evaluation for ornamental, edible and ornamental traits"**

Supported by the U.S. Agency for International Development (USAID), 2000-2003.

R. Kamenetsky and H.D. Rabinowitch (Israel) and F. Khassanov (Uzbekistan).

The aim of the project is the collection, documentation, preservation and initial evaluation of *Allium* flora from Uzbekistan and neighbouring areas. The collecting missions went to the West Tien-Shan area (Chimgan), the southern regions of Uzbekistan and Turkmenistan, to Aksu-Dzhebagly (Kazakhstan), Chatkal biosphere reserve, Ugam-Chatkal national park (Uzbekistan) and to the Fergan depression. The collected material was classified; documented and representative samples of 21 *Allium* species were transferred to Israel for preservation and evaluation. A duplicated parallel collection was established in Tashkent, Uzbekistan. Phenological observations revealed a significant horticultural potential of several *Allium* species as new ornamental crops. The kinetics of florogenesis of *A. ampeloprasum* and the association between phenological cycles and intra-bulb developmental processes were studied, and the scientific foundations were laid for future utilization of these plant species as new ornamental crops in both countries.

- **Project "Garlic and Health; the development of high quality garlic and its influence on biomarkers of atherosclerosis and cancer in humans for disease prevention"**

Supported by the EU, 1999-2003.

- **Floral development of garlic**

Garlic was until recently regarded as a completely sterile plant, propagated only vegetatively. The sequence of morphological processes occurring during floral initiation and development of a number of bolting garlic accessions from the *Allium* genebank in Israel was observed by SEM. The garlic inflorescence is an umbel-like flower arrangement, the branches (flower clusters) of which arise from a common meristem. The numerous flowers have a distinct morphology typical of the genus *Allium.* Flower-stalk elongation precedes the swelling of the apical meristem and its subdivision into several centres of floral development. Within clusters, floral primordia develop unevenly. Differentiation of topsets begins after floral differentiation on the peripheral part of the apical surface, and their size, number and rapidity of development vary among genotypes. At least four morphological types, differing in flower/topset ratio were distinguished among 14 clones studied (Kamenetsky and Rabinowitch 2001; Rabinowitch and Kamenetsky 2002).

- **Environmental control of garlic growth and florogenesis**

Elucidating the effects of temperature and of photoperiod on garlic (*A. sativum* L.) growth and florogenesis might solve the enigma of garlic sterility and provide environmental tools for flowering regulation and fertility restoration. The effects of storage temperature and growth conditions on the interactive relationships between the developing vegetative and reproductive organs were studied. Exposure of the studied garlic genotype to long photoperiod for more than two weeks is required for both dormancy induction of the axillary buds and clove formation. In contrast, a combination of low temperatures with short photoperiod resulted in sprouting and growth of the axillary buds. Four phases were recognized in the florogenesis of garlic, including: transition of the apical meristem, scape elongation, inflorescence differentiation, and completion of floral development. In garlic accession no. 2091, meristem transition is autonomous and occurs in growing plants under a variety of storage and growth conditions. The temperature effect was quantitative: low storage and growth temperatures and long photoperiod promoted scape elongation; whereas warm temperatures and long photoperiod promoted the translocation of reserves to the cloves, and resulted in the degeneration of the developing inflorescence. Optimal

inflorescence development occurs under short photoperiods, with a one-week interruption by long photoperiod, which triggers the essential elongation of the scape in post-transitional plants. Differentiation of topsets follows flower formation and is dominated by and requires lengthy exposure to a long photoperiod. Hence, under short photoperiods with only short interruption of long photoperiod, normal development of fertile flowers occurs. We conclude that in bolting garlic genotypes, manipulation of the environment, both prior to and after planting, can regulate the development of flowers in a topset-free umbel, and lead to regained floral fertility. Normal flowering cannot be achieved if any of the four developmental stages of florogenesis listed above is inhibited (Kamenetsky *et al.* 2004b).

- **Evaluation of the garlic collection for fertility potential**

The collection of a large number of garlic accessions is the only means available for expansion of genetic variability with regard to yield, quality, tolerance to biotic and abiotic traits as well as flowering and possibly fertility restoration. A large number of garlic accessions was recently collected in Central Asia – the main centre of garlic diversity. Plants were documented according to IPGRI rules, and thereafter evaluated and maintained in the field collections of vegetatively propagated alliums in Israel. The studied accessions were subdivided into two distinct sub-populations: semi-bolters and bolters. Most of flower-producing accessions produced both fertile pollen and receptive stigmas, and true garlic seeds were obtained from about 20 accessions (Kamenetsky *et al.* 2004a).

- **Diversity in fertility potential and organo-sulphur compounds among garlics from Central Asia**

120 garlic accessions collected in Central Asia were documented and thereafter maintained in field collections in both Israel and the Netherlands. The collection was evaluated for biological and economic traits. Garlic clones vary in most vegetative characteristics (leaf number, bulb size and structure), as well as in floral scape elongation and inflorescence development. A clear distinction was made between semi-bolting and bolting populations; most of the accessions in the latter populations produced flowers with fertile pollen and receptive stigmas. Wide variations were recorded with regard to differentiation of topsets, their size, number and rapidity of development. Furthermore, significant variation in organo-sulphur compounds (alliin, isoalliin, allicin and related dipeptides) was found within garlic collections and between plants grown under differing environmental conditions. Genetic fingerprinting by means of AFLP markers revealed three distinct groups within this collection, which also differed in flowering ability and organo-S content (Kamenetsky *et al.* 2005).

- **Project "Florogenesis and propagation of tropical shallot"**

  Haim D. Rabinowitch and Rina Kamenetsky.

Growth analyses and microscopic observations revealed strong similarities in organ development between shallots and bulb onions. However, some significant differences were observed, mainly with regard to the minimum physiological age for the differentiation of both laterals and floral initials, and to the development of the inflorescence. When grown from seed, the initiation of laterals and the first signs of floral differentiation already become evident after the third and sixth true leaves, respectively, as compared to the bulb onion which first produces 13 or 10-14 leaves, respectively. The shallot inflorescence can be described as an umbel-like flower arrangement, where branches (flower clusters) arise from a common meristem. Leaf formation continues at the axillary meristems in shallots, simultaneously with floral development of the original apex. Shallots can be induced to flower by cold treatment in storage at 5-10°C, whereas high and intermediate storage temperatures delay the development of the inflorescence. During growth, high temperatures may suppress already-initiated inflorescences. Plants from larger sets flowered more readily

than those from small ones, and genotypes varied significantly in their response to cold induction (Krontal *et al*. 1998, 2000; Rabinowitch and Kamenetsky 2002).

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Allium *germplasm in Lithuania*

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Collecting, evaluation and maintenance of vegetatively propagated *Allium* species at the Lithuanian Institute of Horticulture

The collection of vegetatively propagated alliums at the Lithuanian Institute of Horticulture was established in 1992. This collection includes mainly the most popular alliums, namely, *A. sativum* L. and *A. cepa* var. *aggregatum*[12] (Table 1). New accessions enter the collection continually. Almost all material is maintained in the field collection. In order to minimize loss of the material (winter garlic) during unfavourable winter conditions some of the bulbils and bulbs are kept in a storehouse.

The accessions of garlic are evaluated for 16 characters and those of vegetatively propagated onions for 14 characters. Garlic and onions exhibiting economically important biological and morphological traits are identified for breeding purposes after their evaluation. On the basis of the results obtained, one line of winter garlic has been registered in the National List of varieties (1998) and one line was submitted for official variety testing.

Collecting and investigation of wild alliums at the Institute of Botany

Lithuanian wild *Allium* species have been studied at the Institute of Botany since 1999. There are seven wild species in the genus (and five cultivated ones, except for ornamentals) in Lithuania. The most common are *A. oleraceum* and *A. ursinum*. The other species are rare or very rare. Four species are included into the Red Data Book of Lithuania (Table 2.). The scope of the scientific research here covers species distribution and reproduction as well as the structure of populations. Plant samples are moved from the most investigated populations into the field collection for morphological and biological evaluation after they are characterized in their natural habitats.

The collection of wild alliums consists of 41 accessions of 6 species. All the accessions were collected in natural or semi-natural habitats and are maintained vegetatively. They are not duplicated in any other collections.

Other *Allium* collections in Lithuania

The Botanical Gardens of Vilnius University, Kaunas Botanical Gardens of Vytautas Magnus University, the Botanical Gardens of Klaipėda University and the Botanical Gardens of Šiauliai Universities maintain collections of *Allium* originating mainly from abroad, while most of the accessions at the Institute of Botany and the Lithuanian Institute of Horticulture were collected within the country. In total, 188 accessions representing 34 *Allium* species are held in these collections (Table 3).

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[12] The standard used for this taxon in the European *Allium* Database is *A. cepa* Aggregatum Group.

Table 1. Collection of vegetatively propagated alliums at the Lithuanian Institute of Horticulture

Accession number	Type of sample	Country of origin	Year of inclusion in the collection
Garlic			
8-5	line	Lithuania	1993
9	line	Lithuania	1993
11	line	Lithuania	1993
13	line	Lithuania	1993
13-1	line	Lithuania	1997
13-3	line	Lithuania	1999
14	line	Lithuania	1993
15	line	Lithuania	1993
17-1	line	Lithuania	1995
19	line	Lithuania	1993
19-5	line	Lithuania	1997
19-9	traditional cultivar	Lithuania	1999
20-1	traditional cultivar	Lithuania	1999
20-2	traditional cultivar	Lithuania	2001
21-1	line	Denmark	2001
21-3	line	Denmark	2002
Jarus	variety	Poland	2002
Winter garlic			
1	line	Lithuania	1993
4	line	Lithuania	1993
6	line	Lithuania	1994
7	line	Lithuania	1994
11	line	Lithuania	1997
15	line	Lithuania	1997
16	line	Lithuania	1998
21	traditional cultivar	Lithuania	2000
22	line	Estonia	2002
Ž1	line	Lithuania	1998
Ž2	line	Lithuania	1998
Ž3	line	Lithuania	1999
'J.Gribovskij'	variety	Russia	1994
'Žiemiai'	variety	Lithuania	1993
Vegetatively propagated onion			
V2-1	traditional cultivar	Lithuania	1996
V2-2	traditional cultivar	Lithuania	1999
V3-1	traditional cultivar	Lithuania	1997
V3-2	traditional cultivar	Lithuania	1999
V3-4	traditional cultivar	Lithuania	2000
V3-6	traditional cultivar	Lithuania	2000
V3-7	traditional cultivar	Lithuania	2001
V3-8	traditional cultivar	Lithuania	2001
V3-10	traditional cultivar	Lithuania	2001
V3-12	traditional cultivar	Lithuania	2002
V4	traditional cultivar	Lithuania	2003
'White Gourmet'	variety	The Netherlands	1999

Table 2. Wild *Allium* species of the Lithuanian native flora and number of accessions collected

Species	Occurrence in the wild	Category of the Red Data Book	No. of accessions collected
A. angulosum	Very rare	Rare (3)	1
A. oleraceum	Common	–	16
A. schoenoprasum	Very rare	–	0
A. scorodoprasum	Rare	Rare (3)	3
A. senescens subsp. *montanum*	Very rare	–	1
A. ursinum	Rare	Restored (5)	19
A. vineale	Rare	Vulnerable (2)	1
Total			**41**

Table 3. *Allium* collections in Lithuania

Species	Botanical Gardens				Inst. of Botany	Inst. of Hort.	Total
	Vilnius	Kaunas	Klaipėda	Šiauliai			
A. altaicum Pall.		1					1
A. altissimum Regel	1						1
A. angulosum L.				1	1		2
A. cernuum Roth				1			1
A. caeruleum Pall.		2					2
A. caesium Schrenk		1					1
A. carinatum L. subsp. *pulchellum* Bonnier & Layens		1					1
A. cepa L.		1	1			12	14
A. cristophii Trautv.		1					1
A. cupuliferum Regel	1						1
A. fistulosum L.				1	2		3
A. flavum L.		1	1	1			3
A. galanthum		1					1
A. giganteum Regel	1	1					2
A. hymenorrhizum Ledeb.					1		1
A. jesdianum Boiss. 'Purple King'		1					1
A. karataviense Regel	1	1		1	1		4
A. ledebourianum Roem. et Schult. f.		1					1
A. moly L.	1	1		1			3
A. moly 'Jeannine'	1						1
A. monodelphum Less. ex Kunth.		1					1
A. narcissifolium Vill.		1					1
A. neapolitanum Cyr.		1					1
A. nutans L.		2		1		2	5
A. obliquum L.	1	1		1	1		4
A. oleraceum L.					16		16
A. oreophilum C. A. Mey	1	1		1			3
A. paradoxum G. Don				1			1
A. polyphyllum Kar. et Kir.			1				1
A. porrum L.		1	1				2
A. proliferum Moench Schrad. ex Wilid			1				1
A. pskemense B. Fedtsch.		1					1
A. pyrenaicum Costa et Vayr.			1				1
A. pulchellum Don					1		1
A. ramosum L.			1	1	2		4
A. rosenbachianum Regel	1	1					2
A. rosenbachianum 'Michael Hoog'	1						1
A. rosenbachianum 'Purple King'	1						1
A. sarawschanicum Regel 'Chinoro'	1			1			2
A. sativum L.			1	1		33	35
A. schoenoprasum L.		2		1		5	8
A. schubertii Zucc.	1	1					2
A. scorodoprasum L.				2	3		5
A. senescens L.					1		1
A. senescens subsp. *montanum* Fries					1		1
A. sphaerocephalon L.	1	1	1	1			4
A. stipitatum Regel		1					1
A. stipitatum Regel f. *alba*		1					1
A. stipitatum 'Mount Everest'	1						1
A. thunbergii G. Don.			1				1
A. tibeticum Rendle				1			1
A. turkestanicum Regel					1		1
A. unifolium Kell.	1						1
A. ursinum L.	1	1	1	2	19		24
A. victorialis L.		1		1			2
A. vineale L.				2	1		3
A. zebdanense Boiss. et Noë	1			1			2
Total no. of species	**15**	**28**	**11**	**21**	**15**	**4**	**34**
Total no. of accessions	**18**	**32**	**11**	**24**	**51**	**52**	**188**

The Allium *collection in the Nordic Gene Bank*

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The Nordic Gene Bank (NGB) was established more than 20 years ago with the aim of conserving the germplasm from the five participating countries on a regional basis rather than as five national collections. The material in the NGB is only "Nordic" material originating from Denmark, Finland, Iceland, Norway and Sweden, in the sense that it has either been bred in the region or was previously extensively cultivated.

The NGB is located in Alnarp in the province of Scania, in the southern part of Sweden, on the campus of the Swedish Agricultural University. The Scandinavian region is the home of some *Allium* Breeding companies: Ohlsens Enke, Dæhnfeldt and Hammenhög. Chives are growing wild in the NGB region and several collecting missions have been carried out.

Work with the germplasm is organized by the inter-Nordic vegetable working group.

The collection comprises traditional seed-propagated material of Nordic origin and vegetatively propagated material that has traditionally been grown in the region:

Allium cepa var. *cepa* L.	Onion
Allium cepa var. *solaninum* Alef.	Potato onion
Allium cepa var. *ascalonicum* Backer[13]	Shallot
Allium fistulosum L.	Welsh onion
Allium porrum L.	Leek
Allium schoenoprasum var. *schoenoprasum* L.	Chives
Allium schoenoprasum var. *sibiricum* (L.)	Siberian chives
Allium sativum L.	Garlic

The current status of the collection is shown in Table 1.

Table 1. *Allium* material in the Nordic Gene Bank Collection

Species	Country of origin	No. of accessions			
		Advanced cultivars	Landraces	Wild species	Total
Allium cepa var. *cepa*	DNK	28			
	NOR	3			**41**
	SWE	9	1		
Allium cepa var. *solaninum*	FIN		52		**60**
	SWE		8		
Allium cepa var. *ascalonicum*	DNK		25		**42**
	NOR		17		
Allium schoenoprasum var. *schoenoprasum*	SWE			30	
	DNK		4	4	**43**
	NOR			5	
Allium porrum	DNK	31			
	NOR	1			**40**
	SWE	7	1		
Allium fistulosum	NOR		4		**4**
Allium sativum	FIN		8		**8**

[13] The standard used for this taxon in the European *Allium* Database is *A. cepa* Aggregatum Group.

The vegetatively propagated material of onions in the Nordic Countries, however, is under national responsibility and is traditionally stored in clonal archives in the country of origin. This material is endangered as its conservation has been threatened several times by virus attacks and economic cut-backs. Fortunately, the safety collection located in the Czech Gene Bank of the Research Institute of Crop Production, Olomouc Station, could supply us with some of the missing accessions. Vegetative onions are therefore highly prioritized as the target crop to be stored in the newly established *in vitro* safety base collection in the Nordic Gene Bank.

Storage

Seeds of the NGB accessions are stored in the base collection and the active collection at -20°C after drying to 5-7% moisture content (FAO/IPGRI 1994). The safety storage is subject to natural conditions at -4°C. Generally, we store 4000 viable seeds in the base collection, 10 000 in the active collection and 500 in the safety store. After 15 years in storage, seed germination of samples in the safety store ranges between 75% and 94%. Viability tests are performed after 10 years and regeneration is initiated when germination drops below 60%.

Seventy-six seed-propagated accessions accepted for long-term preservation are safety-duplicated, i.e. 92% of the accessions as the chives are not yet officially accepted.

Characterization and evaluation

The NGB participated in the GENRES-20 project which initiated an increased level of activity in the onions. All the material was characterized using both UPOV test guidelines and the project's minimum descriptor list. An evaluation of 25 accessions for resistance to downy mildew (*Peronospora parasitica*) was performed.

This year a project was initiated to characterize the collection using molecular markers.

Collections

As part of the GENRES project wild chive material was collected, and this work has continued beyond the expiration of the project. Additionally, shallots from Denmark and Sweden are being collected and eight traditionally-grown Finnish garlic samples have also been included in the collection.

Documentation and availability

All our material can be found on the NGB homepage at www.ngb.se. The characterization data have not been fully published yet. The material in the NGB is presently available without any restrictions to *bona fida* users. In future we will adapt to international legislation.

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Allium *genetic resources maintained in the Polish Gene Bank*

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The *Allium* germplasm collection at the Research Institute of Vegetable Crops (RIVC) includes 1392 accessions of cultivated and wild *Allium* species. The current status of our *Allium* collections is shown in Table 1. Passport data for all the collected accessions have been changed in accordance with the FAO/IPGRI *Multi-crop Passport Descriptors* and FAO WIEWS descriptors.

Table 1. Status of *Allium* germplasm collections, RIVC-Skierniewice, 2002

Species	No. of records in database	Passport data	Evaluation / Characterization	Seed in long-term storage	Field collection 2003	Duplication
A. cepa	267	267	94	267		57
A. cepa var. *aggregatum*[14]	179	179	147	34	179	10
A. sativum	499	499	488		383	78
A. porrum	23	23		23		
Other *Allium*	424	424	167	117	300	
Total	**1392**	**1392**	**896**	**441**	**862**	**145**

Within the framework of the national programme of vegetable germplasm conservation, we are continuously maintaining four field collections of the genus *Allium* located in two regions of Poland. During 2000-2003 the following field collections were maintained:

Garlic (*A. sativum* L.)

The garlic collection established in 1986 was originally located in Krzczonów in southern Poland, but in 2003 the collection was transferred to a new location (300 km south of Skierniewice) at Janowice near Bielsko-Biała in the Carpathian mountains. In 2003 the collection included 383 accessions of garlic (Table 1): 141 accessions for winter planting and 242 for spring planting. Some of the material is maintained in the field collection after 3 years in trials, and other accessions are at the stages of multiplication and preliminary characterization.

The accessions of garlic, after initial multiplication, are included in 3 year trials (3-4 replications) to evaluate their economic value. After a 3-year research cycle, the accessions are then maintained in the field collection as one bulk sample (100 plants of each accession). Evaluation is conducted according to the descriptors for *Allium* developed by IPGRI and further adapted by RIVC.

The accessions maintained in the collection are documented for passport data. Minimum characterization (14 traits) was carried out for 259 garlic accessions and data sent to the European *Allium* database (EADB).

Evaluation has been made on 488 accessions according to IPGRI standards and the needs of breeders. Evaluation data include 31 characters from the IPGRI descriptor list, 39 characters related to the economic value, an estimate of the variability of six enzyme systems, and the content of alliine, dry matter, sugars and vitamin C.

[14] The standard used for this taxon in the European *Allium* Database is *A. cepa* Aggregatum Group.

Digital documentation is now available for 260 accessions and includes bulbs, cloves, flower stalk and cross-section of heads. Some of the material (about 40%) has also been documented in the form of slides, photographs and video films which record the habitat of the collected accessions.

On the basis of these results several accessions of garlic have been selected for a breeding programme and three new garlic cultivars ('Arkus', 'Harnas' and 'Orlik') were registered.

Within the framework of the garlic collection, investigations were made dealing with cryopreservation of garlic germplasm. This research work was a continuation of investigations initiated during the IPGRI project carried out at IPK-Gatersleben in collaboration with RIVC-Skierniewice. The aim of the study was to establish an efficient method for garlic germplasm micropropagation and effective methods for long-term conservation using *in vitro* culture and liquid nitrogen. Vitrification methods were investigated. The subjects are the bulbils of 18 accessions of garlic (*Allium sativum* L.) from our collection. Results showed that the best kind of explants to secure high regrowth frequency are shoot tips isolated from bulbils. We found that survival and regrowth after cryopreservation were dependent on the genotype, accession and size of garlic bulbils. The plants of the 18 garlic accessions used in vitrification tests, after a successful adaptation period in the greenhouse, were planted in field trials in 2001 and well-developed bulbs were harvested (Kotlińska 2002a; Makowska and Kotlińska 2000, 2001a,b,c, 2001d). These bulbs are also maintained in the field collection. In 2002 the project dealing with cryopreservation of garlic was stopped because of lack of funds.

During the period covered by this report, we finished the **i**nvestigations conducted during 1986-2000, including those on 292 accessions of *Allium sativum* L. and *A. longicuspis* Regel from the genebank collection maintained at RIVC-Skierniewice. The accessions originated from 23 countries, and 70 of these accessions came from the centre of diversity in Central Asia.

The objectives of the research work were: 1) to evaluate the variability of quantitative and qualitative traits of *A. sativum* and *A. longicuspis* collected in Central Asia; 2) to analyze the isozyme variation; 3) to determine alliine content; and 4) to make a useful classification and to evaluate practical germplasm utilization.

Multivariate statistical methods such as Analysis of Variance (ANOVA) and Multivariate Analysis of Variance (MANOVA) were used. Principal component analysis was performed in order to find which traits have the greatest effect on multitrait variation of the accessions studied and to distinguish these accessions. Then the first two or three principal components were used to show the distribution and similarity of accessions.

Principal component analyses were performed separately for each experiment. The first five principal components explained from 56.2 to 82.5% of the total variation, while the first three explained from 42.9% to 63.8% of the total variation. Principal component analysis was performed on data matrices from several experiments that included 162 garlic accessions in total and 23 accessions of *A. longicuspis* and *A. sativum*.

Cluster analysis was used to distinguish groups of accessions characterized by similar type of intra-population variation. Similarity of the accessions was illustrated with trees constructed using data matrices of traits, principal components and electrophoretic phenotypes. Dendrograms were constructed using Euclidian distances and average linkage or Ward methods.

Bolting garlic accessions revealed great variability for the weight and number of bulbils and also flower number in the inflorescence. On the basis of measurements of these parameters in 97 garlic accessions, five classes for weight and number of bulbils were distinguished. Because these traits are stable over years, they can be used as criteria for grouping accessions in collections.

Twenty-one types of clove arrangements, based on a transverse cut of the head, were observed in 185 accessions. Among the accessions studied, 47.3% are non-bolting, 43.1% are bolting, 3.4% show incomplete bolting and 6.2% are irregularly bolting.

Of 292 garlic accessions, 58.2% are suitable for spring growing, 34.9% for autumn growing and 6.9% for both growing seasons.

The content of alliine in 151 analyzed garlic accessions ranged from 0.13% to 1.65%.

Analyses of 246 clones of cultivated garlic and wild species (*A. longicuspis*) for four enzyme systems revealed 17 banding patterns for six loci (*Tpi-2*, *Est-2*, *Est-4, G6pd, Pgm-1* and *Pgm-2*) and enabled selection of 55 electrophoretic phenotypes.

Evaluation was carried out on 23 accessions of *A. sativum* and *A. longicuspis* collected during the expeditions to the centre of diversity in Central Asia and neighbouring areas, for 24 quantitative and qualitative traits during plant vegetative growth and 26 postharvest traits. Results showed that variation of *A. longicuspis* overlaps the variation range of *A. sativum,* in spite of the fact that there were some differences in morphological traits and isozyme markers.

In addition, six field trials were conducted on a 3-year cycle each. Randomized complete block design was used in field trials, and each accession was replicated 3 or 4 times.

The observations were carried out in accordance with the descriptor list for the genus *Allium* developed by IPGRI and further adapted by RIVC-Skierniewice. Cluster analysis was used to select from 3 to 6 groups characterized by similar variation of the traits studied from 6 experiments involving 20 to 37 accessions each. The results of evaluation of variation of 27 morphological and usable traits of 162 garlic accessions, originating from 16 countries, allowed us to select the 12 most representative and least correlated traits that were useful for grouping these accessions. The garlic accessions studied were divided into 32 groups based on these traits. These groups included 13 groups of bolting garlic accessions, 2 groups of incompletely bolting accessions, 3 groups of accessions irregularly producing flower stalks and 14 groups of non-bolting accessions.

Sixty-six of the evaluated accessions which showed high economic value for the most important usable traits have been selected. The majority of the chosen garlic accessions consisted of landraces of Polish origin. The results suggests close affinity between some of the Polish garlic landraces, mainly of the bolting type, and the accessions collected in Central Asia and West Siberia.

The results showed great variability for the morphological, biochemical and usable traits of accessions maintained in the collection. These accessions are a valuable source of new variation and significantly broaden the range of diversity gathered until now. The results confirm the importance and relevance of gathering and maintaining the germplasm collection. The practical result is to provide breeders with an accessible database and initial material characterized by high economic value, suitable for food processing and the pharmaceutical industry (Kotlińska 2002b).

Shallot (*A. cepa* var. *aggregatum*)

The collection of shallot landraces was established at RIVC in 1988 based on landraces originating from Poland and neighbouring areas. There are no advanced cultivars of shallot in Poland, only landraces growing in home gardens (Kotlińska 2002a).

The shallot collection currently consists of 179 accessions, including 35 originating from Russia, Ukraine, Moldova, Slovakia, Albania and the USA, and the rest from Poland. About 40% of the accessions are capable of producing seeds. We deposited 34 seed samples in seed storage. All of the collected accessions of shallot are documented for passport data and have been evaluated for 40 traits according to IPGRI and UPOV descriptor lists, including

susceptibility to onion fly and to virus diseases. Visual digital documentation is available for 40 accessions and includes images of bulbs, aggregates or clusters, cross-sections, etc.

The amounts and changes in the flavonols (kaempferol, myrecetin, quercetin) content during the vegetation period, during storage and in dehydrated shallot were investigated for 10 landraces of shallot (Horbowicz and Kotlińska 2000, 2001a,b, 2002).

The seeds of 10 shallot accessions are maintained by CGN in Wageningen as duplicates.

Edible and wild species

The collection in Skierniewice includes 300 accessions originally collected in Central Asia and Siberia and wild species occurring in Poland. Among the accessions are vegetatively propagated species and other species which can be more easily propagated vegetatively than by seeds. The accessions are documented for passport data and included in the European *Allium* Database (EADB). Characterization and evaluation, according to IPGRI and USDA descriptor lists, have been done for 167 accessions and cover 49 traits. The evaluation data are included in an electronic database. In the third year, 12 accessions of *Allium fistulosum* are investigated for their usefulness for growing in Polish conditions (Kotlińska and Kojima 2000). Flavonols (myrecetin, kaempferol, quercetin) contents were determined in the leaves and bulbs of nine wild *Allium* species: *A. ledebourianum, A. galanthum, A. altaicum, A. ampeloprasum, A. caesium, A. proliferum, A. fistulosum, A. nutans* and *A. vavilovii* (Horbowicz and Kotlińska 2000).

Onion (*A. cepa* L.)

The onion collection consists of 267 accessions, mainly old Polish cultivars, landraces and breeding material (Kotlińska 2001a,b, 2002c). Characterization, evaluation and seed increases are conducted periodically on the field collection of onion at RIVC-Skierniewice, whenever newly collected accessions are introduced or regeneration is necessary.

Minimum characterization (14 traits) was made for 94 onion accessions from the genebank and sent to the EADB. Characterization covers 46 morphological and economic traits, following IPGRI, UPOV and RIVC descriptor lists. Flavonols (kaempferol, myrecetin, quercetin) content was analyzed in 22 onion cultivars (Horbowicz and Kotlińska 2000, 2001; Buciński *et al*. 2003). The seeds of 57 onion accessions are maintained by CGN in Wageningen as duplicates.

Collecting missions

Seven expeditions were organized in Poland between 2000 and 2002. A total of 671 accessions of vegetable crops and related wild species were collected, including 100 accessions of the genus *Allium* (see Table 2). A part of the original sample is added to the base collection, and another part of the sample is sent to the field collection for multiplication and characterization.

Table 2. *Allium* germplasm collected in Poland during explorations organized by the Polish Gene Bank from 2000 to 2002

Date	Area	No. of accessions collected				
		Onion	Shallot	Garlic	Leek	Other *Allium*
Oct. 2000	Tarnow	7	2	6		4
Oct. 2000	Sokolka	1	21	10		2
Oct. 2001	Augustów	1	8	4		
Oct. 2002	Kurpie I			1		
Oct. 2002	Kurpie II	2	5	1		3
Nov. 2002	Mrągowo-Pisz	1	10	4	1	
Dec. 2002	Ciechanów	2	2		1	1
Total		**14**	**48**	**26**	**2**	**10**
		Total no. of *Allium* accessions = 100				

During expeditions, detailed records are taken of the collecting site, with the use of GPS (Global Positioning System). In addition, all available information (such as local growing systems, local methods of plant protection, utilization for consumption or as medicinal plants, etc.) is recorded. This information is necessary to choose the proper places for reintroduction and on-farm conservation of old cultivars.

Regeneration and characterization

During the period 2000-2002, seed was obtained of 13 accessions of *Allium* spp., 18 of shallot and 18 of onion, and 471 accessions were evaluated in field conditions (114 accessions of *Allium* spp., 32 of onion, 147 of shallot and 178 of garlic).

Utilization of germplasm

During 2000-2002 the genebank obtained 250 *Allium* accessions from Polish donors and 23 accessions from abroad. As a result of seven collecting missions, 100 new *Allium* accessions were added to the collection.

During the same period, 124 seed samples of *Allium* were distributed to users in Poland, including 63 of onion, 6 of shallot, 16 of garlic, 2 of leek, and 37 of other *Allium* species.

Since 2000, 55 seed samples were sent to users abroad (3 of onion, 10 of shallot and 42 of other *Allium* species).

Numerous accessions of *Allium* have been used for studies at the research institutes and universities (Borkowski *et al.* 2001; Buciński *et al.* 2003; Horbowicz and Kotlińska 2002).

In 2002 we began collaboration with non-governmental organizations in the field of reintroduction of old vegetable landraces and cultivars. This year (2003), farmers are growing 44 accessions of 6 vegetable species from the genebank in five selected organic farms in southern Poland. This material includes 7 garlic landraces and 9 shallot landraces. The aim of this work is to reintroduce old cultivars and landraces to their original locality and also to provide demonstration plots for "green schools" to show children and students the biodiversity of vegetables.

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WORKING GROUP SESSION ON *BRASSICA*

Grégoire Thomas and Eduardo Rosa

Review of the workplan

Action	To be carried out by	Deadline
Questionnaire: review of activities		
Correct the data already given	Members who have already answered	June 2003
Send back to G. Thomas the completed questionnaire	Members who have not answered yet	June 2003
Database – Documentation		
Identify missing country data sets by comparing questionnaire and database	Database manager	June 2004
Send a request to these identified collections/members	ECP/GR Secretariat and WG Chair	June 2004
Update the *Brassica* European Database (Bras-EDB) with these data	DB Manager	Dec. 2004
Reinforce the role of the WG members by asking them to ensure transfer of the missing data from their national collections to the DB Manager (also proposed at the Vegetables Network level)	All	Ongoing
Create indicators (fields) in the database to indicate the accessions already characterized/evaluated	DB manager	June 2005
Update the Bras-EDB with these indicators	DB manager	Dec. 2005
Prepare for national data the above indicators and send to DB manager	All	June 2005
Characterization		
Recommend and stimulate the use of the simple descriptors used in GENRES project to progress with characterization	All	June 2006
Evaluation		
Identify a list of evaluation characters (per species) and define a priority list to promote evaluation activities	All, in answer to a questionnaire sent by E. Rosa	June 2004
Regeneration		
Necessarily ongoing but needs rationalization at mid-term through duplicate tracing	All	Ongoing
Tracing duplicates		
Trace duplicates through database passport data	All	Dec. 2004
Communicate with the other holders to assess these duplicates	All (bilateral relation)	June 2005
Provide information and literature on the way to proceed to identify priority (holders) when duplicates exist	G. Poulsen to all	Dec. 2003
Establish a common process to identify priority and responsibility in case of duplicates	All	Dec. 2004
Safety-duplication		
Circulate the list of genebanks offering safety-duplication facilities	G. Thomas	May 2003
Inform the WG Chair on the state of the safety-duplication	All	Dec. 2003
Wild relatives		
Establish a questionnaire to assess availability and state of collection for the wild *Brassica* (n=9 priority)	N. Bas	June 2003
Circulate this questionnaire to members and establish a global overview of the status (in relation to future funding proposal)	G. Thomas and N. Bas	July 2003

Presentations and papers

Brassica *genetic resources in Austria*

Helmut Reiner
Plant-Food-Quality, Vienna, Austria

Introduction

The last country report on this topic dates from the extraordinary meeting of the ECP/GR Working Group on *Brassica* in Rennes, 22 September 1997.[15] Emphasis is therefore given here to developments since 1997.

Structure of Austrian genebanks

1. Arche Noah Seed Archive, a non-governmental organization located in Lower Austria, has become the largest and most important genebank for *Brassica* in Austria in recent years. The curator of the collection is Mrs Michaela Arndorfer (sortenarchiv@arche-noah.at). Data will be included in the Austrian *Index Seminum* database and have been submitted to the ECP/GR *Brassica* Database. Arche Noah maintains the major part of the *Brassica* genetic resources in Austria (108 accessions), and also displays them to the public in the garden. Web site: http://www.arche-noah.at.

2. Austrian genebanks are now integrated into the Austrian Agency for Health and Food Safety (AGES). The *Index Seminum* (database for all genetic resources in Austria) can now be found on a new homepage (http://www.genbank.at). It is integrated into EPGRIS (European Plant Genetic Resources Information Infra-Structure). Most of the material is kept at AGES-Linz (curator in charge: Wolfgang Kainz). All the material will be transferred to Linz, which will then be the most important collection in Austria for genetic resources. But there are comparatively few *Brassica* accessions in Linz (currently 15).

3. Genebank Tyrol (curator: Kaspar Holaus) had to leave its traditional site and regeneration facilities in Rinn near Innsbruck and move to Imst, where it is located at a school. Organizational matters are dealt with in the office of the federal state of Tyrol in Innsbruck (AUT005). The County of Tyrol has not taken its responsibilities for plant genetic resources seriously, and this is a problem in particular for the very valuable collection of alpine spring cereals (summer wheat and summer rye) collected by Erwin Mayr around 1950. This genebank also keeps accessions of alpine turnips (*Brassica rapa* subsp. *rapa*).

4 Genebank Styria: the genebank from the County of Styria is located in Wies (curator: Helmut Pelzmann). There are only a few brassicas in this genebank, e.g. a walking stick cabbage. An additional turnip accession is not yet included in the *Index Seminum*.

Tasks and projects

A lot of regeneration and characterization work needs to be done for *Brassica* in the next few years in Austria. Projects on alpine turnips (*Brassica rapa* subsp. *rapa*) could not obtain funding, neither from the EU nor from the Austrian Ministry of Agriculture. However, funding was obtained from the EU for a project on the evaluation of *Brassica nigra* for

[15] Reiner, H. 1999. Report on Cruciferae germplasm collections in Austria. Pp. 5-7 *in* Report of an extraordinary meeting of the ECP/GR Working Group on *Brassica*, 22 September 1997, Rennes, France (L. Maggioni, compiler). International Plant Genetic Resources Institute, Rome, Italy.

mustard production, organized by Lustenauer Senf. At present, a group centred around Christian and Brigitte Vogl-Lukasser is preparing a project about on-farm conservation for genetic resources of alpine turnips (*B. rapa* subsp. *rapa*). I am also working on wild turnip (*B. rapa* subsp. *campestris).* Trials for testing *Brassica* cultivars for culinary use are currently carried out by Wolfgang Palme from the Vegetable Station in Schönbrunn. In recent years trials on *B. oleracea* and *B. rapa* (pak choi and petsai) were done. There are also some very interesting *B. oleracea* white cabbage accessions, candidates for on-farm conservation.

Status of Austrian *Brassica* collections

(See Table 1)

Table 1. Accessions of the genus *Brassica* in Austrian genebanks

Species	Crop	No. of accessions held by	
		Arche Noah	Governmental genebanks
Brassica oleracea	white cabbage	16	9
	red cabbage	6	
	kohlrabi	6	
	Savoy	4	
	curly kale	12	
	Brussels sprouts	2	
	broccoli	8	
	kale	3	1
	others + f. *oblonga*	6	
Brassica napus	Swede	10	
	rapeseed	1	3
	var. *pabularia*	2	
	others	1	
Brassica rapa	subsp. *rapa* = turnip	12	2
	subsp. *chinensis*	4	
	subsp. *oleifera*	3	
	others	2	
B. juncea		6	1
B. nigra		2	1
Brassica sp.		2	
Total		**108**	**17**
Grand total		**125**	

Literature

Reiner, H., W. Holzner and R. Ebermann. 1995. The development of turnip-type and oilseed-type *Brassica rapa* crops from the wild-type in Europe – An overview of botanical, historical and linguistic facts. Pp. 1066-1069 *in* Rapeseed today and tomorrow. Proceedings of the 9th International Rapeseed Congress, 4-7 July 1995, Cambridge, UK. Vol. 4 (D. Murphy, ed.). Published by the Organising Committee of the Ninth International Rapeseed Congress under the aegis of the Groupe Consultatif International de Recherche sur le Colza (GCIRC), Cambridge, UK.

Vogl, C.R., B. Vogl-Lukasser and H. Reiner. 2003. A documentation of the last remaining pockets of local knowledge on management and processing of *Brassica rapa* ssp. *rapa* (the turnip) in Alpine Eastern Tyrol (Linz district). Oral presentation at the Annual Conference of the Society for Economic Botany, 2-5 June 2003, Sonora Desert Museum, Tucson, Arizona, USA. (planned for publication in Economic Botany).

Status of Brassica *collections in Belgium – Update 2003*

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About 10 years ago this institute was known as PGS (Plant Genetic Systems), a spin-off from the University of Gent, Belgium. It is now part of the company Bayer Bio Science n.v. In the current political and social context relating to genetically modified organisms (GMOs) the testing of GMO oilseed rape has been stopped in Belgium. The working collection of *Brassica* seeds is maintained and regenerated when needed. Safety-duplication is carried out in different locations of the company. Exchange is possible only on a contract basis.

National Botanic Garden of Belgium

Domein van Bouchout, 1860 Meise, Belgium
Director J. Rammeloo
Tel: +32 2 2693905; Fax: +32 2 2701567
Web site: www.br.fgov.be

The Living Plant Collections Database (LIVCOL) is searchable on-line (http://www.br.fgov.be/RESEARCH/COLLECTIONS/LIVING/LIVCOL/index.html). The collection currently contains 130 accessions of the Brassicaceae family.

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The working collection of *Brassica* seeds contains varieties of the following species:
- fodder crops: stubble turnip (*B. rapa*) and forage rape (*B. napus)*
- green manure crops: white mustard (*Sinapis alba*) and fodder radish (*Raphanus sativus*).

There are no characterization data available that could be of interest for the ECP/GR *Brassica* Database. The working collection contains only current varieties, and the data are recorded according to the programmes under way.

DvP holds a collection of *Brassica rapa* landraces which is safety-duplicated at CGN, Wageningen since 1993. There has been no regeneration so far; it should be considered in the near future.

Brassica *collections in Bulgaria*

Stefan Neykov
Institute of Plant Genetic Resources "K. Malkov" (IPGR), Sadovo, Plovdiv, Bulgaria

There are four institutions holding collections of the Brassicaceae family in Bulgaria:
- Institute of Plant Genetic Resources "K. Malkov"-Sadovo, Plovdiv (Curator: Stefan Neykov)
- IHC: Institute of Horticulture and Canning, Plovdiv
- ESVC: Experimental Station for Vegetable Crops, Gorna Oryahovitsa
- Agricultural University, Plovdiv

The status of the collections is shown in Tables 1 and 2.

Table 1. Brassicaceae collections stored in IPGR-Sadovo

Taxon	Total no. of accessions	No. of accessions evaluated		No. of accessions regenerated	
		total	per year	total	per year
Brassica oleracea					
var. *capitata*	307	307	58	259	19
var. *botrytis*	47	47	4	-	-
var. *gemmifera*	28	25	-	8	2
var. *sabauda*	9	9	-	6	1
Brassica rapa					
var. *pekinensis*	17	17	-	10	5
var. *oleifera*	105	62	10	95	8
Brassica napus					
var. *oleifera*	293	285	32	275	25
Brassica juncea	45	45	10	40	8
Brassica nigra	24	24	3	24	4
Camelina sativa	60	50	15	60	4
Crambe abyssinica	20	20	-	20	5
Eruca sativa	3	3	-	3	1
Sinapis alba	55	52	5	55	6
Raphanus sativus					
var. *radicula*	45	40	3	20	4
Total	**1058**	**986**	**140**	**910**	**90**

Table 2. *Brassica* collections stored in other Bulgarian institutions

Holder	Taxon	No. of accessions evaluated		No. of accessions regenerated	
		total	per year	total	per year
IHC Plovdiv	*B. oleracea* var. *capitata*	40	15	40	-
	B. oleracea var. *botrytis*	20	5	-	-
ESVC Gorna Oryahovitsa	*B. oleracea* var. *capitata*	50	20	50	-
Agricultural University Plovdiv	*B. oleracea* var. *capitata*	25	8	25	-
Total		**135**	**48**	**115**	**-**

Brassica *germplasm in the collection of vegetable crops in Poland*

Teresa Kotlińska

Plant Genetic Resources Laboratory, Research Institute of Vegetable Crops (RIVC), Skierniewice, Poland

Present status of collections

The *Brassica* germplasm collection at the Research Institute of Vegetable Crops (RIVC) includes 682 accessions of cultivated vegetable crops. The current status of *Brassica* germplasm is given in Table 1.

The collection of vegetable *Brassica* genetic resources is maintained by RIVC-Skierniewice. The Plant Breeding and Acclimatization Institute (PBAI) in Poznań is responsible for germplasm collections of other *Brassica* species.

Passport data for all collected accessions were changed in accordance with the FAO/IPGRI *Multi-crop Passport Descriptors* and FAO WIEWS descriptors.

Characterization and evaluation

Characterization of individual *Brassica* species is dependent on the financial situation. Up to 2002, 49% of the accessions from 11 species had been characterized and partially evaluated (Table 1).

Part of the collection has been characterized or evaluated for different morphological and agronomic traits according to descriptor lists elaborated by IPGRI, UPOV, RIVC and COBORU (Centralny Ośrodek Badania Odmian Roślin Uprawnych = Research Centre For Cultivar Testing). These computerized data are stored in separate files depending on type of evaluation, year of trial, etc.

The number of characters recorded per crop is as follows:

- White cabbage: 43 characters
- Radish: 9 characters
- Brussels sprout: 31 characters
- Broccoli: 29 characters
- Cauliflower: 30 characters
- Kohlrabi: 33 characters.

Some accessions have been tested for resistance to downy mildew (110 accessions) and clubroot (130 accessions).

Regeneration

During the period 1997–2002, 95 accessions from 5 species (ca. 14%) were regenerated (Table 1). It is very difficult to plan the number of accessions to be regenerated each year, because of the lack of stable financial contributions towards genetic resource conservation.

The accessions with insufficient amounts of seeds or low seed viability in storage are selected for regeneration. The oldest seed samples of *Brassica* germplasm have been kept in storage since 1982.

Regeneration is carried out in isolation cages.

Collected accessions are stored in controlled conditions (-15°C) in the central store located at the National Centre for Plant Genetic Resources located in the PBAI in Radzików.

Up to now *Brassica* germplasm has not been duplicated elsewhere.

Table 1. Status of *Brassica* germplasm, RIVC-Skierniewice, 2003

Taxon	English name	Polish name	Total no. of accessions	Passport data	Evaluation / Characterization	Seed in long-term storage	Regeneration 1997-2002
B. oleracea L. convar. *botrytis* L. (Alef.) var. *italica* (Plenck)	Broccoli	Brokuł	16	16	14	16	
B. napus L. var. *napobrassica* L.	Rutabaga	Brukiew	24	24	1	24	1
Sinapis sp.	Mustard	Gorczyca	19	19		19	
B. oleracea L. var. *acephala* D.C.	Kale	Jarmuż	5	5		5	
B. oleracea L. var. *botrytis* L.	Cauliflower	Kalafior	164	164	102	164	
B. oleracea L.var. *gongylodes* L.	Kohlrabi	Kalarepa	13	13	8	13	
B. oleracea L. var. *capitata* f.*alba* (D.C.) Helm	White cabbage	Kapusta biala	181	181	150	181	62
B. oleracea L.var. *capitata* f.*rubra* (D.C.) Helm	Red cabbage	Kapusta czerwona	9	9	4	9	
B. oleracea L. var. *sabauda* L.	Savoy	Kapusta włoska	17	17	5	17	
B. oleracea L. var. *gemmifera* D.C.	Brussels sprouts	Kapusta brukselska	19	19	5	19	
B. campestris L. subsp. *pekinensis* (Lour) Olsson	Chinese cabbage	Kapusta pekińska	63	63	25	63	
Raphanus sativus L. var. *niger* (Miller) Pers.	Radish	Rzodkiew	25	25		25	
Raphanus sativus L. var. *sativus* L.	Small radish	Rzodkiewka	62	62	14	62	26
B. rapa L. var. *rapifera* Metzger	Turnip	Rzepa	37	37	8	37	3
Other brassicas		Inne kapustne	28	28		28	3
Total			**682**	**682**	**336**	**682**	**95**

Collecting missions

Collecting missions in different regions of Poland and neighbouring countries are organized each year to collect and protect indigenous germplasm which may be in danger of extinction. When possible the Polish Gene Bank joins expeditions organized by other institutions (VIR, USDA, the EKO Foundation, etc.). Between 1997 and 2002 the Polish Gene Bank organized or participated in 31 expeditions, during which a total of 2795 accessions of vegetable crops and wild relatives were collected, including 72 accessions of 9 brassicas (see Table 2).

Table 2. *Brassica* germplasm collected during explorations organized by the Polish Gene Bank from 1997 to 2002

		No. of accessions collected								
Date	**Area**	**Rutabaga**	**Mustard**	**Kohlrabi**	**White cabbage**	**Radish**	**Turnip**	**Small radish**	**Kale**	**Other *brassicas***
Oct. 1997	Bielsko Biała, Żywiec-Poland	1								
Nov. 1997	Zamość, Poland	1			3		1	3		
Aug.-Sep. 1998	Ukraine / Moldova	2		4	13	1	1	2		2
Oct. 1998	Biała-Podlaska, Poland				1			1		
Oct. 1998	Białystok, Poland	2			3			1		
Oct. 1998	Zamość, Poland				2					
July 1999	Eastern Poland*	1	4		2		1	1	1	
July 1999	Syria*				1			2		
Aug. 1999	Greece*							1		1
Oct. 2000	Tarnow, Poland	1	2		1					
Oct. 2000	Sokolka, Poland	1			4		1			
Oct. 2002	Kurpie II, Poland	1			1					
Nov. 2002	Mrągowo-Pisz, Poland				2			1		
Total		**10**	**6**	**4**	**34**	**1**	**4**	**12**	**1**	**3**
		Total no. of *Brassica* accessions = 72								

* in collaboration with USDA

In selected areas each village is explored to collect not only seed material, but also all available information about local growing systems, local methods of plant protection, utilization for consumption or as medicinal plants, etc. Detailed records of the collecting site are taken using GPS (Global Positioning System). This information is also very useful to identify suitable sites for on-farm conservation and the reintroduction of old cultivars.

The sources of collected materials are mostly local markets, home gardens and home stores in isolated villages, where old farmers still maintain landraces of various vegetables in small quantities for domestic use.

Utilization

Between 1997 and 2002, 207 seed samples of *Brassica* genetic resources were distributed to users in Poland and 107 seed samples were sent to users abroad.

Status of the Brassica oleracea*, leafy* B. rapa *and* B. juncea *collections in the Russian Federation*

Anna M. Artemyeva

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

The collection

The vegetable *Brassica* collection contains a total of 3231 accessions including 2654 accessions of *Brassica oleracea*, 533 accessions of leafy *B. rapa*, 33 accessions of leafy *B. juncea* and 11 accessions of wild relatives of *B. oleracea*. An overview of the current status of the collection held at VIR is given in Tables 1 and 2.

Table 1. Status of the vegetable *Brassica* collection in the Vavilov Institute (VIR)

Taxon	No. of accessions	Type of sample			
		Landraces	Old cultivars	Advanced cultivars	Breeding materials / F_1 hybrids
B. juncea (L.) Czern.	33	27		6	
B. oleracea L.					
acephala	148	34	59	45	10
alboglabra	7	7			
botrytis	669	27	159	420	63
capitata (white group)	1080	231	249	347	253
capitata (red group)	161	3	53	91	14
costata	35	35			
gemmifera	113		17	49	47
gongylodes	151	26	55	57	13
italica	148	7	25	56	60
sabauda	142	2	64	49	27
B. rapa L.					
chinensis	114	57	15	29	13
japonica	15	2		11	2
rapa f. *Komatsuna*	23	14		8	1
pekinensis	381	88	47	50	196
Wild	11	11			
Total	**3231**	**571**	**743**	**1218**	**699**
% of total	100	17.7	23.0		21.6

Table 2. Geographical origin of the vegetable *Brassica* collection

Country	No. of accessions	Country	No. of accessions
Russia	293	Poland	22
Europe	**1654**	Others	70
Netherlands	501	**Asia**	**922**
Germany	240	Japan	461
United Kingdom	175	China	232
Denmark	130	Republic of Korea	65
France	90	Vietnam	38
Czech Republic	82	India	38
Italy	51	Kazakhstan	24
Ukraine	48	Others	64
Sweden	42	**America**	**297**
Bulgaria	38	USA	181
Norway	36	Canada	70
Hungary	35	Others	46
Georgia	32	**Africa**	**25**
Spain	31	**Australia and New Zealand**	**40**
Portugal	31		
Total no. of accessions = 3231			

The Russian collection of vegetable *Brassica* is divided into two parts: a permanent (base) catalogue (2139 accessions) and a temporary catalogue (1092 accessions). The permanent catalogue includes landraces and breeding cultivars with adequate quantities of seeds per accession (more than 6000 seeds). All accessions of the permanent catalogue are documented for passport data that can be found on VIR's homepage on the Internet (http://www.vir.nw.ru). The temporary catalogue includes F_1 hybrids, breeding materials and samples with insufficient quantities of seeds (less than 6000 seeds). These latter cultivars need to be regenerated and will then be included in the permanent catalogue. Passport data for these accessions are stored in our documents.

During 2002, the temporary catalogue was revised and decreased by 239 accessions; generally these were breeding materials, obtained by inbreeding of F_1 hybrids. The vegetable *Brassica* collection has increased by 42 accessions and the base part of the collection has increased by 145 accessions after these were multiplied and studied.

The European Database for *Brassica* (Bras-EDB) contains records for 47.6% of the accessions. The passport data of 300 accessions of leafy *B. rapa* and *B. juncea* were transferred to the Bras-EDB in the multicrop descriptor format in April-May 2003.

Safety-duplication and storage

All vegetable *Brassica* collections are located in St. Petersburg in paper bags in aluminium boxes at room temperature. From 1970 to 1995, 79.6% of accessions of the *Brassica* base collections were duplicated in St. Petersburg at 4°C under vacuum in glass jars (3000 seeds per sample) (Table 3). The *Brassica* accessions are known to maintain a high germination at a temperature of 4°C for 20 years only. In the new cold storage in St. Petersburg, 62.8% of the accessions were deposited at the temperature of 4°C in laminated aluminium packages (for short-term storage) over the last years.

Table 3. Storage and availability of the vegetable *Brassica* collection at VIR

Taxon	Base catalogue	Available	Bras-EDB	Storage				
				Long-term	Short-term	Cold (1970-1995)	NSS* (since 1975)	At room temperature only
B. juncea (L.) Czern.	25	25		7	25	5	9	
B. oleracea L.								
acephala	96	46	39	10	61	99	45	9
alboglabra	4	4			1		1	2
botrytis	491	316	180	110	240	343	203	69
capitata (white group)	760	700	604	122	520	716	367	25
capitata (red group)	97	74	50	16	53	86	17	17
costata	27	25		10	13	20	7	
gemmifera	24	20		7	9	20	3	6
gongylodes	113	50	40	10	58	78	43	18
italica	54	44	12	21	26	61	36	9
sabauda	101	67	48	9	102	90	72	11
B. rapa L.								
chinensis	68	62	5	36	44	40	27	1
japonica	11	11	2		7	5	9	
rapa f. *Komatsuna*	4	4	1	3	6		2	
pekinensis	260	244	38	102	178	139	99	12
Wild	4	2			2	1	1	
Total	**2139**	**1694**	**1019**	**463**	**1343**	**1703**	**941**	**179**
% of total	100	79.2	47.6	21.6	62.8	79.6	44.0	8.3

* NSS = National Seed Storage

21.6% of the accessions of the base *Brassica* collections have been duplicated in the VIR genebank in refrigerators for long-term storage at –10°C in laminated aluminium packages (6000 seeds per accession). The seeds were dried before being stored.

Since 1975, 44% of the accessions of the base collections of *Brassica* vegetable crops have been duplicated in the National Seed Storage at Kuban Experimental Station at +4°C in glass jars (6000 seeds per accession). The seeds are dried down to a seed moisture content of about 6%. This is our safety-duplication set. Tests on the germination rates of *Brassica* seeds are conducted regularly at the National Seed Storage. The VIR *Brassica* collections are not duplicated elsewhere.

Accessions of limited size or which are no longer available for exchange due to the small amount of seeds have been prioritized for conservation efforts. During 2002, 400 accessions were deposited in the VIR genebank refrigerators for long-term storage and 200 accessions for short-term storage.

Characterization and evaluation

Most accessions of vegetable *Brassica* collections have been characterized and evaluated for 40 to 43 morphological, biological and agronomic traits at six experimental stations which are located within different ecological-geographical zones of Russia. The accessions have been studied using the same standardized research methods for three years. Separate catalogues are published for resistance to cold (360 accessions), heat (265 accessions), salt (537 accessions), clubroot (1019 accessions), downy mildew (183 accessions), yellows (438 accessions), leaf spot (88 accessions). Other catalogues include detailed descriptions of promising accessions of white cabbage (393 accessions), red cabbage (22), cauliflower (203), broccoli (17), Chinese cabbage (152), pak choi (45), tatsoi (8), mizuna and mibuna (10)

The documentation status of the collection is given in Table 4.

Table 4. Documentation status of VIR's vegetable *Brassica* collection

Name	% accessions	
	Characterization data	Evaluation data
Kale	90	25
Kailan	100	50
Cauliflower	85	65
Broccoli	85	45
Tronchuda	90	50
White cabbage	90	72
Red cabbage	90	45
Savoy	95	35
Kohlrabi	95	30
Brussels sprouts	85	30
Chinese cabbage	85	65
Pak choi	90	70
Mibuna, mizuna	90	90
Komatsuna	90	90
Mustard	85	20

Availability and utilization

Availability of the accessions is determined by their status and seed amount. Samples with insufficient quantities of seeds, and breeding material, including donors of some important traits, are not usually available. At present 79.2% of the accessions of the base collection are available.

During 2002, 250 seed samples of the collection of vegetable *Brassica* were distributed for utilization to breeding institutes/centres and companies, including 80 samples abroad.

Collecting activities

Collecting missions have been reduced. During the period 2000-2002 six local accessions of white cabbage, one of cauliflower and one of mustard were collected.

Future activities

Future activities include the creation of a computerized evaluation database of all *Brassica* accessions. The seeds will be deposited into refrigerators for long- and short-term conservation in St. Petersburg and for safety-duplication in the National Seed Storage. This is considered as the main priority of the National Programme of Plant Genetic Resources.

Bioactive substances in Brassica *green vegetables*

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Introduction

The genus *Brassica* contains vitamins and minerals necessary to main human metabolic processes, and also a class of structurally uniform compounds known as glucosinolates. Glucosinolates are secondary plant products. They give rise to a wide range of biologically active breakdown products such as isothiocyanates, indoles and oxazolidinethiones upon enzymatic degradation by the endogenous enzyme myrosinase (McGregor *et al.* 1983; Verkerk *et al.* 1998). Frequently their combinations have additional health-promoting effects, e.g. anticancerogenic, antioxidative, immunostimulating and antithrombolic effects (Watzel and Leitzmann 1995). Glucosinolate degradation products also contribute to the formation of the flavour of meals prepared from *Brassica* vegetables (Kassahun *et al.* 1996). These facts have made glucosinolates and their breakdown products one of the most extensively studied secondary plant metabolites in the *Brassica* genus.

The vegetables of the *Brassica* genus are rich sources of bioactive substances. They are characterized by high contents of carotenoids, chlorophylls, phenolic acids, flavonoids and sulfides. Due to the health-promoting properties of carotenoids and chlorophylls in human nutrition, the *Brassica* genus has been investigated to determine the contents in total carotenoids, total carotenes and the main carotenoids (β-carotene and chlorophylls a and b). Our studies of bioactive substances have been focused on genetic aspects.

Material and methods

- **Material**

The genetic variation in the content of bioactive substances has been investigated on 17 *Brassica oleracea*, *B. rapa* and *B. juncea* from the VIR collection, grown in the field in St. Petersburg and Volgograd areas (Table 1).

Table 1. *Brassica* germplasm used in the study

Scientific name	Common name	No. of accessions
1. *Brassica oleracea* L. var. *capitata alba*	White cabbage	190
2. *Brassica oleracea* L. var. *capitata rubra*	Red cabbage	38
3. *Brassica oleracea* L. var. *sabauda*	Savoy	33
4. *Brassica oleracea* L. var. *gemmifera*	Brussels sprouts	28
5. *Brassica oleracea* L. var. *botrytis*	Cauliflower	47
6. *Brassica oleracea* L. var. *italica*	Broccoli	42
7. *Brassica oleracea* L. var. *gongylodes*	Kohlrabi	40
8. *Brassica oleracea* L. var. *acephala*	Leafy kale	31
9. *Brassica oleracea* L. syn. *B. sylvestris* L.	Wild	5
10. *Brassica oleracea* L. var. *selenisia*	Ornamental kale	2
11. *Brassica rapa* subsp. *chinensis* (L.) Makino	Pak choi	28
12. *Brassica rapa* subsp. *pekinensis* (Lour.) Olson	Chinese cabbage	102
13. *Brassica rapa* subsp. *nipposinica* (Bailey) Olson	Mibuna, Mizuna	20
14. *Brassica rapa* subsp. *rapifera* f. *Komatsuna* Sinsk.	Komatsuna	14
15. *Brassica rapa* subsp. *narinosa* (Bailey) Olsson	Tatsoi	9
16. *Brassica juncea* Czern.	Leafy mustard	14
17. *Brassica carinata* A. Braun	Ethiopian mustard	14

- **Analysis of bioactive substances**

The plants were harvested when the head or plant diameter had reached its maximum. The samples were analyzed as fresh material. For each cultivar, five plants were selected at random; a section was taken from each plant. These samples were processed and analyzed as described previously (Ermakov *et al.* 1987).

The quantity of ascorbic acid was determined in direct plant extracts with 2,6-dichloroindophenol by visual titration. The carotenoids and chlorophylls were measured by direct determination of the absorbance at different wavelengths, using a standard spectrophotometer. For determination of the total glucosinolates a modified method by estimation of d-glucose released by enzymatic hydrolysis was used.

Results and discussion

Varietal differences were noted for several bioactive substances in *Brassica.* With the knowledge of these varietal differences it may be possible to improve *Brassica* breeding stock through genetic selection to alter the content of bioactive substances.

Significant differences were found in the concentration of bioactive substances between crops in the genus *Brassica*. The content of ascorbic acid, chlorophylls, carotenoids, carotenes, β-carotene and glucosinolates are presented in Table 2.

Table 2. Content of bioactive substances (mg/100 g fm) in the *Brassica* germplasm studied

Species / crop	Ascorbic acid	Chlorophyll a and b	Carotenoids	Carotenes	β-carotene	Total glucosinolates
Brassica oleracea						
White cabbage	32.74* 11.0-71.5**	57.72 1-70	5.19 1-9.18	4.47 0.53-8.63	0.024 0.011-0.037	8.86 2.80-27.80
Red cabbage	66.56 19.72-135.4	92.88 14.8-180.4	-	5.69 1.77-11.68	-	9.48 4.60-23.80
Savoy	55.65 13.1-163.7	79.08 2.04-173.7	1.51 1.06-2.97	0.71 0.65-2.39	0.347 0.156-0.461	9.12 3.60-20.03
Leafy kale	73.41 15.2-163.7	111.19 12.9-224.4	-	4.99 0.20-11.80	-	7.51 3.60-10.25
Brussels sprouts	106.17 12.53-207.7	10.39 3.23-27.50	3.33 1.41-6.97	2.84 1.11-5.59	0.253 0.191-0.372	19.79 7.90-35.69
Cauliflower	66.20 15.5-189.0	5.21 1-23.40	2.66 1.17-7.54	2.50 0.14-5.82	0.163 0.015-0.393	8.61 6.20-16.70
Broccoli	52.57 23.52-118.5	21.82 4.64-49.36	5.47 1.36-12.63	2.68 0.51-4.24	0.864 0.144-2.500	11.17 6.54-17.84
Kohlrabi	49.53 24.66-112.9	87.93 48.5-166.9	-	2.77 2.37-3.36	0.160 0.070-0.387	8.59 6.40-10.22
Wild *B. oleracea*	81.77 8.60-116.80	67.35 47.0-87.70	-	2.82 1.54-5.18	-	8.26 7.42-9.10
Ornamental kale	86.64 33.0-137.30	62.33 1.40-172.50	-	3.66 0.17-9.27	-	12.89 -
Brassica rapa						
Pak choi	33.86* 3.56-145.20**	107.81 64.22-180.8	20.96 4.71-38.41	6.30 3.6-15.54	4.84 2.96-10.18	4.72 1.24-11.80
Chinese cabbage	22.45 3.15-83.60	72.19 3.01-163.25	14.36 0.91-30.30	3.87 0.17-18.89	2.961 0.14-7.12	13.30 0.60-40.00
Mibuna, mizuna	37.79 9.04-126.72	125.46 59.50-163.18	20.78 5.38-34.17	5.59 1.62-12.40	5.09 1.69-7.08	9.90 2.90-16.30
Komatsuna	39.20 12.60-92.40	109.78 67.72-164.99	23.00 2.21-36.78	5.71 2.41-8.70	4.67 2.05-7.40	12.41 7.50-18.44
Tatsoi	41.59 4.20-124.08	97.37 7.06-231.37	19.65 2.73-29.38	5.86 2.03-15.30	4.04 0.32-6.38	9.57 2.60-25.78
B. juncea						
Leafy mustard	42.77 3.80-110.88	123.46 77.24-185.48	23.20 8.16-41.11	6.54 4.14-9.52	5.30 3.43-8.17	13.12 8.13-24.99
B. carinata						
Ethiopian mustard	51.37 17.92-79.0	-	-	3.58 2.62-4.99	-	2.20 -

* = average
** = ranges

- **Ascorbic acid**

Higher concentrations of ascorbic acid occur in the green leaves because this vitamin is synthesized in plant leaves. *Brassica* vegetables are among the richest sources of vitamin C (ascorbic acid) for human nutrition. *Brassica* crops constitute an important source of vitamin C which is valued in diets for its beneficial properties: prevention of infarcts, cancer, or infections, and for its antioxidant power.

Genetic variation for the amount of ascorbic acid (AA) in *Brassica* has been noted. The AA content ranges from 8 to 207 mg/100g fm for *Brassica oleracea* and from 3 to 145 mg/100g for *B. rapa.*

The adult daily norm of vitamin C is 60 μg RDA (Recommended Dietary Allowance). White cabbage, for example, has, on the average, 33 mg of ascorbic acid per 100 g. Thus 100 g white cabbage can supply 55% RDA and only 57 g Brussels sprouts can supply 100% RDA.

- **Chlorophylls a and b**

The chlorophylls are the essential catalysts of photosynthesis and occur universally as green pigments in all photosynthetic plant tissues. They can be found in the chloroplasts in relatively large amounts, often bound loosely to protein but are readily extracted into lipid solvents such as acetone or ether.

Genetic variation has been found for the amount of chlorophylls a and b in *Brassica* crops. Total chlorophyll content ranges from 1 mg/100 g fm (white cabbage, cauliflower) to 224.4 mg/100 g fm (leafy cabbage) for *Brassica oleracea* and from 3 mg/100 g fm (Chinese cabbage) to 231 mg/100 g fm (tatsoi) for *B. rapa.*

- **Carotenoids**

Carotenoids, which are C_{40} tetraterpenoids, are an extremely widely distributed group of liposoluble pigments, found in all kinds of plants. Carotenoids have two principal functions: as accessory pigments in photosynthesis and as colouring matters in flowers and fruits. Carotenoids occur universally, together with β-carotene, in the leaves of higher plants. Carotenoids can be found in the yellow, orange or red colours of plant products. They frequently occur along with chlorophyll in green plant tissue, and thus leafy vegetables such as cabbage are good sources of carotenes, although in these plants the colour of the carotenes is masked by the chlorophyll molecules.

Carotenoid content ranges from 1 (white cabbage) to 13 mg/100 g (broccoli) for *Brassica oleracea*, from 0.9 (Chinese cabbage) to 38 mg/100 g (pak choi) for *B. rapa* and from 8 to 41 mg/100 g (leafy mustard) for *Brassica juncea*.

Along with total energy deficiency, vitamin A and protein deficiencies are estimated to be the causes of the most common dietary needs in the world. In some developing countries, inadequate vitamin A consumption leads to the most common form of preventable blindness and is a major contributor to childhood mortality. Evidence from epidemiological studies indicates that higher intake of carotene or vitamin A may reduce the risk of cancer.

The VIR collection of *Brassica oleracea* contains from 0.14 (white cabbage) to 11.80 mg/100 g fm (leafy cabbage) carotenes; *Brassica rapa* contains from 0.17 to 18.89 (Chinese cabbage).

Among the 500-600 distinct natural carotenoids identified so far, only 50 of them can be converted to vitamin A in the animal body, and among them the *trans*-β-carotene has the greatest vitamin A activity. In *Brassica oleracea* the β-carotene content ranges from 0.011 (white cabbage) to 2.5 (broccoli), in *Brassica rapa* from 0.14 (Chinese cabbage) to 10 mg/100 g (pak choi).

β-carotene makes up a fraction of the total carotenes present in most plant tissues; the size of this fraction, however, may vary from 0.5% in white cabbage to 76-98% in *Brassica rapa* and to 98% in leafy mustard.

- **Glucosinolates**

Sulphur compounds play an important part in the aroma of many vegetables, including *Brassica* crops. The pungency of cabbage, mustard, etc. depends largely upon the generation of mustard oils (Fenwick *et al.* 1983). These are produced by enzyme action on a precursor when the two are brought into contact, by damage of cells or membranes in the process of tissue disruption (cutting, crushing, autolysis). The volatiles responsible for the odour are not even present in the intact tissue. The precursors are glucosinolates, or thioglucosides, present in the cell normally as potassium salts which are colourless and water-soluble. They are considered non-toxic, but their presence can affect some insect behaviour (Finch 1978), and some of the derivatives from glucosinolates are said to be potential goitrogens (Wills 1966), particularly when the diet is deficient in iodine.

However, it is becoming apparent that there may also be beneficial effects apart from the effect on flavour. Compounds formed from glucosinolates may have a possible inhibitory effect on chemical carcinogens (Fenwick *et al.* 1983).

Genetic variation has been found for the amounts of glucosinolates in *Brassica.* Total glucosinolate content ranges from 2.8 mg/100 g fm (white cabbage) to 35.7 (Brussels sprouts) for *Brassica oleracea* and from 0.6 to 40 mg/100 g (Chinese cabbage) for *Brassica rapa.* A significantly higher level in glucosinolates is found in Brussels sprouts and Chinese cabbage.

- **Russian old local cultivars of white cabbage**

These cultivars are of great interest. Table 3 compares their contents for four groups of cultivars of different origins.

Table 3. Substance content in Russian old local cultivars of white cabbage

Substance	Cultivar groups			
	North-Russian	Central-Russian	Central-European	East-Russian
Dry weight (%)	9.07* 6.0-15.2**	9.37 5.6-15.8	7.88 6.3-11.2	8.50 6.7-12.1
Total sugars (%)	3.22 0.5-5.78	5.27 1.3-8.77	3.71 1.9-5.2	4.18 2.5-9.66
Ascorbic acid (mg/100 g)	46.79 12.0-128.4	33.57 6.1-78.6	31.04 12.9-71.5	34.02 15.8-66.0
Chlorophyll a and b (mg/100 g)	70.23 20.3-163.7	31.58 13.9-74.6	-	-
Total glucosinolates (mg/100 g)	6.10 3.2-9.1	11.21 2.8-27.8	12.89 7.9-22.3	5.92 3.1-11.3

* = average
** = ranges

Genetic variation in the content of bioactive substances between groups of Russian cultivars is rather wide. The cultivars from the North-Russian group are distinguished by a high content of ascorbic acid and chlorophyll, the cultivars from the Central-Russian group are remarkable by their high values for dry weight and sugar content.

Furthermore, we have shown that there is potential for differentiating between and within species in the *Brassica* genus. The highest content of the investigated bioactive substances are found in broccoli and red cabbage (*Brassica oleracea*), pak choi, tatsoi (*B. rapa*) and leafy mustard (*B. juncea*). We conclude that the North-Russian and Central-Russian groups of cultivars show the importance of studying these groups for their bioactive substance content and may provide a source of genes for valuable biochemical content.

The information in this report should enable breeders to use their breeding programmes more effectively.

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WORKING GROUP SESSION ON SOLANACEAE[16]

Marie-Christine Daunay and Willem van Dooijeweert

Foreword

The Working Group on Solanaceae has been recently established and therefore it has not yet reached its stable composition. The assembly was very different from that of the *ad hoc* meeting held in Nijmegen, the Netherlands, 21 September 2001. Only three participants attended both meetings: M.C. Daunay (France) and W. van Dooijewert (The Netherlands), Chair and Vice-Chair respectively of the WG; and M.J. Díez (Spain), focal person for Cucurbits.

The representative from Turkey, A. Küçük, has recently retired and has been replaced by S. Mutlu.

Some countries that had sent participants to the 2001 meeting were not represented here (Bulgaria, Czech Republic, Hungary, Russian Federation and Serbia and Montenegro).

On the other hand, several new representatives were present: K. Sarikyan (Armenia), W. Palme (Austria), I. Paran (Israel), P. Coelho (Portugal) and O. Shabetya (Ukraine).

In addition, during the informal inter-sessions, the representatives of Azerbaijan (R. Geydarova) and Poland (T. Kotlińska) expressed their wish to be associated with the Solanaceae WG activities. A. Lebeda (Czech Republic) also expressed his wish to be kept informed of the group's achievements regarding tomato.

Introduction

The Chair presented the context of the recent creation of the WG on Solanaceae. Owing to her capacity as Chair of the GENRES project on eggplant (EGGNET = EGGplant NETwork), funded by the EU during 1999-2004, M.C. Daunay was identified by ECP/GR as a focal person for Solanaceae and was asked to prepare a review of the Solanaceae stakeholders in Europe. The results of this survey were presented at the meeting of the Network Coordinating Group on Vegetables in Vila Real, Portugal, May 2000, whereupon it was decided that a joint *ad hoc* meeting should be organized just after the 2001 EGGNET annual meeting in Nijmegen, the Netherlands, September 2001. This *ad hoc* meeting was held and several decisions were taken at that time.[16]

The group decided to submit a letter of application to the ECP/GR Steering Committee to be recognized as a formal Working Group. This request was approved by the Steering Committee at its eighth meeting in St. Petersburg, October 2001.

The Working Group focuses on cultivated and wild relatives of *Solanum* species (eggplants), *Capsicum* spp., *Lycopersicon* sp., *Physalis* sp. and *Cyphomandra* sp. All of these species originate from other continents than Europe. In Nijmegen, a workplan outlining the first priorities of the group was also established. The achievements of this workplan so far were reviewed during the Skierniewice meeting, but since many new members attended, the session started with the participants introducing themselves and a presentation of the Solanaceae collections held in each of the participating countries.

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[16] See also: Daunay, M.C., L. Maggioni and E. Lipman, compilers. 2003. Solanaceae genetic resources in Europe. Report of two meetings - 21 September 2001, Nijmegen, The Netherlands / 22 May 2003, Skierniewice, Poland. International Plant Genetic Resources Institute, Rome, Italy.

Presentation of the Solanaceae collections in each country

A table summarizing the results of the 2000 survey on Solanaceae genetic resources held in Europe was presented, pointing out the places in Europe where particularly big collections are held. Members were requested to check their own data, and some updates were requested by representatives from Portugal and Turkey.

The status of national collections was then presented by all participants. Members from France, the Netherlands, Spain and Turkey provided only summary reports since full reports had been presented in 2001 in Nijmegen. More extensive presentations were given by the new members from Armenia, Austria, Israel, Portugal and Ukraine.[17]

From these presentations, it appeared that some collections were endangered in Israel and Armenia, for the following reasons:

- Israel: (i) regeneration is not carried out in the Israeli Genebank and the seeds are maintained in short-term storage; (ii) accessions are scattered between many research laboratories in the country.
- Armenia: seeds are kept at room temperature for a long time, and therefore their germination ability is rapidly decreasing.

From the presentation given by Austria, it appeared that the NGO "Arche Noah" holds much more Solanaceae genetic resources than the official institutions.

In Portugal and Ukraine, the Solanaceae collections do not present any specific problem.

The representatives of Azerbaijan and Poland provided information on their Solanaceae collections to the Chair.

Review of progress of the workplan

The establishment of the Solanaceae Working Group was approved by the Steering Committee in 2001. Other priorities defined at the 2001 Nijmegen meeting are listed below. Those considered as most urgent are underlined.

- ***Compiled inventory of the germplasm for each crop: achievements and problems***

The group agreed that this objective has a high priority.

According to the large number of Solanaceae accessions held in Europe (about 5000 accessions for eggplant, 13 000 for pepper and 23 000 for tomato), it was decided at the Nijmegen meeting that the compilation of the passport data would be done separately for each crop. The EGGNET coordination board had taken the responsibility for compiling the eggplant lists, Turkey those of pepper, the Russian Federation those of tomato and Spain those of the other Solanaceae crops (*Physalis* and *Cyphomandra*).

Passport descriptors

The first lists obtained from the partners who attended the Nijmegen meeting contained a set of passport data derived from those used by the EGGNET group. In order to ensure that the structure of the WG databases is uniform at the European level, the updated FAO/IPGRI *Multi-crop Passport Descriptors* (MCPD) will be adopted by the WG from now on. This MCPD list was distributed to the new partners, so that they can provide their lists in the suitable format.

[17] All papers are published in Daunay *et al.* 2003 (see footnote 16).

Compilation of listings for each crop

- **Eggplant**

Almost all the lists of the members who were at Nijmegen have been received by M.C. Daunay (eggplant database manager), but they have not been compiled yet and need to be integrated into the EGGNET files. Data supplied by the Skierniewice participants will also be included according to the MCPD structure. The EGGNET database is already accessible from the ECP/GR Web site (http://www.bgard.science.ru.nl/WWW-IPGRI/eggplant.htm).

- **Pepper**

The lists received were compiled into a single file and given to the Chair at the Skierniewice meeting. The compiled list has to be completed with the lists of the new partners as well as with the lists not sent yet by the Nijmegen participants, in the MCPD structure.

- **Tomato**

Since the tomato database curator (O. Dmitrieva, VIR, Russian Federation) retired, it was not clear whether VIR still wishes to assume responsibility for this database. No information was obtained before the meeting. However A. Artemyeva, attending the session of the *Brassica* WG, promised that a clarification would be sent to the Chair by VIR in the near future. M.J. Díez indicated that Spain would be willing to take responsibility for the central tomato database in case VIR decided to discontinue this task.[18]

- ***Physalis* and *Cyphomandra***

Spain has produced a compiled listing from the lists which were received, and as for eggplant, pepper and tomato, the listings of the members who were at Skierniewice have to be obtained and integrated in the MCPD format.

Therefore, it can be expected that for pepper and the other crops (*Physalis* and *Cyphomandra)*, the inventory will be made accessible from the ECP/GR Web site in the coming months.[19]

An example of the type of passport data expected from the new partners will be prepared by the Vice-Chair and sent to them as an example.

Deadline May 2004 was proposed for finalizing the compilation of the listings for all solanaceous crops.

- ***Identify the degree of duplication among collections***

As the inventory for each crop is still far from complete, identification of the probable duplicates on the basis of the passport data comparison is not possible. Therefore, this objective was given second priority.

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[18] After the meeting the Chair received confirmation from VIR that they would continue to manage the tomato database. The new database manager is Irina Khrapalova (i.khrapalova@vir.nw.ru).

[19] Update at time of publication: the databases are now on-line, as follows:
- Pepper: http://www.bgard.science.ru.nl/WWW-IPGRI-Capsicum/Pepperdb.htm
- *Physalis*: http://www.comav.upv.es/Physalis.html
- *Cyphomandra*: http://www.comav.upv.es/Cyphomandra.html

- ***Produce harmonized protocols for seed regeneration and storage***

This is one of the first priorities of the group. The attending members decided that the Chair and Vice-Chair (i) would request from all partners their regeneration and storage protocols, and (ii) from the analysis of these, regeneration and storage protocols for each crop will be proposed. This task should be completed within 6 months at most.

- ***Produce harmonized descriptors for primary characterization***

The development of a minimum descriptor list for each solanaceous crop is of high priority for the group. For each crop, one country would take the responsibility of receiving from the partners a proposed minimum list of 10 descriptors, which would be of interest for end-users such as breeders.

Responsibilities were assigned as follows: France (eggplant), Netherlands (pepper), Spain (tomato) and Austria (*Physalis* and *Cyphomandra*). From all the descriptors received, a set of a maximum of 10 relevant descriptors (one per crop) will be selected and proposed to all the members of the group.

For *Physalis* and *Cyphomandra*, no descriptor list is available at IPGRI, and few institutions work on those crops in Europe. Therefore the development of a descriptor list will be a bit more difficult and collaboration with experts having good knowledge of these species (in Europe as well as in South America) will be necessary.

- ***Produce a harmonized set of agronomic traits, and corresponding protocols, to be evaluated***

Though evaluation data are of considerable interest to end-users, the production of an agreed list of agronomic traits to be evaluated is presently a second priority.

- ***Disseminate knowledge of international legislation for genetic resources exchanges***

This objective is of high priority for the group, since the legal texts of the Convention on Biodiversity (CBD) and the International Treaty are not easily understandable by the members of the Working Group.

- ***Use the current taxonomy and identify wild species***

The survey conducted in 2000 revealed that in many European Solanaceae collections, the current taxonomy was not used. It is of high priority to replace the erroneous species names by those which are officially accepted by the taxonomists, and this objective should be easily completed if the partners are provided with a proper list of synonymous species names (e.g. *Lycopersicon esculentum racemiflorum = L. esculentum*; *C. annuum longum = C. annuum*). The Chair and Vice-Chair of the Working Group will be responsible for providing the partners with the relevant information.

The identification of wild species is not a first priority for the group, but nevertheless a list of relevant taxonomists who can assist in the botanical identification of wild species of *Solanum*, *Capsicum*, *Lycopersicon*, *Physalis* and *Cyphomandra* should be established. One essential contact is G. van der Weerden, curator of the Solanaceae collection held at the Botanical Garden of the Nijmegen University, and his address will be provided to all partners. M.C. Daunay, W. van Dooijeweert and W. Palme will establish this list of relevant taxonomists.

Conclusion

This session on Solanaceae was very fruitful: several new partners expressed their interest and provided or agreed to provide information on the Solanaceae collections held in their countries. It was agreed that the new data collected in Skierniewice would be added to those of the Nijmegen meeting to produce a common publication since the Nijmegen report was not yet printed at the time of the Skierniewice meeting.

It is now confirmed that many countries have actively expressed their wish to participate in the Solanaceae WG, and that the total number of 40 000 accessions for Solanaceae genetic resources held in Europe, established in 2000, must be revised to take into account the new data obtained at Skierniewice.

The language issue should be given due attention since some members do not communicate fluently in English.

WORKING GROUP SESSION ON UMBELLIFERS

Dave Astley and Teresa Kotlińska

Review of the workplan

The Umbellifer Working Group was represented at the Vegetables Network (VEGNET) meeting by Dave Astley (Chair, United Kingdom), Teresa Kotlińska (Vice-Chair, Poland), László Holly and Zsuzsanna Kollár (Hungary), Kerstin Olsson (NGB), and Janko Rode (Slovenia). An observer from Lithuania, Nijolė Petraitytė, also participated in the meeting. A short discussion took place with Rana Heydarova (observer, Azerbaijan) on the situation of plant genetic resources in Azerbaijan.

The Umbellifer Working Group is responsible for the crops and wild taxa within nine genera, namely *Anethum* (dill), *Apium* (celery, celeriac), *Carum* (caraway), *Chaerophyllum* (chervil), *Coriandrum* (coriander), *Daucus* (carrot), *Foeniculum* (fennel), *Pastinaca* (parsnip) and *Petroselinum* (parsley).

In preparation for the VEGNET meeting a questionnaire was distributed to all national umbellifer specialists requesting an overview of the content of their collections and the activities of their national programme. Up to the meeting date, 13 completed questionnaires had been received. This information has been used to update the overview table of the European Umbellifer collections reported in the VNCG meeting in Vila Real, Portugal, May 2000. The number of accessions now totals 16 079, an increase of 3780 accessions in comparison to 2000 (Table 3). Their distribution over genera is summarized in Table 4.

The group's activities have been biased heavily towards carrot, partly as a consequence of the existence of the EU GENRES Carrot project, but also because all national programmes have an interest in this crop. In contrast the crops of the other eight genera tend to be limited to a smaller number of national programmes and national genebanks. Therefore it is the intention of the group to identify subgroups of national programmes (3 or 4) for *Anethum, Apium, Carum, Chaerophyllum, Coriandrum, Foeniculum, Pastinaca* and *Petroselinum* to develop workplans in association with the major collections of the crops and active work programmes. We need to investigate whether corresponding members of the Working Group will be willing to accept these responsibilities and develop the subgroups and subsequently the workplans.

The group acknowledged the development of the Working Group on Medicinal and Aromatic Plants (MAPs), recognizing the possibility of duplication within the workplans of the two Working Groups. The Chairman agreed to contact Dr Dea Baričevič (Chairperson of the MAP Working Group) to discuss the interests of the Groups and ensure that work is neither duplicated nor ignored by either Group because of poor communication. Fortunately Dr Janko Rode is a member of both the Umbellifer and the Medicinal and Aromatics Plants Working Groups, and therefore we hope the possibility of errors will be minimized.

Table 3. Umbellifer accessions in European Collections (May 2003) (shaded rows = new or updated data)

Country	Institution	*Anethum*	*Apium*	*Carum*	*Chaerophyllum*	*Coriandrum*	*Daucus* cult.	*Daucus* wild	*Foeniculum*	*Pastinaca*	*Petroselinum*	Others
Albania	Tirana	4					1	3			6	
Austria	Arche Noah	8	20	4	4	12	27		8	13	24	8
	Vienna	13	3	34			2				4	2
	Linz						6				4	
Belgium	Genappe	x	x	x		x		x		x	x	
	Merelbeke		25								10	
Bulgaria	Sadovo	38	56	13	1	25	97		17	5	54	
Czech Rep.	Olomouc	18	63	257	2	5	438		19	15	37	12
France	INH Angers				20		585	26				
Germany	Braunschweig	49	77	17		49	169		80		24	
	Gatersleben	144	188		10	412	319		120	41	191	261
Greece	GGB	2	7				3	77			12	
	NAGREF	4	9									
Hungary	Tápiószele	77	68	29		23	168	2	30	33	122	
Italy	IDG Bari		24				15		31		24	
Latvia	Salaspils			1								
Lithuania	Babtai	2	10	130		6	88	1	1	5	8	4
Netherlands	CGN			53								
Poland	Skierniewice	169	19	3	1	2	277	259	2	12	148	
Portugal	BPGV		x			41	5				46	
	Vila Real		x			x					0	
REGIONAL	NGB	10	16	7			75			2	17	6
Romania	Vidra.Jud.Ilfov	5	1			26		1	3		2	
Slovakia	Nove Zamky	1	12				12			1	20	
Slovenia	Ljubljana	1		4		1	3		3	1	3	17
Spain	CRF Madrid					4	3			1	16	
	Zaragoza		10			4	27			1	78	
Switzerland	Nyon		5				47	1			4	
	St.Gallen						2				1	
	Wädenswil						2					
Turkey	AARI	20	9	22	5	21	100	66	10	2	107	
Ukraine	UDS, Poltava	97	11			68	122		39		30	30
	IOB, Kharkiv	127	39	3		47	341			9	54	
	IEL, Crimea	30				120			110			
United Kingdom	HRIGRU		25			3	735	61		20	21	
	SASA		116				548					
Russia	VIR	811	580	246	17	586	3067	35	257	91	425	88
Azerbaijan	Baku	x	x	x			117		x	x	x	
ECP/GR Total	**16079**	**1630**	**1393**	**823**	**60**	**1455**	**7284**	**532**	**730**	**252**	**1492**	**428**
Total 2000	12299	1321	898	399	52	1202	5272	404	544	177	997	1033
USDA GRIN		81	286	36	36	150	721	55	59	73	154	

x = undetermined number of accessions

Table 4. Number of accessions per genus in the European Umbellifer collections based on data in the questionnaire

Genus	No. of accessions
Anethum	1630
Apium	1393
Carum	823
Chaerophyllum	60
Coriandrum	1455
Daucus cultivated	7284
Daucus wild	532
Foeniculum	730
Pastinaca	252
Petroselinum	1492
Others	428
Total	**16079**

Documentation

The European Umbellifer database (EUDB) is available both searchable on-line and as a downloadable file. However, there is a requirement to collect passport data from national programmes not represented in the EUDB in order to direct the future Working Group programme. There was discussion on the possible effects that the EURISCO database will have on the EUDB and the group's requirement for data from national programmes not currently represented. EURISCO will be launched in September 2003. However, the group has a requirement for data in addition to the MCPD, in particular relating to ecogeographic data for wild taxa and socioeconomic data and a review of the uses of cultivated material. Therefore the group decided to contact national umbellifer representatives to request updated data sets including comment on the additional fields. The ecogeographic data will be used to identify possible protected areas containing umbellifer taxa in order to develop an *in situ* conservation programme for the umbellifer taxa. In addition, the ecogeographic data will be used to identify gaps in the existing collections and to target future collection programmes. The *ad hoc* meeting of the Umbellifer Working Group in Edinburgh in 2001 identified areas of priority for the collection of wild taxa and landraces of carrot/*Daucus*. The group will attempt to update this list based on the questionnaire replies and produce a new collection workplan as and when additional information is received from national programmes. The situation in the other 8 umbellifer genera is far from clear and requires the input of specialist subgroups as proposed above. At the initial *ad hoc* meeting of the group in Kraków the group agreed to identify taxonomic experts on umbellifers to assist the group with taxonomic problems. The current discussion identified the lack of taxonomic expertise for umbellifers as an ongoing problem associated with the collection of material and associated data of wild taxa. The group proposed to continue efforts to identify taxonomic experts willing to assist the group.

The group discussed the inclusion of characterization data in the EUDB. The GENRES Carrot project has produced significant characterization data, which should be associated with the EUDB. However, this work is extremely difficult because of the lack of data set uniformity and the requirement to include multiple data sets over time and from diverse locations. The group concluded that the complexity of such a data set would be greater for the whole of the Umbellifer Working Group and will present extremely difficult problems for the database manager. An additional problem associated with the collection of characterization data is that descriptor lists are available only for carrot/*Daucus* (IPGRI) and celery, celeriac, dill and fennel (UPOV), but not for the other genera in the Working Group

remit.[20] Therefore the group proposed an alternative solution to highlight specific Working Group actions including characterization work as short paragraphs on the Umbellifer pages of the VEGNET Web site. Following the Network-wide discussions, the group agreed to adopt a recommendation of the *Brassica* WG to include a field in the database indicating the presence of characterization data. A link to multiple data sets can be included in the EUDB.

Characterization

The group has been active within the GENRES Carrot project including collaboration with Teresa Kotlińska, RIVC-Skierniewice, Poland. It was clear that the volume of characterization work achieved was very largely a consequence of the availability of the EU-funded GENRES project. Outside the GENRES project the effort in characterizing genetic resources material is a reflection of local and/or commercial interest, and governed strictly by financial limitations. Many genebanks collaborate with commercial companies and receive characterization data and images from them, but this is irregular and directed by the commercial interests rather than by the genebanks. However, the group is keen to continue these productive collaborations.

The data received in the 13 questionnaires showed that during 1990-2002 there were 3569 accessions of the total 9101 accessions characterized/evaluated. The percentage of accessions characterized varies widely for the different crops, e.g. carrot 76%, *Petroselinum* 9% and *Apium* 6%.

Virtually all the effort in characterization has been concentrated on carrot. We reported above the status and availability of descriptor lists for the umbelliferous crops other than carrot. There are descriptor lists available for celery, celeriac, coriander, dill and fennel, but there has been no attempt within the group to identify minimum characterization descriptors for these crops. The group proposed to identify colleagues within the group with specific interests in the various genera and to initiate subgroups to develop specific workplans for these umbelliferous crops and wild taxa including the identification of minimum characterization descriptors. In the questionnaire responses some national programmes reported research activities on umbelliferous crops other than carrot.

Evaluation

The GENRES Carrot project has carried out screening projects to analyze dry matter, carotenes, sugars and nitrate in carrot roots, and to evaluate responses to various diseases of carrot. Also work on the molecular evaluation of carrot was carried out in INH (Institut National d'Horticulture), Angers, France and BAZ (Bundesanstalt für Züchtungsforschung an Kulturpflanzen), Quedlinburg, Germany (GENRES) and in RIVC-Skierniewice/ Agricultural University Kraków. The value of the work was recognized by the group, but many felt that the cost was prohibitively high for many national programmes. The BAZ Quedlinburg reported significant inputs into molecular research for *Apium, Carum, Foeniculum* and *Petroselinum* in association with commercial companies in Germany. Research work at the N.I. Vavilov Research Institute of Plant Industry (VIR), St. Petersburg includes projects on disease and pest resistance, CMS (cytoplasmic male sterility) and increasing the content of specific biochemical components of the plant product. In the Czech Republic there is research on the bactericidal effects of essential oils.

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[20] IPGRI has published a monograph on coriander: Diederichsen, A. 1996. Coriander. *Coriandrum sativum* L. Promoting the conservation and use of underutilized and neglected crops. 3. International Plant Genetic Resources Institute, Rome, Italy (available on-line at http://www.ipgri.cgiar.org/publications/pubfile.asp?ID_PUB=375).

Regeneration

The group reported that for carrot a majority of national programmes were in a position to regenerate the material in their own collections. The group is involved in an ongoing emergency action to regenerate accessions of landraces of carrot for the Vavilov Institute (VIR). Tatyana Khmelinskaya, the curator of the *Daucus* collection at VIR provided the group with the passport data of the collection in order to facilitate consultation with her on the selection of material. To date more than 150 accessions have been regenerated under this emergency action programme. An agreement was formulated between VIR and four ECP/GR national programmes (France, Italy, Poland and United Kingdom) to regenerate specific carrot material and return the bulk of the seed produced to VIR for long-term storage. The agreement allowed the GENRES partners to retain seed samples for characterization within the GENRES project.

The group needs to assess the requirement for regeneration in the *Anethum, Apium, Carum, Chaerophyllum, Coriandrum, Foeniculum, Pastinaca* and *Petroselinum* collections within the national programmes and to review progress.

Identification of duplicates

The *ad hoc* meeting of the Umbellifer Working Group in Edinburgh in 2001 reviewed the question of the identification of duplicate material in the European collections. The group proposed to identify the most original sample (MOS) for the accessions of the wild taxa within the European collections. This work is ongoing and will provide information essential for future collection and *in situ* projects. Mathilde Briard in INH-Angers assessed the accessions of yellow-rooted carrot in the European collections for duplication using molecular markers. This work will continue within the GENRES project and the national programme of France. The group agreed that duplicates in cultivated collections should be identified within national programmes, but for the immediate future material will be maintained in the collections rather than removed.

Safety-duplication

The group identified safety-duplication as an absolute priority within the workplan. The group stressed the need for this topic to be addressed and promoted at the level of the Steering Committee. The group proposed that safety-duplication should appear specifically in the recommendations of Task Sharing in Recommendation 20 of the Task Force for the Phase VII draft document. The questionnaire responses showed that a significant number of national collections are not safety-duplicated. In the 13 recent questionnaire responses only 48 carrot accessions were reported as being safety-duplicated from a total of 9101 accessions. The Chairman will circulate a list of institutions willing to act as "black box" repositories to all national programme umbellifer specialists.

Collecting

During the period 1999-2002 the following collecting missions were organized:

- Greece: collected cultivated and wild *Daucus*.
- Czech Republic: collected landraces of dill, wild parsnip, wild *Daucus*. The main aim of the expeditions was aromatic species such as caraway, chervil.
- Slovenia: in one expedition a total of 1186 accessions were collected, 3% of which were Umbellifers.
- Poland: 7 expeditions in 2000-2002 collected a total of 671 vegetable accessions including 85 Umbellifer accessions (see details in paper by T. Kotlińska, p. 81).

Conservation of wild relatives

The group recognized the requirement for a review of the content of the EUDB, the quality of the passport data and the initiation of an ecogeographic survey of the taxa for the nine genera. The results of the data surveys will promote both the collection of wild taxa for *ex situ* conservation and the identification of protected areas where these taxa are conserved *in situ*. The group discussed existing (Hungary/IPGRI) and proposed (Poland) *in situ* and on-farm conservation programmes with regard to the umbellifer wild taxa. The group will carry out an ecogeographic survey in order to direct the future workplans. In addition, the group recognized the value of promoting on-farm conservation of landraces within traditional agriculture in regional socioeconomic development programmes. Programmes planned in Poland will identify areas where traditional agriculture is still practised in order to promote local production and marketing systems, organic production, local crafts, the conservation of crop diversity alongside a public awareness and education programme.

Presentations and papers

Umbellifer genetic resources in Lithuania

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Introduction

In Lithuania the work on genetic resources of Umbellifers is mainly carried out at three research and educational institutions: the Lithuanian Institute of Horticulture *(Daucus, Coriandrum, Apium, Pastinaca, Foeniculum,* etc.*)*, the Lithuanian University of Agriculture (*Carum*) and the Kaunas Botanical Garden of Vytautas Magnus University (*Coriandrum*, *Apium*, *Pastinaca*, *Foeniculum,* etc.). Some field collections are maintained at the Institute of Botany (*Angelica, Myrrhis*).

In order to facilitate the conservation of genetic resources and reduce the number of regenerations, the seeds of Umbellifer vegetable varieties, herbs and wild populations are kept under long-term seed storage at the national plant genetic resources coordinating centre, the Lithuanian Institute of Agriculture. Seeds are dried for 2-3 months to 5-8% moisture content and stored in foil-laminated bags at -18°C.

Caraway

Within the Lithuanian National Plant Genetic Resources programme, common caraway (*Carum carvi* L.) is assigned to the group of medicinal and aromatic plants. Historical data show that caraway was already being used as a condiment in Lithuania in the 14th century. Work on caraway cultivation techniques was started in 1935 by J. Grybauskas at the Botanical Garden of Kaunas (Dastikaitė 1997) and was later continued by Dr D. Budriūnienė and, since 1974, carried on by Dr A. Dastikaitė who created the variety 'Gintaras', now included in the National List of Varieties.

Nowadays we find that anthropogenic and technogenic factors are causing decreases in caraway habitats (natural meadows) and leading to a reduction of the genetic resources of the species. Morphological and biochemical investigations of wild caraway populations have been carried out at the Lithuanian University of Agriculture since 1996 (Sliesaravicius *et al.* 2000). The field collection of caraway totals 130 accessions (see Table 1).

Research work on caraway has been developing as follows:

- The influence of environmental conditions (temperature, moisture, light) and anthropogenic factors (mowing, grazing) on the stability of the main plant characters (plant height, branching height, number of inflorescences, essential oil and carvone content, 1000-seed weight, fruit yield per plant) have been studied *in situ* in the natural habitats of common caraway since 1996.
- Biodiversity and stability of main parameters have been studied *ex situ* in the caraway field collection since 1998.
- Plant productivity potential, flowering induction and initiation, and resistance to abiotic factors (low temperature and water stress) have been studied since 2002.
- Investigations on genetic polymorphism started in 2003.

Carrot

Carrot breeding in Lithuania was started in 1948 at the State Breeding Station. Numerous carrot accessions were collected during field trips (Table 1). Intervarietal crossing and the purposeful selection of hybrids were used in variety breeding. In 1957 carrot breeding was transferred to the Vytėnai Experimental Station (currently the Lithuanian Institute of Horticulture). Breeding was carried out by Dr J. Mačys, joined later by Dr Armolaitienė.

In Lithuania the carrots most preferred and appreciated by consumers are traditionally those of the 'Nantes' type (Gaučienė 2001). The objective of carrot breeding is to select and develop productive, storable, disease-resistant varieties and hybrids with carotene content not lower than 15 mg/%. The breeding work so far has produced the carrot varieties 'Garduolės 2', 'Šatrija', 'Vytėnų nanto', 'Vaiguva', and the hybrids 'Svalia F_1' and 'Skalsa F_1'.

In 1973 Dr O. Gaučienė initiated a new direction in carrot breeding, the creation of heterotic hybrids. In order to obtain 100% hybrid seeds the female (seed) parent has to possess male sterility. In carrots grown in Lithuania sterile plants are found in the field at 3-7%.

At the Institute sterile lines (which are analogues to varieties) of carrots 'Garduolės 2', 'Šatrija', 'Vytėnų nanto' – i.e., analogues with cytoplasmic male sterility (CMS) – have been created. They are used for the creation of F_1 hybrids. The first carrot hybrids 'Svalia F1' and 'Skalsa F1' have been registered in the National Variety List (Bobinas and Bartkaitė 2001).

Coriander and other Umbellifers

The coriander (*Coriandrum sativum* L.) variety 'Raslė' was developed at the Lithuanian Institute of Horticulture by individual and mass selection. 'Raslė' is an early, productive and disease-resistant variety, especially selected for resistance to ramulariosis, the disease caused by *Ramuliaria coriandri* Moesz. It is an annual spice herb, cultivated here for its seeds, which have an average content of essential oils of 1.3%. The weight of 1000 seeds is 10.3 g. The period from full seed germination to the beginning of seed maturation spans 76 days. Flowering duration is 34 days. The average seed yield is 1.9 t/ha (Maročkienė 2002).

Dill (*Anethum graveolens* L.), parsnip (*Pastinaca sativa* L.), lovage (*Levisticum officinale* L.), fennel (*Foeniculum vulgare* Mill.) and others are maintained in the field collections of the Lithuanian Institute of Horticulture, the Institute of Botany, and the Kaunas Botanical Gardens of Vytautas Magnus University.

Table 1. Umbellifer genetic resources in Lithuania

Taxon	Common name	No. of accessions					
		Total	Advanced cultivars	Land-races	Breeders' lines	Wild	Held in long-term seed storage
Anethum L.	Dill	2	2				
Apium L.	Celery	10	2				
Carum L.	Caraway	130	1		5	124	68
Coriandrum L.	Coriander	6	1		4		1
Daucus sp.	Wild species	1				1	
Daucus carota L.	Carrot	94	38	6	50		14
Foeniculum Miller	Fennel	1	1				
Pastinaca L.	Parsnip	5	5				
Petroselinum Hoffm.	Parsley	8	8				
Angelica archangelica L.	Angelica	3				3	
Myrrhis odorata (L.) Scob.	Myrrh	1			1		
Levisticum officinale W.D.J. Koch	Lovage	2			2		
Total		**263**	**58**	**6**	**62**	**128**	**83**

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Umbellifer crop genetic resources in Poland

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The collection of genetic resources of Umbellifer crops totals 892 accessions of cultivated and wild species of the following genera: *Anethum* L., *Apium* L., *Coriandrum* L., *Daucus* L., *Foeniculum* Miller, *Pastinaca* L., *Petroselinum* Hoffm., *Carum carvi* L. and *Anthriscus cerefolium* L. (syn. *Chaerophyllum cerefolium* Cranc.) The current status of the collection is given in Table 1. Most of these nine crop species are used as vegetables, culinary herbs and aromatic and medicinal plants. The umbellifer collection consists mainly of *Daucus*, *Anethum* and *Petroselinum*.

Dill is very popular in the Polish kitchen and as a medicine. Dill landraces grow in almost every home garden, so a wealth of variable material has been maintained here for a long time. During the last decade 8 new dill cultivars were bred and included in the national list. Root parsley and root celery are more popular than the leaf forms, but both the roots and leaves are used for food and in medicine. The national list contains 11 Polish cultivars of root parsley and 8 of root celery. However, each year brings a rapid decrease in the number of root parsley landraces.

Parsnip is not commonly grown for consumption; some old local cultivars still exist in southwestern Poland. In recent years several breeders have included parsnip in creative breeding programmes.

Wild *Daucus carota* grows everywhere in Poland, making the maintenance of local carrot cultivars in home gardens difficult. Often the farmers replace old carrot landraces because of contamination by wild carrot, which leads to the production of white, wild-type roots.

In Poland other native species of the Umbelliferae such as *Chaerophyllum bulbosum, Carum carvi, Sium sisarum, Pimpinella* sp., *Angelica silvestris, Archangelica officinalis* and others are used as vegetables, and as aromatic herbs or medicinal plants. The collection of aromatic and medicinal plants is maintained at Warsaw Agricultural University (SGGW) and at the Institute of Medicinal Plants in Poznań. The seed material is packed in glass jars and maintained under long-term storage conditions at 5-7% seed moisture content and -15°C.

Documentation

The passport data prepared in the FAO/IPGRI *Multi-crop Passport Descriptors* format have been sent to the EUDB (European Umbellifer Database). Minimum characterization data for 200 carrot accessions were sent to the EUDB. Characterization and evaluation data were scored for 295 accessions using IPGRI, UPOV and RIVC descriptor lists. These data include 226 accessions of carrot, 47 of parsley and 22 of dill (Table 1). Carrot is characterized for 42 traits, parsley and dill for 11 traits.

Data relating to the collection are stored in MS Access and MS Excel. Images of leaf and root characteristics made for validated carrot accessions are stored in JPEG format.

Table 1. Status of Umbellifer germplasm, RIVC-Skierniewice, 2003

Species	English name	Polish name	Total no. of accessions	Type of sample*				Passport data	No of characterized / evaluated accessions	Seed samples in storage	Regeneration 1999-2002
				AC	BL	LR	W				
Anethum L.	Dill	Koper	169	4		165		169	22	169	
Apium L.	Celery	Seler	19	7		12		19		19	
Coriandrum L.	Coriander	Kolendra	2			2		2		2	
Daucus L.	Carrot	Marchew	536	103	70	105	259	536	226	536	67
Foeniculum Miller	Fennel	Koper włoski	2			2		2		2	
Pastinaca L.	Parsnip	Pasternak	12	3		9		12		12	
Petroselinum Hoffm.	Parsley	Pietruszka	148	24		124		148	47	148	10
Carum carvi L.	Caraway	Kminek	3			3		3		3	
Anthriscus cerefolium L. (syn. *Chaerophyllum cerefolium* Cranc.)	Garden chervil	Tribula ogrodowa	1					1		1	
Total			**892**	**141**	**70**	**422**	**259**	**892**	**295**	**892**	**77**

* AC = advanced cultivars; BL = breeding lines; LR = landraces; W = wild

Evaluation and regeneration

In the reporting period 77 accessions were regenerated (67 of carrot and 10 of parsley). Accessions are regenerated in isolation cages using wild bees or pollinated by hand. Observations on morphological traits of leaf and root characteristics are made on 50 random plants from each plot. Characterization of morphological traits and the evaluation of six biochemical compounds were carried out based on IPGRI and UPOV carrot descriptors (Kotlińska *et al.* 2001, 2002).

In 1998 RIVC received 44 carrot accessions from VIR, St. Petersburg to regenerate. Up to now 16 accessions have been regenerated, 6 of them being multiplied twice. Some of the material did not germinate or the germination rate was very low, therefore it has been difficult to increase seed within the planned timeframe. Regenerated seed samples of 13 accessions were sent back to VIR. The regenerated accessions from VIR have also been characterized and evaluated with regard to morphological and biochemical traits in accordance with IPGRI standards. To date 37 accessions have been characterized (see Table 2). Small seed samples of accessions remain for repeat multiplication.

Table 2. Carrot accessions provided in 1998 by VIR to RIVC to increase seeds

VIR Accession number	Name of accession	Country of origin	Total seed increase(*)	Sent back to VIR	Full characterization
1362	Miestnaya	BGR			+
1276	Mestnaya BLR	BYS			+
1378	Krasnaja	HUN			+
1531	Leningradskaja	RUS			
1580	Miestnya Krasnaja	RUS			+
1583	Miestnaya	EST			
1596	Altaiskaja Ukorochennaja	EST	+		+
1598	Mestnaya	UKR	+		+
1602	Miestnya	UKR			+
1614	Miak 195	UZB			+
1616	Mirzoj Zeltaja 304	UZB			+
1680	Dikorastushchaja	GEO			+
1622	Mestnaya	RUS			+
1653	Miestnya	LTU			+
1660	Miestaya	LTU	+		+
1662	Mestnaya LTU	GEO			+
1681	Osiennaja	GEO			+
1683	Vesennaja	GEO			
1705	Osinskaja	RUS			
1706	Mestnaya	UKR			+
1932	Sibirskaja Krasnaja	RUS			+
1936	Leninakanskaja	ARM			+
2042	Stupicka Poldluha	CZE			
2067	Duvicka-Freege	POL			+
2072	Vitaminnaja	RUS			
2197	Miestnya	AFG			+
2339	Voronezhskaja	RUS			+
2478	Akhtubinskaja	RUS			
2545	Dlinnaja	ZAR			+
1359	Miestnya	BGR			+
1411	Bilkova Bielaja	RUS			
1563	Leninakanskaja	RUS			
1934	Birjuchekutskaja 415	RUS			+
1307	Gribowskaja 514	RUS	+	+	+
1370	Khibinskaja	RUS	++	+	+
1365	Miestnaya	BGR	+	+	+
1468	Krasunskaja	RUS	+	+	+
1613	Mirzoj Krasnaja 228	UZB	+	+	+
1652	Mestnaya	LTU	++	+	+
1707	Miestnaya	UKR	++	+	+
1708	Miestnaya	UKR	+	+	+
2017	Losinoostrovskaja 13	RUS	++	+	+
2066	Nantejska-Freege	POL	++	+	+
2074	Mestnaya	KAZ	+	+	+
2119	Lobberychska SWHIV	RUS	+	+	+
2479	Volzhskaja	RUS	++	+	+

(*) ++ = regenerated twice

Collecting expeditions

Between 2000 and 2002 seven expeditions were organized in Poland, during which a total of 671 accessions of vegetable crops and wild relatives were collected, including 85 accessions of Umbellifer crops (see Table 3). One part of the original seed sample was added to the base collection, and another part is included in the field collection for multiplication and characterization.

Provenance data related to collecting sites were recorded using GPS (Global Positioning System). All available information (local growing systems, local methods of plant protection, usage for consumption or as medicinal plants, etc.) was gathered. This information helps to identify suitable farms for the reintroduction and conservation of old cultivars on farms.

Table 3. Umbellifer germplasm collected in Poland during expeditions organized by the Polish Gene Bank from 2000 to 2002

Date	Area	No. of accessions collected					
		Carrot	Parsley	Celery	Dill	Caraway	*Daucus* sp.
Oct. 2000	Tarnow	1	3	1	8	1	
Oct. 2000	Sokolka	2	2		8	1	3
Oct. 2001	Augustów	1	2	1			
Oct. 2002	Kurpie I						
Oct. 2002	Kurpie II	1	13	1	9		
Nov. 2002	Mrągowo-Pisz		8		7		
Dec. 2002	Ciechanów		7	1	4		
Total		**5**	**35**	**4**	**36**	**2**	**3**
		Total no. of Umbellifer accessions= 85					

Utilization

During the period 1999-2002, 451 seed samples of Umbellifer crops were distributed, including 424 samples to breeders and scientists within Poland (277 samples of carrot and wild *Daucus*, 81 of parsley, 58 of dill, 7 of parsnip and 1 of celery), and 27 to users abroad (21 seed samples of carrot, 2 of parsley, 3 of dill and 1 of celery).

The genetic diversity has been evaluated for 95 accessions of carrot and 105 accessions of wild *Daucus* sp. from the genebank, and carrot accessions are being screened for resistance to *Alternaria* sp. at the Agricultural University in Kraków (Grzebelus *et al.* 2002a, 2002b).

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AD HOC MEETING ON LEAFY VEGETABLES

Aleš Lebeda and Ietje W. Boukema

Introduction

A meeting of the *ad hoc* group on Leafy Vegetables was held during the ECP/GR Vegetables Network meeting (22-24 May 2003, Skierniewice, Poland).

Seven participants attended the meeting: E. Křístková and A. Lebeda (Czech Republic), V. Cadot (France), I.W. Boukema (The Netherlands), K. Wedelsbäck-Bladh (NGB), J.V. Valcárcel Germes (Spain) and D. Pink (United Kingdom),

The agenda is given in Appendix A.

A. Lebeda introduced the status on leafy vegetables as was discussed during the Network Coordinating Group Meeting in May 2000 (Vila Real, Portugal).[21] It was concluded that the Leafy Vegetables group would focus on the most important crops, i.e. lettuce, spinach and *Cichorium* and their wild relatives.

The European Leafy Vegetable Collections

The participants presented the current status of the leafy vegetable germplasm collections in their countries (see below, pp. 95-128). Overviews of the collections were given; however, information on some important collections (e.g. Russian Federation, Italy, Germany, Poland, Turkey) is missing and should be requested. From these overviews it became apparent that the major part of these collections represents lettuce, spinach and *Cichorium* and that many minor leafy vegetable crops are only present in small numbers.

The organization of germplasm collections varies according to the country. France operates in a different way from the other European countries: the management of genetic resources in France is organized with networks in the framework of the National Charter for the Conservation of Genetic Resources coordinated by BRG (Bureau des Ressources Génétiques, Paris, France). In Spain several institutions, such as the Polytechnic University of Valencia (UPV) and AgriFood Research Institute of Zaragoza have their own genebanks.

During the meeting inventories were made of the status of safety-duplication (Appendix B), characterization and regeneration (Appendix C) and regeneration protocols (Appendix D).

The status of the already existing *Lactuca* database (ILDB, International *Lactuca* Database) was presented by I. Boukema. This database has not been changed since its creation in 2000.[22]

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[21] See pp. 48-58 *in* Maggioni, L. and O. Spellman, compilers. 2001. Report of a Network Coordinating Group on Vegetables. *Ad hoc* meeting, 26-27 May 2000, Vila Real, Portugal. International Plant Genetic Resources Institute, Rome, Italy.

[22] Stavělíková, H., I.W. Boukema and Th.J.L. van Hintum. 2002. Plant Genetic Resources Newsletter 130:16-19.

Discussion and workplan

Databases

Achievements

1. The participants gave overviews about leafy vegetable collections in national genebanks including all the leafy vegetable crops involved. However, the attention was further focused on the three most important crops: lettuce, spinach and *Cichorium* and their wild relatives.
2. International database: CGN established the International *Lactuca* Database (ILDB) in 2000. Information about this database was published in the *Plant Genetic Resources Newsletter* in 2002 (see above).

Main problems

1. Some collections are not yet included in the ILDB (e.g. NGB, Italy).
2. There are so far no European (or international) databases for spinach and *Cichorium*.

Proposed solutions and actions

1. It was agreed that spinach had the highest priority for the development of a European database. Participants (CGN, Wageningen or UPV, Valencia) will look for possibilities to develop these databases. Action: **before end of 2003**: decide who will carry out this task.
2. The development of a European *Cichorium* database has the second priority. V. Cadot (GEVES, Brion, France) will investigate the possibility of carrying out this task. Action: **before end of 2004:** decide who will carry out this task.[23]

Characterization and evaluation

Achievements

1. All participants have developed their own descriptors for the characterization of lettuce, spinach and *Cichorium,* because IPGRI descriptors are not yet available. Some countries (Czech Republic) have published specific descriptors (e.g. for wild *Lactuca* spp.).
2. An inventory of the status on characterization was made by the participants during the meeting.
3. The minimum descriptors were discussed and agreed upon during the meeting for all three crops, i.e. lettuce and wild *Lactuca* spp., spinach, and four groups of *Cichorium*. Per group of crops 7 to 8 characters were selected (Appendix E).

Main problems

1. Common IPGRI descriptors are not available.
2. No evaluation data available on new diseases (or new races of existing diseases) in lettuce, spinach and *Cichorium.*

[23] It was subsequently agreed that CGN, Wageningen, The Netherlands would be responsible for the ECP/GR Spinach database end GEVES, Brion, France for the ECP/GR *Cichorium* database.

Proposed solutions and actions

1. Basic descriptors on wild *Lactuca* spp. were published in the *Plant Genetic Resources Newsletter* as a result of an international cooperation (GENE-MINE project).[24]
2. The minimum list of descriptors, as agreed during the meeting, is given in this report (Appendix D).
3. To screen in collaborative (EU-funded) projects wild relatives of lettuce and collections of spinach and *Cichorium* for resistance to these diseases.

Regeneration

Achievements

1. The status of regeneration and regeneration protocols as given by the participants are summarized in Appendix C of this report.
2. It became clear that the participants can manage the regeneration of their own collections.

Main problems

1. No information is available about the status of regeneration of some other important collections (e.g. VIR, Russian Federation).

Proposed solutions and actions

1. To obtain information about the status of regeneration in these collections.[25]

Safety-duplication

Achievements

1. The status of safety-duplications of the national collections was given by the participants. All partners have arranged this already. Most partners offered space in their long-term storage facilities to host safety-duplicates (see Appendix B).

Main problems

1. Some other important collections have not yet arranged their safety-duplication (e.g. VIR).
2. Collections of minor leafy vegetable crops are endangered because of their low priority. Safety-duplications of minor leafy vegetable crops have not been arranged.

Proposed solutions and actions

1. To obtain information on the status of safety-duplications of minor leafy vegetables and stress the importance of safety-duplication for the collections which have not yet arranged this.

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[24] Doležalová, I., E. Křístková, A. Lebeda, V. Vinter, D. Astley and I.W. Boukema. 2003. Plant Genetic Resources Newsletter 134:1-9.

[25] Information about the status of regeneration of several collections were received after the meeting and included in Appendix C. The VIR collection includes 660 spinach accessions, 1540 lettuce accessions and 370 accessions of *Cichorium*.

Duplication

Achievements and problems

1. The partners recognized that in lettuce collections a high percentage of duplication within and between collections exists. For wild *Lactuca* spp. the detection of duplicates is considered to be very important for the screening efficiency of these collections. The detection of duplicates is also important for a good overview of the available diversity in collections.

Proposed solutions and actions

1. To detect, where possible, the most original samples (MOSs) for wild *Lactuca* species in the collections. The database manager is expected to do this in cooperation with the collection holders (on the basis of passport data). The information obtained is to be added to the ILDB.

Conservation and management of wild relatives

Achievements

1. In Europe wild relatives of lettuce and *Cichorium* are very common. For lettuce wild species are available in the most important collections.

Main problems

1. The poor availability of accessions of some wild *Lactuca* spp., especially from the secondary and tertiary genepools.
2. Only very limited numbers of wild spinach and *Cichorium* spp. are available.

Proposed solutions and actions

1. A more intensive cooperation with the countries of origin for collecting activities of the three species (*Lactuca*, *Spinacia* and *Cichorium)*.

Conclusions and proposals for the future

- The *ad hoc* group will apply for the status of a formal Working Group to the Steering Committee of ECP/GR.[26]
- The group wanted to apply for an EU-funded project focused on leafy vegetables.
- The group decided that the people responsible for the *ad hoc* group on Leafy Vegetables will be Aleš Lebeda (Palacký University, Olomouc, Czech Republic) and Ietje Boukema (CGN, Wageningen, The Netherlands).

[26] The establishment of the Working Group was endorsed by the Steering Committee (see Report of the Ninth Steering Committee Meeting, Menemen, Izmir, Turkey, 22-25 October 2003 - http://www.ecpgr.cgiar.org/SteeringCommittee/Outcome_SC9/SC9Report_nocover.pdf).

Appendices

*Appendix A. Agenda of the A*d hoc *Meeting on Leafy Vegetables, 22 May 2003, Skierniewice, Poland*

The ECP/GR *ad hoc* group on Leafy Vegetables (10:45–12:30 and 14:00-14:45)

- Self-introduction of the participants
- Scope of the informal group on Leafy Vegetables (crops: lettuce, endive/chicory, spinach, others) (*A. Lebeda and I. Boukema*)
- Leafy vegetables genetic resources in Europe: general situation (*A. Lebeda and I. Boukema)*
- Short review of national collections and activities (per partner, on the topics below)
- Introduction to the topics for discussion (see below) and proposal for defining an agreed workplan (*I. Boukema and A. Lebeda*)

Discussion of the workplan and schedule (14:45–15:30 and 16:00–17:15)

- **General topics**

1. **Leafy Vegetables Databases**
   - recent status ILDB
   - need for other leafy vegetable crop databases
2. **Status of national databases** and possibility of compilation of data from holding institutions to create crop databases (who will do the work?)
3. **Storage**
   - identification of duplicates
   - safety-duplication
   - availability of long-term conservation facilities
   - institutions available to host safety-duplicates
4. **Regeneration protocols** (for most important crops; lettuce endive/chicory, spinach, others?), status of regeneration
5. **Primary characterization, descriptor lists**
   - availability of descriptors for leafy vegetable crops
   - status of characterization
   - agree on minimal lists of descriptors per crop

- **Specific topics (17:15–17:45)**

1. **Collecting missions, recent status and need for further collecting**
2. **Current and future research directions in leafy vegetable crops in Europe**
3. **Cooperation between holding institutions and others** (Universities, research institutions, plant breeders, etc.)
4. **Financial support (???)**

Conclusion (17:45–18:00)

- Future contacts and activities inside and outside the group in Phase VII of ECP/GR
- Responsible persons (Chair, Vice-Chair, etc.)
- Concluding remarks

Appendix B. Leafy vegetable European collections: safety-duplication status

Country	Institute	Storage temperature for duplicates	Already arranged	Institute	Offering to host accessions
Bulgaria	IPGR	-18°C			
Czech Republic	RICP	-20°C	YES	RICP Piešťany	YES
France	GEVES	-18°C	YES	SNES	YES
Germany	IPK	-15°C			
Hungary	RCA	-20°C at NBC		TABI Tápiószele	YES
The Netherlands	CGN	-20°C	YES	HRI	YES
Nordic Countries	NGB	-4°C	YES		YES
Poland	RIVC	-18°C at POLIHAR	Not Yet		YES
Portugal	BPGV	-20°C			
Russian Federation	VIR	-10°C	Not Yet		NO
Spain	COMAV-UPV	- 3°C	YES	BGHZ and CRF	NO
Spain	BGHZ	-18°C	YES	UPV and CRF	-
United Kingdom	HRI	-20°C	YES	CGN	YES

Appendix C. Leafy vegetable European collections: status of characterization and regeneration

Percentage of accessions that have been characterized

Country	Institute	Lettuce (%)	Spinach (%)	*Cichorium* (%)	Others (%)
Bulgaria	IPGR	30	25		
Czech Republic	RICP	50	100		
France	GEVES	62*	73*	70	
Germany	IPK	80	80	95	
Hungary	RCA	90	40	100	30
The Netherlands	CGN	95	95	(-)	(-)
Nordic countries	NGB	50	10		
Poland	RIVC	10			
Russian Federation	VIR	95	90	90	
Spain	COMAV-UPV	55	15		
United Kingdom	HRI	10			

(-) = no collection present

* ownership not GEVES but breeders

Percentage of accessions that have been regenerated

Country	Institute	Lettuce (%)	Spinach (%)	*Cichorium* (%)	Others (%)
Bulgaria	IPGR	30	55		
Czech Republic	RICP	50	100		
France	GEVES			50	
Germany	IPK	80	80	90	
Hungary	RCA	90	40	100	30
The Netherlands	CGN	95	95	(-)	(-)
Nordic countries	NGB	100	100	100	
Poland	RIVC	10			
Russian Federation	VIR	90	90	90	
Spain	COMAV UPV	55	20	60	
United Kingdom	HRI	55	80	65	

(-) = no collection present

Appendix D. Leafy vegetable European collections: regeneration protocols (number of plants per accessions, isolation, pollinators)

Country	**Institute**	**Lettuce**	**Spinach**	***Cichorium***
Bulgaria	IPGR	40-60 plants/accession in the field	100-120 plants/accession isolated in the field	
Czech Republic	RICP	- cultivated: 15-18 plants/accession in isolation cages. - wild: 16-20 plants/ accession in greenhouse	40 plants/accession in isolation cages with pollen-proof plastic gauze	(-)
France	GEVES			cross-pollinated species: 60 plants/accession; insect-proof cages; bees or flies
Germany	IPK	20 plants/accession in the field	100 to 150 plants per accession isolated in the field	24 plants per accession isolated in the field or green-house
Hungary	RCA	24 plant/accession, in open field; no isolation	36 plants/accession, in the field and backyards, isolation in space	18 plants/ accessions, in experimental fields isolation in space
The Netherlands	CGN	- cultivated: 8 (homogeneous) or 16 (heterogeneous) plants/accession; heading types: GA3 20 ppm; no isolation. - wild: 16-24 plants/accession; vernalization; no isolation; panicles hulled in perforated plastic bags. - cross-breeding species: isolation cages with blowflies	50-80 plants/accession; distance isolation in glasshouses; wind	(-)
Nordic countries	NGB	50-100 plants/accession in glasshouse	50-100 plants/accession in isolated cages	
Poland	RIVC	30-50 plants/accession in glasshouse in isolation cages		
Russian Federation	VIR	15 plants/accession - cultivated: no isolation - wild: in isolation cages	30-40 plants/accession in isolation cages wind	about 30 plants/accession 50% acc. in isolation cages 50% acc. in isolation plots pollinated by bees and flies
Spain	COMAV-UPV	cultivated: 15-20 plants/accession	40-50 plants/accession in isolated fields	(-)
United Kingdom	HRI	- cultivated: 20 plants/accession in glasshouse with cooling; no isolation; - wild: panicles hulled in perforated plastic bags	80 plants/accession in isolation under glasshouse conditions	40 plants/accession in insect-proof cages pollinated by blow flies

(-) = no collection present

Appendix E. Minimum descriptors for leafy vegetables

Cultivated lettuce (*Lactuca sativa* L.)

Descriptor name	Descriptor state	Note
Seed colour	1 = white/cream 2 = yellow 3 = brown 4 = black	
Flower anthocyanin content	0 = absent 1 = present	
Leaf anthocyanin content	0 = absent 3 = weak 5 = medium 7 = strong	At harvest maturity
Outer leaf colour	1 = yellow green 2 = green 3 = grey green 4 = blue green 5 = red green	At harvest maturity
Outer leaf colour intensity	3 = light 5 = medium 7 = dark	At harvest maturity
Head shape	0 = head not formed 1 = elliptic 2 = broad elliptic 3 = circular 4 = transverse elliptic	At harvest maturity in longitudinal section
Heart formation	0 = absent 3 = slight 5 = moderate 7 = well developed	At harvest maturity
Homogeneity	1 = completely homogeneous 3 = slightly heterogeneous 5 = moderate heterogeneous 7 = very heterogeneous 9 = completely heterogeneous	At harvest maturity

Wild *Lactuca* spp. (*L. serriola* and related species from primary genepool *L. saligna, L. virosa*)

Descriptor name	Descriptor state	Note
Seed colour	1 = white/cream 2 = yellow 3 = brown 4 = black	
Spines on stem	0 = absent 3 = few 5 = moderate 7 = many	
Spines on leaf midrib	0 = absent 3 = few 5 = moderate 7 = many	
Leaf incision of rosette leaves	1 = not incised 2 = pinnatilobed (up to 1/3) 3 = pinnatifid (1/2) 4 = pinnatipart (2/3) 5 = pinnatisect (more than 2/3)	Depth of incisions from blade margin to the main vein
Leaf incision of cauline leaves	1 = not incised 2 = pinnatilobed (up to 1/3) 3 = pinnatifid (1/2) 4 = pinnatipart (2/3) 5 = pinnatisect (more than 2/3)	Depth of incisions from blade margin to the main vein
Flower anthocyanin content	0 = absent 1 = present	
Flowering time		Number of days from sowing until first flower head

Spinach (*Spinacia oleracea* L.)

Descriptor name	Descriptor state	Note
Seed spines	0 = absent 1 = present	
Stem anthocyanin content	0 = absent 3 = weak 5 = medium 7 = strong	
Leaf shape excluding basal lobes	1 = elliptic 2 = broad elliptic 3 = circular 4 = ovate 5 = broad ovate 6 = triangular	*Score at 7th leaf stage*
Leaf colour	1 = yellow green 2 = grey green 3 = dark green	Score at 7th leaf stage
Leaf colour intensity	3 = light 5 = medium 7 = dark	Score at 7th leaf stage
Leaf blistering	3 = weak 5 = medium 7 = strong	Score at 7th leaf stage
Bolting time		Number of days from sowing until 15% of plants have stem of 5 cm
Monoeciousness	0 = no monoecious plants 3 = 25% 5 = 50% 7 = 75% 9 = all	% of monoecious plants

Leaf chicory (*Cichorium intybus* L.) UPOV TG/154/3

Descriptor name	Descriptor state	Note
UPOV n°7: Leaf: colour (excluding midrib)	1 = green 2 = yellowish green 3 = reddish green 4 = red	
UPOV n°8: Leaf: intensity of colour	3 = light 5 = medium 7 = dark	
UPOV n°11: Leaf: anthocyanin colouration at harvest maturity	1 = absent 9 = present	
UPOV n°19: Plant: head formation	1 = absent 9 = present	
Head: colour of outer leaves	Main colour of outer leaves 1 = green 2 = yellowish green 3 = reddish green 4 = red	
UPOV n°32: Time of beginning of bolting	1 = very early 3 = early 5 = medium 7 = late 9 = very late	
Morphotype (cultigroup)	1 = Barba di Cappuccino 2 = Améliorée 3 = Catalogna 4 = Pan di Zucchero 5 = Rossa di Treviso 6 = Rossa di Verona 7 = Palla rossa (Rossa di Chioggia) 99 = others	

Witloof (*Cichorium intybus* L. var. *foliosum*) UPOV TG/173/3

Descriptor name	Descriptor state	Note
UPOV n°6: Leaf: length	1 = short 5 = medium 7 = long 9 = very long	
UPOV n°10: Leaf: intensity of green colour	3 = light 5 = medium 7 = dark	All observations on the leaf should be made on the full grown leaf
Leaf: anthocyanin content	1 = absent 9 = present	All observations on the leaf should be made on the full grown leaf
UPOV n°21: Bolting tendency (from an early sowing)	3 = weak 5 = medium 7 = strong	
Head: shape	1 = cylindrical 2 = cylindrico-globular 3 = globular	
UPOV n°27: Head: length	1 = very short 3 = short 5 = medium 7 = long 9 = very long	
Head: colour	1 = yellow 2 = red	All the observations on the head should be made at the time of harvesting of the heads before exposure to daylight

Endive - cut and plain chicory (*Cichorium endivia* L.) UPOV TG/118/4

Descriptor name	Descriptor state	Note
UPOV n°1: Plant: botanical type	1 = plain type 2 = intermediate type (between cut and plain types) 3 = cut type	
UPOV n°2: Plain-type varieties only: sub-type	1 = Grosse Bouclée 2 = A coeur Plein 3 = Géante maraîchère 4 = Cornet	
UPOV n°3: Non-plain type varieties only: Plant: sub-type	1 = Wallonne type 2 = De Louviers type 3 = D'été à Coeur Jaune type 4 = others (including intermediate types between cut and plain types)	
UPOV n°7: Heart : colour	1 = yellowish green 2 = green	
UPOV n°8: Heart: intensity of green colour	3 = light 5 = medium 7 = dark	
UPOV n°14: Leaf: colour	1 = yellowish 2 = green 3 = greyish green	All the observations on the leaf should be made just before harvest maturity on leaves excluding the outer and center leaves
UPOV n°15: Leaf: intensity of green colour	3 = light 5 = medium 7 = dark	
UPOV n°28: Flower: colour	1 = white 2 = pink 3 = blue 4 = violet blue	
UPOV n°30: Time of bolting	3 = early 5 = medium 7 = late	

Industrial chicory (*Cichorium intybus* L.) UPOV TG/172/3

Descriptor name	Descriptor state	Note
Root: shape	3 = cylindrical 5 = cylindro-conical 7 = conical	
Insertion of root crown	3 = raised 5 = flat 7 = depressed	
Dry matter content of root (optional)	3 = weak 5 = medium 7 = high	
UPOV n°3: Leaf: attitude	1 = erect 3 = semi-erect 5 = horizontal	
UPOV n°4: Leaf: length	3 = short 5 = medium 7 = long	3 = De Magdebourg 5 = Halles 7 = Flandres
UPOV n°5: Leaf/ width	3 = narrow 5 = medium 7 = broad	3 = Dageraad 5 = Halles 7 = Flandres
UPOV n°18: Bolting tendency (from an early sowing)	3 = weak 5 = medium 7 = strong	

Presentations and papers

Genetic resources of leafy vegetables in the Czech Republic

Eva Křístková and Věra Chytilová

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Introduction

Activities connected with the preservation, documentation and utilization of plant genetic resources in the Czech Republic are funded by the Ministry of Agriculture through the National Programme of Conservation and Utilization of Genetic Resources of Cultivated Plants. The Research Institute of Crop Production in Prague-Ruzyne (RICP) is the national coordinator of this programme, which includes the activities of 10 private and/or state institutions for the maintenance of genetic resources of all plant species cultivated in our climatic area.

The Gene Bank in Olomouc, a branch of the RICP, is responsible for the genetic resources of vegetable, medicinal, aromatic and spice plant species traditionally grown in the Czech Republic. Work with genetic resources has a tradition of more than 50 years. Collections maintained by the Gene Bank in Olomouc include more than 10 000 accessions, i.e. 1/5 of all accessions maintained in the Czech Republic (Dušek *et al*. 1998).

Structure of the leafy vegetable collection

Resulting from historical developments, cultivation traditions and customer tastes, the most important leafy vegetables in the Czech Republic are the lettuces (*Lactuca sativa* L.). Of the other species, spinach (*Spinacia oleracea* L.) is the most cultivated (and/or imported) and consumed. An overview on leafy vegetable growing and breeding in the Czech Republic was written by Moravec *et al.* (1999).

Other leafy species have only a limited economic importance, but their genetic resources should be taken in consideration in the context of plant diversity protection. The list of leafy vegetable genetic resources conserved in the Czech Republic is given in Table 1.

Table 1. Genetic resources of leafy vegetables in the Czech Republic

Family	Genus / species	No. of accessions	Holding institutions / curators *
Asteraceae	*Lactuca* spp.	1524	RICP / EK
	Cichorium endivia L.	24	RICP/ EK
	Cichorium intybus L.	28	RICP/ EK
	Cynara scolymus L.	3	RICP / VCh
	Chrysanthemum coronarium L.	1	RICP / VCh
Brassicaceae	*Eruca vesicaria* (L.) Cav. subsp. *sativa* (Mill.) Thell.	2	RICP/ EK
		17	Oseva
	Lepidium sativum L.	1	RICP / VCh
Chenopodiaceae	*Spinacia oleracea* L.	17	RICP / VCh
Liliaceae	*Asparagus officinalis* L.	11	MUAF
Polygonaceae	*Rheum rhabarbarum* L.	11	MUAF
Tetragoniaceae	*Tetragonia expanza* Murr.	15	RICP / VCh
Valerianaceae	*Valerianella locusta* (L.) Latterade em. Betcke	1	RICP / VCh

* Institutions: RICP = Research Institute of Crop Production, Gene Bank in Olomouc;
MUAF = Mendel University of Agriculture and Forestry, Faculty of Horticulture, Lednice na Moravě
Oseva = Oseva Pro Ltd., Opava
Curators: EK = Eva Křístková , VCh = Věra Chytilová

Passport data for all accessions of leafy vegetable genetic resources are available on the Web site (http://genbank.vurv.cz/genetic/resources/).

Collection of *Lactuca* genetic resources

- **Recent development of the collection**

During the last eight years the number of accessions has increased considerably. During the period 1994-2002 810 new accessions were added to the collection (Table 2). Old missing Czech lettuce cultivars available in the world's genebanks and in Czech breeding and seed companies were reintroduced.

Table 2. New accessions of *Lactuca* genetic resources acquired by the RICP Gene Bank in Olomouc in 1994-2002

Species	No. of accessions acquired in year								
	1994	1995	1996	1997	1998	1999	2000	2001	2002
Lactuca sativa	42	99	27	31	7	1	19	3	0
Wild species	1	131	195	13	6	44	136	6	49

Approximately 500 newly acquired accessions were kindly provided by Prof A. Lebeda (Palacký University in Olomouc, Czech Republic). These accessions are represented mostly by wild species and originated from USDA/ARS germplasm collections in Salinas, IVT (Institute for Horticultural Breeding, now part of Plant Research International, Wageningen, The Netherlands), HRIGRU (Genetic Resources Unit, Horticulture Research International, Wellesbourne, UK), IPK (Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany) and VIR (Vavilov Research Institute, St. Petersburg, Russian Federation). The set of differential genotypes for the determination of *Bremia lactucae* races originates from the collections of Prof. A. Lebeda.

Collecting activities developed in cooperation with Palacký University in Olomouc resulted by the end of April 2003 in a total of 275 new and original accessions. Additional information is given below in the section "Collecting, characterization and evaluation activities".

- **Structure of the collection**

By the end of April 2003 the collection consisted of 878 accessions and/or records of *Lactuca sativa* and 646 accessions and/or records of wild *Lactuca* species. The butterhead lettuce is the most frequently represented in the group of cultivated lettuces (Table 3).

On the basis of passport data, especially donor number, duplicates within accessions can be detected. Some accessions having the same cultivar name originate from different sources. For example, the cultivar 'Attraction' is represented by 13 accessions. However, some cultivars have the same name but are morphologically different.

Table 3. Structure of the *Lactuca sativa* collection in the RICP Gene Bank in Olomouc (April 2003)

Subtaxon*	Morphotype	No. of accessions
***Lactuca sativa* L.**		
var. *capitata* L. *nidus tenerrima* Hel.	Butterhead lettuce	663
var. *capitata* L. *nidus jäggeri* Hel.	Crisphead lettuce	21
var. *longifolia* Lam. (syn. var. *romana* hort. in Bailey)	Cos (Romaine) lettuce	16
var. *angustana* Irish ex Bremer (syn. var. *asparagina* Bailey, syn. *L. angustana* hort. in Vilm.)	Stalk lettuce	2
var. *acephala* Alef. (syn. var. *secalina* Alef., syn. var. *crispa* L.)	Cutting lettuce	52
	not specified	124
Total		**878**

* Intraspecific classification based on Rodenburg (1960) and de Vries and Raamsdonk (1994)

The group of wild *Lactuca* species includes 24 species and interspecific hybrids of *L. serriola* and *L. sativa* (Table 4). Infraspecific classification is not shown; however, it was done for some species (e.g. *L. serriola, L. saligna, L. viminea*). The taxonomy of wild species was verified and some accessions were re-determined (Doležalová *et al.* 2003). The taxonomic classification of Table 4 below does not follow the new classification, as it was established before publication of the above-mentioned paper.

Table 4. Structure of the collection of wild *Lactuca* species in the RICP Gene Bank in Olomouc

Section / subsection*	Genus / species	No. of accessions
Lactuca* spp.		
Interspecific hybrids	*L. serriola* L. x *sativa* L.	4
Lactuca L. / *Lactuca* L.	*L. aculeata* Boiss. & Ky.	4
	L. altaica Fisch. & Mey.	5
	L. angustana All.	1
	L. livida Boiss. & Reut.	4
	L. saligna L.	99
	L. serriola L.	401
	L. virosa L.	86
Lactuca L. / *Cyanicae* DC.	*L. perennis* L.	5
	L. tenerrima Pourr.	1
Phoenixopus (Cass.) Bentham	*L. viminea* (L.) J. & C. Presl	5
Mulgedium (Cass.) C.B. Clarke	*L. taraxacifolia* Chalk.	1
	L. tatarica (L.) C.A.Mey.	1
Lactucopsis (Schultz Bip. ex Vis. et Panč.) Rouy	*L. quercina* L.	3
Tuberosae Boiss.	*L. indica* L.	4
	L. squarrosa (Thunb.) Miq. (syn. *L. indica* L.)	2
African group	*L. capensis* Thunb.	1
	L. dregeana DC.	3
	L. homblei De Wild.	1
North American group	*L. biennis* (Moench) Fernald	3
	L. canadensis L.	1
Genera related to the genus *Lactuca**		**1**
	Cicerbita alpina (L.) Wallr. (syn. *L. alpine* (L.) Gray)	2
	Ixeris dentata (Thunb.) Nakai (syn. *L. dentata* L. (Thunb.) Robins.)	
	Mycelis muralis (L.) Dum. (syn. *L. muralis* (L.) Gaertn.)	1
	Youngia denticulata (Houtt.) Kitam. (syn. *L. denticulata* (Houtt.) Maxim.)	1
Species unknown		6
Total		**646**

* Classification based on Lebeda and Astley (1999)

- **Status and origin of accessions**

The records of *Lactuca sativa* accessions include 43 landraces, 804 advanced cultivars, 28 breeding lines and 5 accessions of unknown status.

Accessions of *Lactuca* spp. originate from approximately 34 countries worldwide (Table 5). The majority of the accessions are from Europe.

Table 5. Origin of *Lactuca* genetic resources in the RICP Gene Bank in Olomouc

Country of origin	No. of accessions		Country of origin	No. of accessions	
	L. sativa	Other species		*L. sativa*	Other species
Europe			**Americas**		
Austria	32	4	Brazil	2	-
Belgium	1	2	Canada	-	3
Bulgaria	1	4	USA	68	33
Czech Republic*	110	132	Venezuela	-	1
Denmark	11	-			
France	72	52	**Asia**		
Germany	145	11	China	14	1
Greece	-	25	Iran	-	1
Hungary	14	5	Iraq	-	2
Italy	8	42	Israel	-	39
The Netherlands	171	4	Japan	-	1
Poland	1	1	Turkey	-	59
Portugal	1	3			
Romania	2	-	**Africa**		
Slovak Republic	4	9	Kenya	-	1
Slovenia	-	5			
Former Soviet Union	10	17	**Australia**		
Spain	-	25	Australia	1	-
Sweden	12	5			
Switzerland	30	7	**Unknown**	102	142
United Kingdom	58	10			
Former Yugoslavia	8	-			
Total *L. sativa* = 878 accessions **Total other species = 646 accessions**					

* including former Czechoslovakia

Availability of accessions

Accessions are freely available for research, breeding and educational purposes on the basis of international agreements and standards. Availability of accessions in the Czech national germplasm collection, derived from their passport data, is listed in Table 6. Accessions with a sufficient amount of seed are generally considered as available (letter Y). If the amount of seeds is low and/or germination rate has decreased, the accession must be regenerated and is temporarily not available (letter N). The availability of certain accessions (e.g. breeding lines) is possible after permission of the donor (letter L). If the accession does not exist any more because of the loss of seeds, elimination of a duplicate and/or other reasons, only passport data remain in the database. The availability of such an accession is marked by the letter X and its number cannot be used again for another sample. Within the *Lactuca* spp. germplasm collection, for a total of 47 *Lactuca sativa* accessions and 42 wild species accessions, the seeds are no longer available and only records in the passport data exist.

Table 6. Availability of *Lactuca* spp. accessions in the RICP Gene Bank in Olomouc (April 2003)

Genus / Group	No. of accessions according to availability*		
	Y	N	L
Lactuca sativa	801	18	12
Wild *Lactuca* spp.	211	116	277

* Y = available; N = temporarily not available (low seed amount); L = available with donor permission

Regeneration of accessions, storage conditions, safety-duplication

- **Regeneration**

During the regeneration process, international standards are followed and biological requirements of individual species are taken into account. *Lactuca sativa* accessions are regenerated in isolation cages placed on the soil and spaced at 2.3 m x 5.5 m each, covered by glass or by plastic net. Wild species are regenerated in plastic containers with garden soil in the greenhouse. Each accession is represented by 15-20 plants. Our technical capacity enables the regeneration of approximately 100 accessions of *L. sativa* and 40 accessions of wild *Lactuca* species each year.

- **Storage**

Harvested seeds are dried at room temperature, cleaned and then sent to the main store in the RICP Gene Bank in Prague-Ruzyne, where seeds are dried to 5-6% moisture content, placed in hermetically closed jars and stored at about -5°C in separate active and base collections. The working collection is kept by the Gene Bank branch in Olomouc.

- **Safety-duplications and "black-boxes"**

We would like to offer the capacity of the RICP Gene Bank in Prague–Ruzyne for "black-boxes" and/or safety-duplication to other genebanks.

Under an agreement between representatives of the Czech Republic and Slovakia, duplicate samples of the collection of the most important accessions, consisting predominately of Czechoslovak original cultivars and landraces, are being prepared for transfer to the Gene Bank in Piešťany (Slovak Republic).

Collecting, characterization and evaluation

- **Collecting**

Collecting wild *Lactuca* species is a very important part of the genebank's activities. It has been developed in cooperation with Palacký University in Olomouc. During collecting missions to European countries in 1995–2002 a total of 1624 seed samples were collected (Doležalová *et al.* 2001; Lebeda *et al.* 2001). These samples are being regenerated, characterized for morphological traits and used for further research and education purposes (Křístková *et al.* 2002). A total of 275 new and original accessions of *L. serriola, L. saligna* and *L. viminea* were included into the Czech national *Lactuca* spp. collection.

- **Characterization and evaluation**

Basic morphological characterization and photographic documentation of accessions are carried out either during their regeneration or in special trials under field conditions. Documentation of wild species is completed by the preparation of herbarium specimens. National descriptor lists were elaborated for *L. sativa* with 47 descriptors (Křístková *et al.* 2005) and for wild *Lactuca* species with 88 descriptors (Doležalová *et al.* 2002). The list of 26 basic descriptors for wild *Lactuca* species was prepared for the purposes of the EU-funded project GENE-MINE –"Improved use of germplasm collections with the aid of novel methodologies for integration, analysis and presentation of genetic data sets" (Doležalová *et al.* 2003).

The morphological description serves as the base for the confirmation of the taxonomic status of wild *Lactuca* species, evaluation of infraspecific variability and identification of duplicates. Descriptive approaches are complemented by other methods, including molecular biology and biochemistry. In general the results obtained confirmed the existence of wide morphological and physiological variability within the accessions under study.

National and international links and cooperation

The Olomouc station has good conditions for the preservation of the vegetable genetic resources of the Czech Republic. Beside the advantages of tradition, technical equipment and an experienced staff, the links with universities, research institutes and breeding stations also have a fundamental importance. The RICP Gene Bank in Olomouc is open to all researchers, breeders and students.

In the period 1995–2002 a total of 758 accessions were provided to users in the Czech Republic and abroad. In addition approximately 50 accessions are used each year for morphological studies carried out at Olomouc.

Research work with the *Lactuca* spp. germplasm collection is being developed in cooperation with the Palacký University in Olomouc. In 1999 the EUCARPIA International Scientific Conference on Leafy Vegetable Genetics and Breeding was organized in Olomouc (Lebeda and Křístková 1999).

The Gene Bank in Olomouc participates in the EU project GENE-MINE. One of its main tasks is the study of morphological and biological variation within and between European sub-populations of *L. serriola.*

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The working collection of the genus Lactuca *at the Palacký University, Czech Republic*

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Introduction

The active preservation of genetic variability of wild plant species plays an irreplaceable role in crop improvement and food production (Gass *et al.* 1999). A clear understanding of genetic resources is an important key for their practical conservation and utilization (Lebeda and Astley 1999; Lebeda and Boukema 2001). From almost 100 wild *Lactuca* species known, only *L. sativa* is cultivated throughout the world. Despite the extensive utilization of wild *Lactuca* relatives (progenitors) in common lettuce breeding, information on their taxonomy and ecobiology is still rather limited (Lebeda *et al*. 1999, 2001a,b). The Department of Botany of Palacký University at Olomouc, Czech Republic holds a working collection of the genus *Lactuca*, which has been widely used in basic research and education. This collection builds upon studies initiated in the 1970s by A. Lebeda at the Plant Breeding Station Smržice, Czechoslovakia (Lebeda 1996).

The *Lactuca* working collection

The collection contains 678 accessions of 16 species originating from various ecogeographical areas of Europe, Asia, Africa, North America, hybrids of *L. serriola* x *L. sativa* and undetermined *Lactuca* species. Within the collection there are 81 accessions and seed samples representing three species, *L. canadensis*, *L. serriola* and *L. tatarica* from North America (Table 1). It also conserves a differential set for lettuce downy mildew (*Bremia lactucae*) consisting of nearly 60 *L. sativa*, *L. serriola* and *L. saligna* accessions (genotypes). The working collection was primarily established for phytopathological research and for the research activities of students. Recently, it has been enriched with new and unique accessions with the aim of conserving biodiversity and advancing the study of inter- and intraspecific variability, taxonomy and ecobiology, as well as the phylogenetic and evolutionary relationships of wild *Lactuca* species.

Maintenance

Accessions (16 plants per population) are regenerated in an insect-free glasshouse under controlled conditions following international standards for genetic resources (van Hintum and Boukema 1999). Accessions are multiplied under long-day conditions; however, species flowering under shorter photoperiods (e.g. *L. indica*) are kept in a vegetative stage till late autumn. Biennial (*L. biennis*, *L. canadensis*, *L. virosa*) and perennial (*L. viminea*, *L. perennis*, *L. tatarica*, *L. tenerrima*) species are overwintered as basal rosettes. Since *L. sativa* and the majority of wild species are self-fertilizing, the accessions are not isolated during multiplication. However, accessions of allogamous species (*L. perennis*, *L. viminea* subsp. *chondrilliflora*) are isolated (the minimum isolation distance between accessions is approximately 0.75 m) and pollinated manually.

Seed sample viability is determined in germination tests and ranges between 85-90%. Seeds are dried to a moisture content of about 5% before packing. Accessions are preserved in laminated aluminium bags in medium-term storage at +4°C and/or in a deep-freezer at -20°C for long-term storage.

Table 1. Number of accessions and seed samples stored in the *Lactuca* working collection of the Department of Botany, Faculty of Science, Palacký University

Taxon	No. of accessions	No. of seed samples*
L. aculeata Boiss.	2	
L. altaica Fisch. et C.A. Mey.	1	
L. biennis (Moench) Fernald	1	
L. capensis Thunb.	1	
L. canadensis L.	1	8
L. dregeana DC.	4	
L. indica L.	3	
L. perennis L.	1	
L. saligna L.	67	
L. sativa L.	53	
L. serriola L.	516	72
L. serriola x *L. sativa*	3	
L. *taraxacifolia* Schum. et Thonn.	1	
L. tatarica C.A. Mey.	1	1
L. tenerrima Pourr.	1	
L. viminea (L.) J. et C. Presl	3	
L. virosa L.	16	
Lactuca sp.	3	
Total	**678**	**81**

* Not regenerated sample of seeds, not included in the regular genebank collection

Characterization and evaluation

Accessions of wild *Lactuca* spp. have been assessed throughout the growing period following basic morphological descriptors (Doležalová *et al.* 2002a, 2003a) and botanical names have been verified (Doležalová *et al.* 2003b). About 100 accessions of *L. sativa,* 150 accessions of *L. serriola* and other wild *Lactuca* species have been screened for downy mildew (*Bremia lactucae*) resistance during the last six years. Response to natural infection by powdery mildew (*Golovinomyces cichoracearum,* syn. *Erysiphe cichoracearum*) has been evaluated in nearly 70 accessions of *L. serriola* and wild *Lactuca* species (Lebeda 1994). The evaluation database of our working collection includes information on chromosome number, relative 2C nuclear DNA content, esterase zymograms and AFLP analysis of almost 50 accessions of wild species (Doležalová *et al*. 2002b). Detailed records of the characteristics of anatomical features of the accessions, including photographic documentation, are also available (Lebeda *et al.* 1999, 2001b). Most passport data are computerized; however, considerable amounts of the characterization and evaluation data are only recorded in publications or notebooks and need to be computerized.

Collecting

The main goals of collecting missions to unexplored areas of the Czech Republic, Europe and the USA have been the ecogeographic study of *Lactuca* populations in the nature and the enrichment of the germplasm collection with new and unique *Lactuca* accessions useful for future research. In the years 1995-2002, expeditions were conducted in 11 European countries (Austria, Czech Republic, France, Germany, Greece, Italy, the Netherlands, Slovenia, Sweden, Switzerland, United Kingdom), 8 states of USA (Arizona, California, Idaho, Iowa, South Dakota, Utah, Wisconsin, Wyoming) and Canada. Some field observations were also made in New Zealand in February 2003. Almost 1000 seed samples of 4 wild *Lactuca* species were collected (Křístková and Lebeda 1999; Doležalová *et al.* 2001; Křístková *et al*. 2001; Lebeda *et al.* 2001a) following international standards for germplasm acquisition (Guarino *et al.* 1995), with the majority of the collections being provided to the RICP (Research Institute of Crop Production in Prague-Ruzyne), Genebank in Olomouc.

Research activities

Comprehensive research on taxonomy, ecobiology and plant pathology of the genus *Lactuca* initiated and organized by the Department of Botany of Palacký University at Olomouc has focused on wild species occurring in their natural habitats as well as on genetic resources already maintained in genebanks. These activities began in 1995 (Lebeda *et al.* 1999) and are summarized below.

- Genetic resources of wild *Lactuca* species, their geographic distribution, ecology and representation in genebank collections (Doležalová *et al*. 2001; Křístková *et al*. 2001; Lebeda *et al*. 2001a, 2004a,b);
- Morphological and anatomical characterization of wild *Lactuca* (Doležalová *et al.* 2003c; Lebeda *et al.* 1999, 2001b);
- Development of morphological descriptors of *Lactuca* (Doležalová *et al*. 2002a, 2003a,c);
- Karyological and DNA content variation in *Lactuca* species (Doležalová *et al.* 2002b);
- Isozyme and AFLP variation in *Lactuca* species (Doležalová *et al.* 2003c; Dziechciarková *et al*. 2004);
- Taxonomic revision of some wild *Lactuca* genetic resources (Doležalová *et al.* 2002b, 2003b);
- Research of *L. serriola* populations for resistance to downy mildew (*Bremia lactucae*) (Lebeda and Zinkernagel 2003);
- Occurrence of diseases and their spatial and temporal distribution in natural *Lactuca* habitats (Lebeda 2002; Lebeda *et al*. 2002a,b; Lebeda and Petrželová 2003; Petrželová and Lebeda 2003);
- Genetic background of spatial and temporal variation in the virulence of pathogen populations (e.g. *B. lactucae*) on naturally occurring wild *Lactuca* species (Lebeda 2002; Lebeda and Petrželová 2003);
- Research on mechanisms of resistance in *Lactuca* species against biotrophic parasites (Lebeda *et al.* 2001c, Lebeda and Sedlářová 2003);
- Creation of a collection of pathogen isolates (e.g. *B. lactucae*) for the exploitation of variability of resistance in *Lactuca* (Lebeda and Petrželová 2003).

Within the framework of the EU Project GENE-MINE – "Improved use of germplasm collections with the aid of novel methodologies for integration, analysis and presentation of genetic data sets", the following topics have been investigated:

- Determination of the natural distribution areas of wild *Lactuca* species based on a literature survey and comparison with genebank holdings in order to identify natural areas absent from or under-represented in the collections;
- Examination of the genetic diversity across the European distribution area, focusing on natural populations of *Lactuca serriola,* based on morphological description, molecular characterization and screening for functional characters;
- Identification of areas of over- or under-representation within the genebank collections based on the assessed distribution of genetic diversity;
- A functional assessment directed towards characters conferring resistance to *Bremia lactucae* because of the serious impact of this pathogen in lettuce.

International cooperation

Over more than 20 years, an extensive network of cooperating institutions has been created around the world. Some of the most important partners include: IPGRI (Rome, Italy), HRI (Wellesbourne, UK), CGN, PRI and WU (Wageningen, the Netherlands), USDA/ARS (Salinas, Pullman, Ames, USA), University of California (Davis, USA), TU München

(Freising-Weihenstephan, Germany) and Komenský University (Bratislava, Slovak Republic).

Conclusion

New information obtained from the Palacký University working collection through a comprehensive research programme is contributing to the enrichment of knowledge on the complex variability of the genus *Lactuca*. Based on the results of our research, the working collection can be utilized to study the structure, biodiversity and ecobiology of natural populations and the taxonomic status of *Lactuca* germplasm in genebank collections.

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The National Collection of Cichorium *genetic resources in France* [27]

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Introduction

In accordance with the commitments taken through the International Undertaking on Plant Genetic Resources for Food and Agriculture, within the Global Plan of Action of the FAO on plant genetic resources, and within the Convention on Biological Diversity, France has set up a national strategy for the management of animal, plant and microbial genetic resources, coordinated by the Bureau des Ressources Génétiques (BRG). The management of genetic resources is organized within networks in the framework of the National Charter for the Conservation of Genetic Resources. By 2003, 30 cooperative networks had been set up, among which the chicory network concerns leafy vegetables.

Since 1994, the *Cichorium* network, led by V. Cadot from the Groupe d'Etude et de contrôle des Variétés et des Semences (GEVES) of Brion has carried out standard operations such as regeneration, evaluation and characterization, conservation, distribution and management of the database, according to the procedures defined in the chicory charter. The aim is to manage a national collection which has been identified, classified and stored, and which is available for use by the research community.

Structure of the chicory network

The cooperative network is made up of 13 curators and a coordination unit. It is assisted by a steering committee (Table 1).

- **The curators**

The curators are associated with public or private bodies participating in the conservation, characterization, evaluation and regeneration of material.

- **The coordination unit**

The primary role of the coordination unit is to organize and to monitor the operation of the network and to ensure the distribution of seeds of the national collection of chicory genetic resources and of some information about associated data. The coordination unit is made up of a coordinator, nominated for 5 (renewable) years by the steering committee, and 7 representatives of the curators, nominated by the curators for 3 (renewable) years.

- **The steering committee**

The steering committee lays down the main lines of the network's activities and guarantees the scientific and technical quality of the work. The chairman of the steering committee is the director of the BRG or his representative. The steering committee meets once a year.

[27] (updated June 2005)

Table 1. Composition of the chicory network

Partner status	Institution (*)	Curators (activities)	Coordination unit	Steering Committee
State organizations	GEVES, Brion	Moderator Conservation Evaluation Passport data	Yes	Yes
	INH, Angers	Evaluation Regeneration	Yes	Yes
	CRRG	Regeneration	Yes	Yes
	CTPS			Yes
	SNES	Evaluation (disease resistance)		Yes
	BIOGEVES	Evaluation (molecular markers)		Yes
Breeders	Clause Tezier	Regeneration	Yes	Yes
	Enza Zaden	Regeneration		
	Florimond Desprez	Regeneration Evaluation	Yes	Yes
	Gautier	Regeneration		
	Hoquet Graines	Regeneration	Yes	Yes
	Momont	Regeneration		
	Novartis	Regeneration		
	Rijk Zwaan	Regeneration		
	Seminis	Regeneration		
	Vilmorin	Regeneration	Yes	Yes
Interprofessional institutes	FNPE	Evaluation		Yes
	AFCEV			Yes
	CTIFL			Yes
	FNAMS			Yes
Others	Scientific expert			Yes
	Botanical expert			Yes

(*) GEVES: Groupe d'Etude et de contrôle des Variétés et des Semences
INH: Institut National d'Horticulture
CRRG: Centre Régional de Ressources Génétiques Nord Pas-de-Calais
CTPS: Comité Technique Permanent de la Sélection
SNES: Station Nationale d'Essais de Semences
FNPE: Fédération Nationale des Producteurs d'Endives
AFCEV: Association Française pour la Conservation des Espèces Végétales
CTIFL: Centre Technique des Fruits et Légumes
FNAMS: Fédération Nationale des Agriculteurs Multiplicateurs de Semences

Operation of the network

- **Status of the national collection**

Chicory, known since 2500 BC, belongs to the genus *Cichorium* (family Asteraceae), which comprises two main species of interest to breeders and farmers: *Cichorium intybus* and *Cichorium endivia.* In May 2003, the national collection contains 236 accessions belonging to these two species (Table 2).

The *Cichorium intybus* collection contains three main crops:

- witloof chicory, consisting mainly of old Belgian populations which had to be urgently regenerated, since they were threatened by genetic erosion because of hybrid development;
- leaf chicory (radicchio, 'Treviso' types, 'Verona' types,…) originating mainly from Italy where several types are grown, and of which different plant parts can be consumed (stems for Catalogna, leaves for Chioggia); and
- root chicory, comprising roasting chicory, sugar chicory and fodder chicory.

The *Cichorium endivia* collection contains two crops: plain and cut chicory, used in fresh salad and in pre-packed processed food.

Table 2. Composition of the chicory national collection

Species	Crop	No. of accessions
C. endivia	Cut chicory	42
	Plain chicory	36
	Total *endivia*	**78**
C. intybus	Witloof chicory	96
	Leaf chicory	34
	Industrial chicory	11
	Fodder chicory	3
	Wild	4
	Others	10
	Total *intybus*	**158**
Total		**236**

Criteria for admission into the national collection have been defined in the chicory charter, as follows:

a. Criteria for admission into the national collection

1. French cultivars deleted from the National List of French varieties (lists a and b)
2. French landraces and local varieties
3. French or foreign breeding lines, in particular those which were used in breeding currently cultivars, registered in the French or European official list.
4. Original or wild material obtained from collecting in French territory
5. Material valued because it contains identified genes, such as genotypes used as controls in certain nurseries or trials, differential hosts, etc.
6. Material which is little known but which is recognized as a genetic resource and which is difficult to obtain.

b. Criteria for withdrawal from the national collection

Obvious, partial or total duplication.

- **Management of the national collection**

a. Conservation

The collection is conserved within three genebanks, managed by the network coordinator:

- A long-term bank where seed material is stored in a deep freezer at about -18°C, located at GEVES of Brion;
- A safety bank where the duplicate of the collection is kept at a site different from the long-term bank, at SNES in Angers, in a deep freezer at about -18°C;
- An active bank where seed samples for distribution are stored in a cold room at about 4°C and 30% RH.

After partial desiccation, the seed samples are stored under vacuum in special aluminium foil bags of 0.3 g, or 3 g for distribution, the safety bank and the long- term-bank, and of 25 g for the maintenance stock in the active bank.

b. Regeneration

As *Cichorium intybus* and *C. endivia* are cross-pollinated species, multiplication under insect-proof conditions using flies or bees is recommended, with a minimum of 60 plants per population to avoid genetic drift. Eleven curators participate each year to carry out 35 to 40 multiplications. Germination tests are carried out just after regeneration and then periodically. The renewal frequency depends on the agreed multiplication years for national genotypes (every 10 years), but also on the stock quantity produced and the percentage of germination. By 2003, more than 50% of the accessions had been regenerated (123/236).

Subsidies from the French Ministry of Agriculture in 1996-97 enabled the network to acquire a cold room, two deep-freezers and 40 insect-proof pollination cages.

c. Characterization and evaluation

Since 1995, the curators have carried out evaluation and characterization studies in order to obtain descriptions, to eliminate duplicates and to verify regenerated sample identification.

- **Morphological and physiological characters**

Descriptors used are either UPOV or national descriptors. The numbers of descriptors per crop and the curator's company name are given in Table 3. The steering committee has advised that all these descriptors can be potentially used as primary descriptors. In 2003, more than 2/3 of the collection has been characterized (168 descriptions/236).

Table 3. Morphological descriptors for *Cichorium* and curators in charge of evaluation

Crop	No. of descriptors	Curators
Endive (*C. endivia*)	28	GEVES, INH
Witloof chicory	29	FNPE, GEVES
Leaf chicory	25	GEVES, INH
Industrial chicory	12	Florimond DESPREZ

- **Disease resistance descriptors**

Since 1998, three pathology laboratories (INRA = Institut National de la Recherche Agronomique; SNES = Station Nationale d'Essais de Semences; and FNPE = Fédération Nationale des Producteurs d'Endives) have been able to set up resistance tests on *Cichorium intybus* (especially on witloof) for three important diseases: *Thielaviopsis basicola, Phytophthora cryptogea* and *Dickeya dianthicola*. Evaluations for resistance to these diseases started in 2001 and are supported by the French Ministry of Research. Another programme, supported by the Ministry of Agriculture (Contrat Plan Etat Region) for 2000–2006, is carried out by GEVES, SNES, CTIFL, Momont and Vilmorin, to evaluate chicory for resistance to two foliar diseases: *Alternaria dauci* f.sp. *cichorii* and *Puccinia cichorii*. In the future, these five descriptors will be introduced as secondary descriptors but information about the protocols and the evaluation results are not yet accessible to non-members of the diseases working group.

d. Distribution

The distribution of samples is ensured by the network coordinator. Access to national genetic resources is unrestricted and free of charge for partners of the network (supply and distribution of seeds) and for non-members (except for management and postage fees). For the latter, in case of non-reciprocal exchange, the steering committee's opinion will be requested.

e. Database

Until now, a first database created in 1994 by GEVES of Brion has managed the passport, seed storage, regeneration, evaluation and germination data, while a second database contains the descriptions. In 2003 a student was assigned the mission to create a unique database to facilitate the extraction of data for the network's users. For this new database, 22 items of passport data, either EURISCO (European Plant Genetic Resources Search Catalogue) descriptors or national descriptors, have been selected.

Future activities

- To publish passport data and minimal descriptors on the BRG Web site (www.brg.prd.fr), on the EURISCO Server and as a printed catalogue.
- To start collaboration with the BIOGEVES in order to begin molecular characterization by ISSR (Inter Simple Sequence Repeat) for endives and then to extend this to other crops in order to find out more about the structure of the national collection and to define a core collection.
- To develop procedures in order to become an accredited network for genetic resources.
- To contribute to the activities of the ECP/GR Working Group on Leafy Vegetables.

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Status of the CGN leafy vegetables collection

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Introduction

The Centre for Genetic Resources, the Netherlands (CGN) holds the mandate for conserving and promoting the utilization of animal and plant genetic resources in the Netherlands. CGN is an independent research unit of the Wageningen University and Research Centre which assists the government in its statutory tasks. The reliable and independent implementation of this work is guaranteed by the Statute of Statutory Tasks.

CGN focuses on a limited number of collections, for which it attempts to maintain stocks of high quality seed which is readily available to *bona fide* users. CGN strives to increase knowledge about its germplasm relevant to the users. The Plant Genetic Resources Unit of CGN (CGN/PGR) uses the facilities and labour of Plant Research International (PRI).

The complete CGN/PGR collection holds about 22 000 accessions, comprising 23 crops.

The leafy vegetables collection

The leafy vegetables collection of CGN consists of two collections: lettuce and spinach. These collections originate from the former Institute for Horticultural Plant Breeding (IVT) and were working collections for breeding purposes. In particular, they were used for the search for resistance to *Bremia* and aphids in lettuce and *Peronospora* in spinach. CGN adopted the collections in 1985 (lettuce) and 1987 (spinach).

The lettuce collection is one of the most important collections of the CGN. High priority is given to creating a representative sample of the total genetic variation in cultivated lettuce and its wild relatives and to obtain as much information as possible via evaluation and research (Boukema *et al.* 1990). The collection is regularly replenished with representative samples of new Dutch and other European cultivars. Part of the collection originates from expeditions to Egypt, Israel, Turkey, Russia (Daghestan), Azerbaijan, Uzbekistan and Kyrgyzstan (van Soest *et al.* 1998). Wild material was also introduced from Botanical Gardens and from other genebanks. Currently (May 2003) the lettuce collection holds 2506 accessions. Alongside the collections in the USA, it is one of the major collections in the world. The collection includes 1169 cultivars, 970 accessions of wild species, 203 landraces, 22 accessions of research material and 142 of unknown population type. Most of the wild species originate from Europe and the Near East. Of the cultivated material the greater part originates from Europe. The cultivated lettuces include butterhead (746), crisp (241), cos (228), cutting (168), latin (63), stalk (34) and oilseed (16). In the crisp lettuce group a large number of accessions originate from the USA. The stalk lettuce is mainly from China, and the oilseed from Egypt. The population type per cultivar group or species is shown in Table 1.

The spinach collection includes 385 accessions, 382 cultivated and 3 wild (*S. turkestanica*) This spinach collection is one of the largest in the world, comparable with the collections in the USA and Russia. Most of the material originates from Europe. Some of the landraces comes from the Far East. One accession of *S. turkestanica* originates from Uzbekistan, the origin of the other two is not known.

Table 1. Number of lettuce accessions per cultivar type or species and population type

Cultivar type/species	Population type					Total
	Cultivar	Landrace	Research	Wild	Unknown	
L. sativa group Butterhead lettuce	690	17	10		29	746
L. sativa group Crisp lettuce	207	18	5		11	241
L. sativa group Latin lettuce	52	5	1		5	63
L. sativa group Cos lettuce	109	88			31	228
L. sativa group Cutting lettuce	92	43			33	168
L. sativa group Stalk lettuce	2	10			22	34
L. sativa, cultivar group not known	17	3			4	24
L. serriola or *L. sativa* group Oilseed lettuce		16				16
L. sativa x *L. serriola*			5	4	7	16
L. serriola			1	730		731
L. dregeana				2		2
L. aculeata				2		2
L. altaica				2		2
L. saligna				69		69
L. virosa				104		104
L. indica		3		3		6
Other *Lactuca* species (wild material)[1]				38		38
Lactuca, undetermined species				1		1
Species of genera related to *Lactuca* [2]				15		15
Total	**1169**	**203**	**22**	**970**	**142**	**2506**

[1] *Lactuca biennis, L. canadensis, L. dentata, L. homblei, L. raddeana, L. perennis, L. tatarica, L. tenerrima, L. viminea, L. quercina*

[2] *Chondrilla juncea, Cicerbita alpina* and *C. plumieri, Mycelis muralis, Steptorhamphus tuberosus*

Regeneration

Most of the lettuce and spinach material (95%) has been regenerated under controlled conditions. Since *L. sativa* and most of the wild species are obligate self-fertilizing species, no isolation is needed during regeneration. For homogeneous cultivars 8 plants are used for regeneration, and for heterogeneous landraces and wild species, at least 16 plants. The outbreeding species such as *L. perennis* and *L. tatarica* are regenerated in isolation rooms. Blow flies are used for pollination. The wild species are either annuals, winter annuals, biennials or perennials. To obtain seeds in one growing season, all wild species are vernalized for 6 weeks at 1°C, when the seeds are just germinating. Heading types are treated with gibberellic acid (20 ppm GA3) at a young stage to speed up bolting and to prevent the plants from rotting. Some species like *L. indica* need short days for flower initiation. To prevent seed contamination with lettuce mosaic virus (LMV), all plants used for seed production are leaf sampled and tested for LMV at a young stage. Panicles of wild species are hulled in perforated plastic bags to prevent seed shattering or contamination with seeds from adjoining accessions.

Spinach is wind-pollinated and in general dioecious. Regeneration takes place in isolation rooms and 80 plants per accession are used.

Storage

Seeds are dried until the moisture content is 5%. Sample viability is determined in germination tests. The germination percentage should be at least 80% for cultivars and 60% for wild species.

Five different samples for storage can be distinguished: germination samples (200 seeds), regeneration and safety-duplication samples (100), user samples (100) and a residual sample.

The seeds are packed in laminated aluminium foil bags and stored at –20°C. The seed storage facilities of CGN consist of the following different compartments: two deep-freeze stores at -20°C, a cool store at +4°C with eight deep-freezers, a drying room at 15°C and 15% RH, and a working room at 20°C.

All samples except the user samples are stored in the deep-freeze stores. The user samples are stored in deep-freezers in the cool store.

The samples are placed in numbered boxes, which are grouped by crop and placed on numbered shelves in the storage rooms. The location (box, shelf) of each accession is recorded in the CGN information system.

Safety-duplication

The whole collection is duplicated at the Genetic Resources Unit of HRI, Wellesbourne, UK.

Characterization and evaluation

Large parts of the lettuce and spinach collection have been characterized for 35 and 15 different characters respectively. Most of these characters are morphological plant and seed traits. Cultivars are characterized in field trials, during which the identity of the accessions is also checked with the help of crop specialists. The wild lettuce species are characterized during regeneration in the glasshouse.

Evaluation data on characters like disease resistance are derived from users of the material. Users are requested to return their evaluation data. These data are recorded in the CGN information system. For lettuce, data are available on resistance to *Bremia lactucae*, *Erysiphe cichoracearum* and different aphid species (Lebeda *et al.* 1991; Bonnier *et al.* 1992). Data on resistance to *Peronospora farinosa* are available for spinach. Both crops were screened for nitrate content.

Almost the entire lettuce collection was used in the EU demonstration project "Application of marker technology for the improvement of *ex situ* germplasm conservation methodology". With these results, we can trace duplicates and discard them from the collection (van Hintum *et al.* 2003).

Utilization

Seeds are sent upon request to *bona fide* users after they have signed a Material Transfer Agreement (MTA).

Both collections have been very much used. About 1100 samples of lettuce and 280 samples of spinach are distributed to users per year.

Documentation

Passport, characterization, evaluation and genebank management data are fully computerized. Passport data of both crops and most of the characterization and evaluation data on lettuce are searchable on-line. All data can be downloaded from www.cgn.wur.nl/pgr.

Furthermore, CGN has established the International *Lactuca* Database (ILDB) (Stavělíková *et al.* 2002). The status of the database is presented p. 129. The ILDB can be searched on-line or downloaded from http://www.cgn.wur.nl/pgr/collections/ildb/.

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More references can be found at: www.cgn.wur.nl/pgr

Collections of leafy vegetables in the Nordic Gene Bank

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Introduction

The Nordic Gene Bank (NGB), an institution which reports to the Nordic Council of Ministers, is a centre for the conservation and utilization of plant genetic resources in the Nordic countries. The NGB was established 24 years ago. The genebank is situated in the south of Sweden, about 10 kilometres north of the centre of Malmö.

NGB has a seed store containing approximately 31 000 seed samples. The collection consists of bred varieties, old landraces and wild populations of cultivated crops. A large part of the stored material consists of "special collections". These consist of material from various research projects.

The collections

At the Nordic Gene Bank 98 accessions from the leafy vegetables group are stored at the genebank, divided in three different taxa. The largest group is *Spinacia oleracea* with 66 accessions, followed by *Lactuca sativa* with 30 accessions and *Cichorium endivia* with 2 accessions. About 2/3 of the accessions in the group originate from Denmark (Table 1).

Table 1. The leafy vegetable collection maintained at NGB

Species	Country of origin	Type of sample				Total
		Advanced cultivars	Landraces	Breeding lines	Wild species	
Lactuca sativa - garden lettuce	24 DNK 6 SWE	30				30
Spinacia oleracea - spinach	52 DNK 14 SWE	66				66
Cichorium endivia - garden endive	2 DNK	2				2
Total		**98**				**98**

Storage conditions

After harvest the seed samples are thoroughly dried before they are packed in aluminium bags. All seeds are stored in freezers at -20°C. Their ability to germinate is regularly checked in order to find accessions with decreasing germination percent. The regeneration of the seeds is made by different institutions and breeding companies in the Nordic countries.

NGB has established a safety base collection in the permafrost of the Svalbard Islands. The store is in a coal mine belonging to the Norske Spitsbergen Kulkompani. The seed samples can be preserved there for the future without additional inputs of energy being required. The temperature in the mine is constant, varying between -3°C and -4°C. About two-thirds of the accessions in the leafy vegetable group are stored in Svalbard.

Documentation

For all 98 accessions in the leafy vegetable group passport data are stored at the NGB. In total 25 accessions were distributed during the years 1999-2002 as shown in Table 2.

Table 2. Status of the NGB leafy vegetable collection

Species	Total no. of accessions	Passport data	Seed in long-term storage	Regeneration	Safety-duplication	Distributed since 1999
Lactuca sativa	30	30	23	6	22	14
Spinacia oleracea	66	66	46	10	32	11
Cichorium endivia	2	2	2		2	
Total	**98**	**98**	**71**	**16**	**56**	**25**

Genetic resources of leafy vegetables in Poland

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The germplasm collection of leafy vegetables is maintained at the Research Institute of Vegetable Crops (RIVC) within the national programme on genetic resources of vegetable crops. The collection includes 515 accessions representing 17 families and 10 genera. Numbers of accessions, type of sample and countries of origin are given in Table 1. The major collections are of lettuce and red beet.

Storage and regeneration

The seed samples are deposited in the central genebank storage located at the National Centre for Plant Genetic Resources (Plant Breeding and Acclimatization Institute, PBAI) in Radzików under controlled conditions (0°C or -18°C). Seeds are dried to 5–7% moisture content and stored in screw-top glass jars. The oldest seeds in our store have been kept for 22 years.

Those accessions which consist of a very small amount of seeds are progressively regenerated. Regeneration and evaluation are carried out in the seed and breeding companies or agricultural universities on the basis of an agreement with the Plant Genetic Resources Laboratory in Skierniewice. Regeneration of accessions depends on the financial resources available each year. Seed samples of the accessions are freely available if there are enough seeds. To date the collected accessions of leafy vegetable have not been duplicated.

Documentation and characterization

Passport data for all accessions, prepared in accordance with FAO/IPGRI *Multi-crop Passport Descriptors* and FAO WIEWS descriptors, are included in the ILDB (International *Lactuca* Database, available at http://www.cgn.wur.nl/pgr/collections/ildb/). Characterization and evaluation data are stored in a computerized database using Dbase, MS Access and MS Excel softwares. Information is available upon request, as email attachments, on CD-ROM and floppy discs.

Characterization has been done for 157 accessions, including 48 of red beet, 54 of asparagus and 55 of lettuce (Table 1). Characterization according to IPGRI, UPOV and RIVC descriptor lists includes morphological and agronomic traits, disease resistance and reaction to stress conditions.

Collecting expeditions

Each year the genebank organizes collecting expeditions in different regions of Poland and neighbouring countries to collect local forms and wild relatives. During the period 2000-2002 seven expeditions covering different regions of Poland were organized. A total of 671 accessions were collected, including 50 accessions of leafy vegetables (see Table 2).

Table 1. Status of the leafy vegetable collection in the Polish Gene Bank, RIVC-Skierniewice, 2003

Genus / species	English name	Polish name	No. of accessions	Type of sample*				Country of origin (ISO code)	No. of accessions characterized
				AC	BL	LR	W		
Cichorium intybus	Chicory	Cykoria	10	3		6	1	POL - 6, UKR - 1, USA - 2, SYR - 1	
Atriplex hortensis	Garden orach	Loboda ogrodowa	4				4	ALB - 2, POL - 1, MDA - 1	
Valerianella locusta	Corn salad	Roszponka	2	1		1		FRA - 1, POL – 1	
Rheum rhabarbarum	Rhubarb	Rabarbar	6	1		5		ALB - 1, POL - 4, UKR - 1	
Lepidium sativum	Garden cress	Rzezucha	2			2		POL - 1, SYR – 1	
Rumex acetosa	Sorrel	Szczaw	9	1		8		POL - 7, ALB - 1, GRC - 1	
Spinacia spp.	Spinach	Szpinak	23	16		7		JPN - 12, POL - 7, SYR - 1, TUR - 2, GRC – 1	
Asparagus officinalis	Asparagus	Szparag	55	45	9	1		NLD - 5, DEU - 15, CHN -1, USA - 1, POL – 33	54
Lactuca sativa	Lettuce	Sałata	296	203	16	77		NLD - 19, GBR - 16, AUS - 3, DEU - 14, JPN - 71, USA - 25, FRA - 8, HUN - 4, ROM - 2, ISR - 1, LTV - 1, MDA - 1, UKR - 6, ALB - 1, SVK - 5, SWE - 1, DNK - 4, CHE - 1, POL - 113	55
Lactuca sativa	Stem lettuce (garden lettuce)	Glabiki krakowskie	6	5		1		JPN - 4, POL - 2	
Lactuca serriola			15				15	JPN – 15	
Lactuca saligna			2				2	JPN - 2	
Lactuca virosa			10				10	JPN - 10	
Cichorium endivia	Endive	Endywia	1					GRC - 1	
Beta vulgaris	Red beet	Burak czerwony	70	8		62		RUS - 4, UKR - 11, MDA - 1, ROM - 1, LVA - 1, POL - 52	48
Beta vulgaris var. *cicla*		Burak liściowy	2					GRC - 2	
Beta vulgaris subsp. *maritima*	Sea beet		2					GRC - 2	
Total			**515**	**283**	**25**	**170**	**32**		**157**

* AC = advanced cultivar; BL = breeding line; LR = landrace; W = wild

Table 2. Leafy vegetable germplasm collected in Poland during expeditions organized by the Polish Gene Bank from 2000 to 2002

Date	Area	No. of accessions collected					
		Lettuce	Red beet	Corn salad	Sorrel	Spinach	Asparagus
Oct. 2000	Tarnow	1	2				
Oct. 2000	Sokolka	6	5				1
Oct. 2001	Augustów	4	4				
Oct. 2002	Kurpie I		1				
Oct. 2002	Kurpie II	6	3	1		1	
Nov. 2002	Mrągowo-Pisz	3	3				
Dec. 2002	Ciechanów	4	3		2		
Total		**24**	**21**	**1**	**2**	**1**	**1**
		Total no. of leafy vegetables accessions = 50					

Utilization of the germplasm

The Plant Genetic Resources Laboratory cooperates with breeding companies and agricultural universities in carrying out research work or breeding programmes on the plant species of interest. The cooperation covers regeneration of seeds or vegetative parts, maintenance of field collections (e.g. asparagus), evaluation of morphological and marketable characters, resistance to pathogens, etc. The genebank material is used in creative breeding programmes and other studies such as:

- *Lactuca sativa*: resistance to diseases, influence of chemical compounds on the level of disease infection (Borkowski *et al.* 2001);
- *Beta vulgaris*: phylogeny study, molecular markers, biochemical analyses, nutrition components, marketable value, resistance to *Cercospora beticola*;
- *Asparagus officinalis*: study on marketable value, *in vitro* propagation, resistance to diseases.

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Status of leafy vegetable collections in Spain

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Introduction

The increasing concern regarding the process of genetic erosion of traditional varieties in Spain led to the setting-up in the early 1980s of the Centre of Conservation of Plant Genetic Resources (CCRF), dedicated to the *ex situ* conservation of this material. At the same time, several institutions, such as the Polytechnic University of Valencia (Universidad Politécnica de Valencia, UPV) and the AgriFood Research Institute of Zaragoza (Servicio de Investigación Agroalimentaria de Zaragoza, SIA), created their own genebanks to conserve mainly traditional varieties (Nuez and Fernández de Córdova 1994).

Activities related to the conservation of agrodiversity supported by the government were boosted in 1988 with the funding of the project "Collecting, Multiplication and Evaluation of Vegetable Genetic Resources for their Conservation in Genebanks", and later in 1993 with the establishment of the "Programme for the conservation and use of genetic resources". The National Plant Genetic Resources Network was created as a consequence of this programme, and the CCRF gave rise to the Centre for Plant Genetic Resources (Centro de Recursos Fitogenéticos, CRF). This institution maintains the base collection of this network and also constitutes the documentation centre for the whole network. At the moment, all these activities still have the support of the government.

The genebank of the Centre for Conservation and Breeding of Agricultural Biodiversity (COMAV), formerly the genebank of the UPV, and the vegetable genebank of the SIA (Zaragoza Germplasm Bank, BGHZ) centre their activities on the conservation of vegetable varieties, whilst the CRF keeps a collection not only based upon vegetables but also of other crops such as legumes, cereals, etc.

This report analyzes the recent status of the main Spanish collections of the following leafy vegetables: lettuce (*Lactuca sativa* L.), spinach (*Spinacia oleracea* L.), endive (C*ichorium endivia* L.) and chicory (C*ichorium intybus* L.).

Economic importance of leafy vegetables

In Spain 14% of vegetable production is of the leafy vegetables, of which 67% belong to the four species analyzed in this report (Table 1).

Spain and Italy are the major lettuce producers in Europe, each with 30% of the total European production (FAOSTAT 2003). In Spanish horticulture, lettuce is the third most important crop in production (in tons), following tomato and melon. This species is the most important of the leafy vegetables, representing 60% of their production. Two-thirds of the lettuce production is based on heading lettuces, and the remainder consists of 'romana' or 'romaine' type (or loose head). Almost 40% of Spanish production is exported. Major producer areas are located in the southeast of Spain, where almost all heading varieties are produced.

Spain is the third European producer of spinach, of which 6% is exported. Most cultivated varieties are hybrids, due to their higher yields and resistance to more races of mildew (Irigoyen and Muro 2000). Spinach production is centred in Extremadura, Navarra and Cataluña.

Fifty percent of the production of endive is in Cataluña. Varietal types intended for the processing industry (cut endive) are evolving (Alba 2000). Chicory, despite being a minor

crop, is increasing in importance (Roselló 2000). Thirty-five percent of the production of both vegetables is currently being exported.

Most of the production of leafy vegetables takes place in open-air conditions.

Table 1. Production of leafy vegetables in Spain (Source: MAPA 2000)

Crop	Production (t)	%
Lettuce	1 018 503	59.53
Cabbage*	340 174	19.88
Celery	85 488	5.00
Chard	59 880	3.50
Spinach	52 639	3.08
Endive	50 805	2.97
Kale	43 786	2.56
Chicory	14 759	0.86
Other leafy vegetables	44 782	2.62
Total	**1 710 816**	**100**

* Includes different types of cabbage and Brussels sprouts

Cabbage, celery, chard and kale are included in other ECP/GR Working Groups so they will not be considered in this report.

Production of lettuce, spinach and endive has remained stable during the last 10 years (Fig. 1).

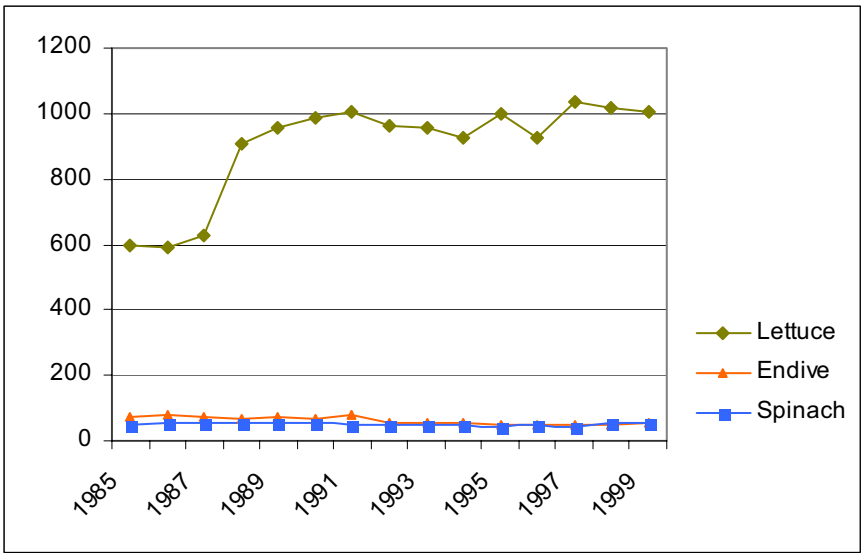

Fig.1. Evolution of lettuce, endive and chicory production (Mt) (Source: MAPA 2000)

Status of collections

Although several institutions hold seed collections of the leafy vegetables, the major part of the conserved material is kept in the genebanks of CRF, COMAV-UPV and BGHZ. Ever since the 1980s these centres have maintained materials collected during their own prospecting expeditions in Spain, or seeds transferred from other institutions. The collection is based on traditional or local varieties, though advanced cultivars and related wild species re conserved as well (Table 2).

Table 2. Collections of leafy vegetables of CRF, COMAV-UPV and BGHZ and their origin

Lactuca sativa						
Origin	**Genebank**					
	CRF		**COMAV-UPV**		**BGHZ[1]**	
	LR[2]	**AC[3]**	**LR**	**AC**	**LR**	**AC**
Spain						
Andalucía	60		44			
Aragón	6		14	1		
Asturias	3					
Baleares	3		7			
Canarias			18	1		
Cantabria	7					
Cataluña			50			
Castilla La Mancha	56		11			
Castilla León	91		48			
Extremadura	21		7			
Madrid	1					
Murcia	11					
Navarra	10					
Valencia			33	5		
Africa			1	1		
America (Argentina, Cuba)	2			3		
Iran		1				
Turkey		1				
Unknown	8	42				
Total	**279**	**44**	**233**	**11**	**-**	**-**
	323		**244**		**456**	
	1023					

Spinacia oleracea						
Origin	**Genebank**					
	CRF		**COMAV-UPV**		**BGHZ[1]**	
	LR[2]	**AC[3]**	**LR**	**AC**	**LR**	**AC**
Spain						
Andalucía			4			
Aragón			7			
Baleares			1			
Canarias			2			
Cataluña			5			
Castilla La Mancha	4		5			
Castilla León	2					
Valencia			12			
Cuba				1		
Asia				1		
Total	**6**	**-**	**36**	**2**	**-**	**-**
	6		**38**		**52**	
	96					

Cichorium endivia						
Origin	**Genebank**					
	CRF		**COMAV-UPV**		**BGHZ[1]**	
	LR[2]	**AC[3]**	**LR**	**AC**	**LR**	**AC**
Spain						
Andalucía			2			
Aragón	1		1			
Cataluña	2		16			
Castilla La Mancha	6					
Castilla León	13		5			
Extremadura	1					
Madrid	2					
Murcia						
Navarra	4					
Valencia			1			
Total	**29**	**-**	**25**	**-**	**-**	**-**
	29		**25**		**68**	
	122					

[1] Data regarding origin of accessions not available
[2] Landrace
[3] Advanced cultivar

Only three accessions of chicory are maintained in BGHZ.

Concerning species related to lettuce, the CRF collection also includes one accession of *Lactuca indica* L. and one of *Lactuca saligna* L.

Storage conditions in genebanks

In order to ensure the viability of the stored seeds, the recommendations of FAO/IPGRI (1994) regarding temperature and humidity are followed. Before being placed in the refrigerated chambers, seeds are desiccated, reducing seed water content to 6%. CRF, which keeps a base collection, stores the seeds at a temperature below -18ºC. BGHZ conserves multiplied accessions at -18ºC, and accessions to be multiplied at -3ºC. COMAV is constituted as an active collection which deals with seed requests from public or private institutions. In this centre the storage conditions in the chambers are -3ºC and 30% relative humidity.

Multiplication and regeneration

Besides collection activities and storage of seeds, multiplication and regeneration are other tasks developed in the project "Collecting, Multiplication and Evaluation of Vegetable Genetic Resources for their Conservation in Genebanks". This project is coordinated by Fernando Nuez (COMAV-UPV) and participants are the CRF, BGHZ, COMAV-UPV and eight other institutions with staff specialized in the cultivation of various horticultural species. The multiplied accessions are sent to COMAV which stores and sends out this material to CRF and BGHZ in order to conserve safety-duplicates (Table 3). Thus the risk of loss of these accessions is reduced.

Table 3. Number and percentage of safety-duplicates held in COMAV-UPV and CRF genebanks

Crop	Duplicates stored in COMAV-UPV			
	Accessions from CRF		Accessions from BGHZ	
	No. of duplicates conserved	% of the collection of CRF	No. of duplicates conserved	% of the collection of BGHZ
Lettuce	265	82	213	47
Spinach	4	67	8	15
Endive	19	65	18	26
Chicory	-	-	1	33

Crop	Duplicates stored in CRF			
	Accessions from COMAV-UPV		Accessions from BGHZ	
	No. of duplicates conserved	% of the collection of COMAV-UPV	No. of duplicates conserved	% of the collection of BGHZ
Lettuce	129	53	233	51
Spinach	7	18	11	21
Endive	17	68	13	19
Chicory	-	-	3	100

The BGHZ genebank also conserves safety-duplicates of the CRF and COMAV-UPV collections.

Characterization

Passport data of all collected accessions are recorded to identify the origin of the material.

There are no specific descriptor lists published by IPGRI for the characterization of lettuce, spinach and endive, thus a descriptor list developed by Spanish experts in leafy vegetables is followed. A list of descriptors agreed by consensus should be developed in order to standardize characters and to enable the exchange of information between different institutions.

COMAV has characterized part of its lettuce (57%) and spinach (15%) collections. BGHZ has characterized approximately 15% of the lettuce accessions.

Documentation

All passport data are maintained in databases developed by each centre. This information is exchanged among the centres that belong to the national network and is centralized in the base collection database of the CRF. This information can be accessed from the INIA (Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria) Web page (www.inia.es).

All characterization data recorded in COMAV-UPV are held in databases. The organization of this information led to the publication of a monograph on seed collections of lettuce held by COMAV (Nuez *et al.* 2000).

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Leafy vegetables in the United Kingdom

David Pink and Dave Astley
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There are a number of leafy vegetable crop collections in the United Kingdom with varying responsibilities as base and working collections, each having a different mandate.

Horticulture Research International, Wellesbourne – The Genetic Resources Unit

The HRIGRU is active in the conservation of leafy vegetable crops, mainly lettuce, but also holds smaller collections of chicory, endive and spinach. HRIGRU has collaborated with the Centre for Genetic Resources, the Netherlands (CGN) over many years. In 1989 following discussions between HRIGRU, CGN and the International Board for Plant Genetic Resources (now IPGRI), HRIGRU and CGN agreed to take on the primary responsibility for specific crops, HRIGRU for carrot and CGN for lettuce. In discussion with Ietje Boukema (CGN) it was agreed that all the HRIGRU *Lactuca* material would remain in the HRIGRU long-term seed store. CGN have access to all the passport data relating to the *Lactuca* collection. Data relating to *Lactuca* accessions classified as available in the HRIGRU context were included in the International *Lactuca* Database (ILDB) maintained at CGN. Therefore work relating to the HRIGRU *Lactuca* collection has been limited to the distribution of material to users, providing support for research programmes in the UK and regenerating material that originated in the UK. As a part of the HRIGRU-CGN agreement we store "black box" safety-duplicates for CGN on a *quid pro quo* basis. Duplicate seed samples of new HRIGRU accessions are despatched to CGN as soon as possible after receipt, but accessions in store are being despatched routinely as and when resources permit. The percentage of the HRIGRU collection in safety-duplication with CGN varies between the taxa, but in general there is a significant requirement for HRIGRU to improve the safety-duplication of these collections. As a partner in the EU GENE-MINE project, HRIGRU was involved in the collecting of seed samples of *Lactuca serriola* across the ecogeographical distribution of the taxon in the UK for analysis by project partners. From a UK perspective we need to collect further representative samples from wild populations of *L. virosa* and *L. saligna*.

Other leafy vegetable material (spinach, chicory and endive) is treated as a part of the HRIGRU collections. It is therefore documented, conserved and distributed following standard HRIGRU protocols. The current total of accessions for the various leafy vegetable taxa, an estimate of their availability and the extent of safety-duplication is given in Table 1. Availability of accessions is determined by seed numbers and/or percentage germination.

Information relating to the collections is mainly passport data (FAO/IPGRI *Multi-crop Passport Descriptors*) stored in MS Access.

Contact: Dave Astley

Research

Current research at HRI that utilizes *Lactuca* genetic resources includes:

- Using an *L. virosa* accession as a source of resistance to lettuce big vein virus;
- Using the old variety 'Iceberg' (syn. 'Batavia blonde à bord rouge') as a source of quantitative resistance to *Bremia lactucae* and *Myzus persicae;*
- Screening *L. serriola* accessions for resistance to lettuce mosaic virus.

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[28] On 1st April 2005 HRI became a department of the University of Warwick with a consequent change of name to Warwick HRI.

Table 1. HRIGRU leafy vegetables collections

Genus / species	No. of accessions	No. available	Safety-duplicated
Lactuca			
aculeata	1		no
alpina	1		no
altaica	12	3	2
biennis	1		
canadensis	1		no
dentata	1		no
livida	4	3	1
perennis	8		no
quercina	2		no
sagittata	3		no
saligna	24	9	7
sativa	1437	769	387
sativa var. *angustana*	8	4	4
scariola	3		no
serriola	115	24	30
serriola ?	2		no
squarrosa	1		no
tatarica	2		no
viminea	3	3	2
virosa	26	16	12
Cichorium			
endivia	31	24	3
intybus	31	14	8
Spinacia			
oleracea	124	100	106

Henry Doubleday Research Association, Ryton-on-Dunsmore

HDRA holds a collection of "heritage" varieties which are no longer available commercially. The collections are distributed to HDRA members and amateur gardeners, who also act as seed donors and multipliers. A majority of these accessions are duplicated at HRIGRU.

Contact: Bob Sherman.

Web site: http://www.hdra.org.uk

Royal Horticultural Society

The RHS maintains the UK national collection of rhubarb varieties plus some accessions of *Rheum* spp. at its garden at Harlow Carr, Yorkshire. The collection of over 130 accessions includes wild Asian species, medicinal and decorative species such as *Rheum palmatum* and Victorian culinary cultivars such as 'Prince Albert' and 'Victoria'. It also includes newer introductions, such as cultivars bred at Stockbridge House research station near Selby, Yorkshire.

Web site: http://www.rhs.org.uk

The International Lactuca *Database (ILDB)*

Data provided by I. Boukema, CGN, the Netherlands.
The ILDB is searchable on-line at http://www.cgn.wur.nl/pgr/collections/ildb/.

Number of accessions per institution in the ILDB

Collection	Status of sample					Total
	Wild	Landrace	Breeders' lines	Cultivar	Unknown	
Bulgaria, Sadovo, Plovdiv				412	171	583
Czech Republic, Olomouc	195	30	5	591	507	1328
France, Brion					534	534
Germany, Braunschweig	52	11		78	6	147
Germany, Gatersleben					870	870
Hungary,Tápiószele	20	80			230	330
Iran, Karaj		28				28
The Netherlands, Wageningen	838	201	22	1157	141	2359
Poland, Skierniewice	28	56	4	194	1	283
Portugal, Braga		138			1	139
Russian Federation, St. Petersburg		57			652	709
Slovakia, Nove Zamky				8		8
Slovenia, Ljubljana		167		4		171
Spain, Valencia		237		7		244
Spain, Zaragoza				70	402	472
Switzerland, Changins, Nyon					32	32
Turkey, Izmir					256	256
United Kingdom, Wellesbourne	64	16	1	676	13	770
USA, Salinas					1221	1221
USA, Pullman	177	124		564	450	1315
Total	**1374**	**1145**	**32**	**3761**	**5716**	**12028**

Number of accessions per species in the ILDB

Species	No. of accessions	Species	No. of accessions
L. aculeata	6	*L. sativa*	9928
L. altaica	14	*L. sativa x serriola*	21
L. biennis	5	*L. scarioloides*	11
L. canadensis	3	*L. serriola*	1375
L. dentata	4	*L. squarrosa*	2
L. dregeana	11	*L. tatarica*	4
L. homblei	2	*L. tenerrima*	9
L. indica	12	*L. viminea*	14
L. livida	12	*L. virosa*	243
L. perennis	42	unknown species	93
L. quercina	7	other species*	8
L. saligna	202		
Total no. of accessions = 12 028			

* *L. alpina, L. angustana, L. capensis, L. denticulata, L. georgica, L. raddeana, L. taraxacifolia* and *L. undulata*, each represented by one accession

Number of accessions per phenotypic group in the ILDB

Species	Phenotypic group	No. of accessions
Lactuca sativa	group Butterhead Lettuce	2492
	group Cos Lettuce	898
	group Crisp Lettuce	656
	group Cutting Lettuce	500
	group Latin Lettuce	84
	group Oilseed Lettuce	8
	group Stalk Lettuce	127
	unknown group	5163
Total		**9928**

GENERAL APPENDICES

Appendix I. Proposal to the ECP/GR Steering Committee for the establishment of a Cucurbits Working Group

Cucurbit genetic resources in Europe

More than 25 000 accessions of cucurbits are currently stored in European genebanks. Approximately half of these accessions belong to the genus *Cucumis*, almost 7000 accessions are of the *Cucurbita* genus and a little more than 4000 of *Citrullus* genus. Most of the collections (23 000 accessions) are made up of the main cultivated species (*Citrullus lanatus, Cucumis melo, C. sativus, Cucurbita maxima, C. pepo, C. ficifolia, C. argyrosperma* and *C. moschata*). Most of them are held in only 10 Institutions, located in Bulgaria, Czech Republic, Germany, Hungary, The Netherlands, Poland, Russian Federation and Spain.

In spite of this important effort on genetic resources activities on cucurbits there has been no coordinated activities in Europe to collect, conserve, document and make available to users the genetic resources of these crops.

Background

In the *ad hoc* meeting of the Network Coordinating Group on Vegetables held in Vila Real (Portugal) in May 2000, the establishment of three new informal working groups was approved, one of them on cucurbit crops. The first activity was the preparation of a small meeting, in collaboration with the recently approved EU-funded project RESGEN CT99-108 on *Cucumis melo*.

Ad hoc *Meeting of the Group*

Within this context, invited partners attended an *ad hoc* meeting in Adana, Turkey organized within the framework of the ECP/GR Vegetables Network and back-to-back with a meeting of the EU-funded project RESGEN CT99-108 on *Cucumis melo.*

The meeting involved four partners of the EU-funded *Cucumis melo* project (RESGEN-CT99-108) from Portugal, Spain and Turkey, together with representatives from Spain, the Netherlands and Turkey not involved in the project. An additional four experts from countries in Eastern Europe, specifically Bulgaria, Czech Republic, Hungary, and the Russian Federation also participated.

This informal meeting was held directly following the second annual *Cucumis melo* project meeting 17-19 January 2002. Most of the institutions holding the largest Cucurbitaceae collections in Europe were represented at the meeting, enabling interaction of the project partners with the additional representatives. The purpose of this interaction was to initiate the organization of Cucurbit genetic resources in Europe based upon this EU-project collaboration. Focus areas identified included muskmelon, cucumber, watermelon, squash and pumpkins, as well as other minor cucurbits such as *Lagenaria*, *Benincasa*, *Momordica*, etc.

The group discussed all the aspects of genetic resources conservation for these genera, highlighting specific areas requiring immediate actions. The importance of pursuing a number of collaborative objectives was also agreed upon. The most relevant were the following:

- The establishment of a European Central Cucurbits Database (ECCUDB). It is being currently developed by the Center for the Conservation and Improvement of the Agrodiversity at the Polytechnic University of Valencia, Spain. Initially this will be limited to passport data stored in the FAO/IPGRI *Multi-crop Passport Descriptors* format. At this moment passport data of more than 8000 accessions are included.

- Revision of the current level of safety-duplication and long-term storage facilities for genetic resources of Cucurbits. The participants felt that the establishment of the European database would provide a better basis for the coordination of this important task. A plan of action was already agreed during the meeting.
- Improve and harmonize the seed regeneration and characterization protocols for Cucurbits in Europe. Planning to do this task was also developed during the meeting.

During the Vegetables Network and *ad hoc* Leafy Vegetables meeting held in Skierniewice, Poland in May 2003, other countries attending this meeting expressed their interest in participating in the activities of the Cucurbits group. These countries were Armenia, Israel, Poland and Ukraine. Italy was contacted after this meeting, expressing also its interest. The actions and proposals of the Informal Cucurbits Working Group were presented during this meeting. These actions were the following:

Documentation: proceed with the development of the Central Cucurbits Database at the Polytechnic University of Valencia (UPV, Spain).

Characterization: establishment of Minimum descriptor lists for melon, cucumber, watermelon, pumpkin and minor cucurbits. Responsibility is shared between the members.

Safety-duplication: the level of safety-duplication, long-term conservation facilities and availability to host black boxes was stated by each institution during the first meeting. Partners will be encouraged to make plans for safety-duplication.

Proposal

To formalize this networking initiative, strengthen European collaboration and to ensure more stable financial support, as focal person on Cucurbits, I submit a request for the establishment of a Working Group on Cucurbitaceae to the next meeting of the Steering Committee of ECP/GR, to be held in 2003 for your consideration and approval.

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

Importance of leafy vegetables

The group of leafy vegetables is represented by a large number of vegetable crops from different botanical families. At least eight species belonging to the six families are considered economically important. Leafy vegetables belongs to the most important vegetable crops in Europe[29,30,31], for example, the world lettuce seed market is about 80 million Euro, of which about 50% is in Europe.

Leafy vegetables genetic resources in Europe

In Europe there are at least 17 institutions conserving leafy vegetables genetic resources with more than 12 000 accessions (41 plant species; 10 crops, 31 wild relatives) currently stored in European collections. Approximately 82% of these accessions are represented by lettuce (*Lactuca sativa*) and wild *Lactuca* spp. The second and third most important crops in genetic resources collections are spinach (ca. 9% accessions) and *Cichorium* (ca. 7% accessions). Most of these leafy vegetable accessions are held in the Czech Republic, France, Germany, Hungary, The Netherlands, Poland, Spain, Turkey and UK.[31] There is increasing interest of breeders in the utilization of germplasm from these collections.[31,32,33]

Background

In May 2000, in Vila Real (Portugal) the ECP/GR Vegetables Network Coordinating Group considered the importance of extending collaborative action to new vegetables crops. Within this context, I.W. Boukema (CGN, Wageningen, The Netherlands) and A. Lebeda (Palacký University, Olomouc, Czech Republic) were invited to prepare and present a very detailed survey on leafy vegetables germplasm and their status in Europe[31]. From this presentation and the following discussion, it became evident that the leafy vegetables genetic resources were underestimated within the scope of ECP/GR and there was a strong need to improve and coordinate activities in this area. A decision was made that the main focus should be on lettuce, spinach and *Cichorium*. During the same meeting A. Lebeda and I.W. Boukema were invited to act as focal persons for a "Leafy Vegetables Informal Group" with responsibility to coordinate future ECP/GR activities related to leafy vegetables genetic resources. The first meeting of the "Leafy Vegetables Informal Group" was organized as *ad hoc* meeting during the ECP/GR Vegetables Network meeting (22-24 May, Skierniewice, Poland). The objective of this first *ad hoc* meeting of a "Leafy Vegetables Informal Group" was to start collaboration on leafy vegetables genetic resources (esp. lettuce, spinach, *Cichorium*) between European partners. This meeting brought together representatives of the significant institutions holding collections of lettuce, spinach, *Cichorium*, and their wild relatives. The participants developed the objectives, a workplan for future activities and the management of the Group.[34] The group expressed strong

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29 George, A.T. 1999. Vegetable Seed Production, 2nd edition. CABI Publishing, Wallingford, UK.

30 Ryder, E.J. 1999. Lettuce, endive and chicory. CABI Publishing, Wallingford, UK.

31 Lebeda, A. and I.W. Boukema. 2001. Leafy Vegetables Genetic Resources. Pp. 48-57 *in* Report of a Network Coordinating Group on Vegetables, *ad hoc* meeting, 26-27 May 2000, Vila Real, Portugal (L. Maggioni and O. Spellman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

32 Lebeda, A. and E. Křístková, editors. 1999. EUCARPIA Leafy Vegetables ´99. Palacký University, Olomouc, Czech Republic.

33 Hintum, Th.J.L. van, A. Lebeda, D.A. Pink and J.W. Schut, editors. 2003. EUCARPIA Leafy Vegetables Conference 2003, Proceedings of the EUCARPIA Meeting on Leafy Vegetables Genetics and Breeding, 19-21 March 2003, Noordwijkerhout, The Netherlands. Centre for Genetic Resources, The Netherlands (CGN), Wageningen, The Netherlands.

34 This volume, pp. 82-85.

views on the need to continue the work and concluded that a recommendation be forwarded to the ECP/GR Steering Committee seeking the formal establishment of a Leafy Vegetables Working Group within the ECP/GR Vegetables Network.

The agreed list of actions has already led to some significant developments and detailed objectives were discussed during the Skierniewice ECP/GR Vegetables Network and *ad hoc* Leafy Vegetables meeting.

Objectives

- Create an inventory of leafy vegetables germplasm, including minor leafy vegetables
- Create European databases for spinach and *Cichorium*
- Re-examine passport descriptor lists and characterization protocols in order to improve standardization and to develop minimum descriptors
- To obtain information about the status of regeneration, improve and harmonize protocols for seed regeneration and seed storage
- To obtain information about the status of safety duplications in all collections, including minor leafy vegetable crops
- Identify, where possible, the most original samples (MOS) of wild *Lactuca* spp. in the collections by the database manager in cooperation with the collection holders. The information would be added to the International Lettuce Database (ILDB).
- Increase cooperation in collecting activities with the countries of origin of the three crops (lettuce, spinach, *Cichorium*) and associated wild relatives
- Identify the taxonomic status of invalidated (wild) species/accessions maintained in genebank(s)
- The group expressed interest to apply for a EU project focused on leafy vegetables
- Disseminate results and achievements.

Leafy Vegetables Working Group management

In agreement with the Skierniewice *ad hoc* meeting[34], Aleš Lebeda, would act as the lead focal person of the Working Group together with I.W. Boukema. They would initiate and coordinate the objective-related activities to be carried out by each member of participating countries. One of the major tasks will be to establish a network of stakeholders for leafy vegetables genetic resources on a country level. General information collected relating to the Working Group objectives (Lebeda and Boukema 2001[31], 2003[34]), together with the experience obtained from projects e.g. the GENE-MINE project, will be the guideline for developing further activities up to the end of 2004. Once established, the Leafy Vegetables Working Group will continue its activities as an independent Working Group within the ECP/GR framework.

Formalization of an ECP/GR Working Group on Leafy Vegetables, accompanied by limited funding to hold a small meeting in 2005 would be sufficient to expand current collaboration to the entire European region focusing on the most important leafy vegetables for the Region. We believe that the establishment of a Leafy Vegetables Working Group within the ECP/GR Vegetables Network will initiate a more productive collaboration on leafy vegetables genetic resources in Europe. The group members appreciate the encouragement and support of the ECP/GR Steering Committee.

Aleš Lebeda (Palacký University, Faculty of Science, Department of Botany, Olomouc, Czech Republic)

Ietje W. Boukema (Centre for Genetic Resources, Wageningen, The Netherlands)

28 August 2003

Appendix III. Collaboration between genebanks and breeders for the conservation and use of vegetable genetic resources in Europe

An initiative taken by the ECP/GR Secretariat to strengthen collaboration between genebanks and the private sector for the regeneration of endangered vegetable accessions was proposed during the ECP/GR Vegetables Network meeting in Skierniewice, Poland in May 2003 (see p. 8, this volume). The proposal was welcomed by the Network and the ECP/GR Secretariat was given responsibility to collect requests for help from genebanks and offers to contribute to regeneration work by breeding companies. As of June 2005, several expressions of interest in this initiative were obtained from breeders from various European countries, both from the private and public sector. However, there were no corresponding requests from genebanks to use the services of the breeders.

As positive results, a couple of bilateral and within-country initiatives were started following the ECP/GR proposal, but none of them required the coordination of the Secretariat or any legal or technical advice:

- In Germany, the genebank of IPK found private partners who were willing to help in the regeneration of wild *Allium* accessions.
- In Italy, the University of Catania signed a Memorandum of Understanding with a consortium of private breeders establishing conditions for activities of mutual interest regarding regeneration, characterization and evaluation of vegetable species i.e. Brassicaceae, Solanaceae, Liliaceae and Umbelliferae.

Table 1 summarizes the information available at time of publication.

Table 1. Expressions of interest to participate in genebank–breeder collaboration as of June 2005 (partners currently involved in bilateral collaboration are shaded)

Country	Institute / Company (contact person)	Scope of collaboration	Information provided by
Genebanks			
Germany	Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK) (J. Keller)	Seed propagation of wild species of *Allium*	J. Keller (IPK)
Italy	Dipartimento di OrtoFloroArboricoltura e Tecnologie Agroalimentari (DOFATA), Università di Catania (F. Branca)	Various vegetable species i.e. Brassicaceae, Solanaceae, Liliaceae, Umbelliferae	L. Maggioni (IPGRI)
Breeders and other partners			
Germany	Marner GZG Saaten AG (M. Rauber)	*Allium* initiatives	J. Keller (IPK)
	Calbenser Handelsgesellschaft mbH (R. Tischer)	*Allium* initiatives	J. Keller (IPK)
Italy	Peotec Seeds (P. Passeri)	n.s.	L. Maggioni (IPGRI)
	Istituto Sperimentale Agronomico (ISA) (D. De Giorgio)	n.s	C. Fideghelli (ISF)
	Istituto Sperimentale per le Colture Industriali (ISCI) (P. Ranalli)	n.s.	C.Fideghelli (ISF)
	Istituto Sperimentale per l'Agrumicoltura (ISA) (G. Reforgiato Recupero)	n.s.	C. Fideghelli (ISF)
	Istituto Sperimentale per la Frutticoltura (ISF) (C. Fideghelli)	n.s.	C. Fideghelli (ISF)
	Consorzio per la Valorizzazione delle Sementi (CONVASE) (A. Lipparini)	n.s.	F. Branca (DOFATA)
The Netherlands	Enza Zaden Company (n.s.)	Regeneration of endangered material of vegetable species	M.C. Daunay (INRA)
	Dutch *Allium* breeders united in Plantum NL (n.s.)	Regeneration of *Allium* species under the coordination of CGN	I. Boukema (CGN)
	Dutch Leafy Vegetables breeders united in Plantum NL (n.s.)	Regeneration of leafy vegetable material of endangered collections, under the coordination of CGN	I. Boukema (CGN)
Slovak Republic	Slovak Association of Seed Traders and Breeders (SASTAB) (F. Debre)	n.s.	J. Turok (IPGRI)
Spain	Seminis Vegetable Seeds Ibérica S.A. (G. Anastasio Ramón)	n.s.	M.J. Díez Niclós (UPV)

n.s. = not specified

Appendix IV. Acronyms and abbreviations

AFCEV	Association Française pour la Conservation des Espèces Végétales (French Association for the Conservation of Plant Species), France
AFLP	amplified fragment length polymorphism
AGES	Österreichische Agentur für Gesundheit und Ernährungssicherheit GmbH (Austrian Agency for Health and Food Safety), Austria
ARO	Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel
BAZ	Bundesanstalt für Züchtungsforschung an Kulturpflanzen (Federal Centre for Breeding Research on Cultivated Plants), Quedlinburg, Germany
BGHZ	Banco de Germoplasma Hortícola de Zaragoza (Zaragoza Germplasm Bank), Spain
BMBF	Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research), Germany
BPGV	Banco Português de Germoplasma Vegetal (Portuguese Plant Germplasm Bank), Braga, Portugal
Bras-EDB	*Brassica* European Database
BRG	Bureau des Ressources Génétiques (Genetic Resources Board), Paris, France
CBD	Convention on Biodiversity
CCDB	Central Crop Database
CGN	Centre for Genetic Resources, the Netherlands, Wageningen
CIFA	Centro de Investigación y Formación Agroalimentaria (Agricultural Research and Training Centre), Spain
CMS	cytoplasmic male sterility
COMAV	Centro de Conservación y Mejora de la Agrodiversidad Valenciana (Centre for the Conservation and Breeding of the Agricultural Biodiversity), Valencia, Spain
CRF	Centro de Recursos Fitogenéticos (Centre for Plant Genetic Resources), Spain
CRRG	Centre Régional de Ressources Génétiques Nord Pas-de-Calais (Regional Centre for Genetic Resources of Nord Pas-de-Calais), France
CTIFL	Centre Technique des Fruits et Légumes (Technical Centre for Fruit and Vegetables), France
CTPS	Comité Technique Permanent de la Sélection (Permanent Technical Committee for Plant Breeding), France
DvP-CLO	Departement voor Plantengenetica en –veredeling - Centrum voor Landbouwkundig Onderzoek (Department of Plant Genetics and Breeding - Agricultural Research Centre), Melle, Belgium
EADB	European *Allium* Database
ECCUDB	European Central Cucurbits Database
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
EGGNET	EGGplant NETwork
EPGRIS	European Plant Genetic Resources Information Infra-Structure
ESVC	Experimental Station for Vegetable Crops, Gorna Oryahovitsa, Bulgaria
EU	European Union
EUCARPIA	European Association for Research on Plant Breeding
EUDB	European Umbellifer Database
EUFORGEN	European Forest Genetic Resources Programme
EURISCO	European Plant Genetic Resources Search Catalogue
FNAMS	Fédération Nationale des Agriculteurs Multiplicateurs de Semences (National Federation of Seed Producers), France

FNPE	Fédération Nationale des Producteurs d'Endives (National Federation of Chicory Producers), France
GEVES	Groupe d'Etude et de contrôle des Variétés et des Semences (Group for the Study and Monitoring of Varieties and Seeds), France
GMO	genetically modified organism
HDRA	Henry Doubleday Research Association, Ryton-on-Dunsmore, United Kingdom
HRI	Horticulture Research International, Wellesbourne, United Kingdom
IB	Institute of Botany, Vilnius, Lithuania
IGB	Israeli Gene Bank for Agricultural Crops
IHC	Institute of Horticulture and Canning, Plovdiv, Bulgaria
ILDB	International *Lactuca* Database
INH	Institut National d'Horticulture (National Institute of Horticulture), Angers, France
INIA	Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (National Institute of Food and Agriculture Investigation and Technology), Spain
INRA	Institut National de la Recherche Agronomique (National Institute for Agronomical Research), France
IPGR	Institute of Plant Genetic Resources "K. Malkov", Sadovo, Plovdiv, Bulgaria
IPK	Institut für Pflanzengenetik und Kulturpflanzenforschung (Institute for Plant Genetics and Crop Plant Research), Gatersleben, Germany
LIH	Lithuanian Institute of Horticulture, Babtai, Lithuania
LMV	Lettuce mosaic virus
MAPA	Ministerio de Agricultura, Pesca y Alimentación (Ministry of Agriculture, Fisheries and Food), Spain
MCPD	Multi-crop Passport Descriptors
MOS	most original sample
MTA	Material Transfer Agreement
NGB	Nordic Gene Bank, Alnarp, Sweden
NGO	non-governmental organization
PBAI	Plant Breeding and Acclimatization Institute, Radzików, Poland
PGRFA	Plant Genetic Resources for Food and Agriculture
PRI	Plant Research International, Wageningen, The Netherlands
RCA	Institute for Agrobotany, Tápiószele, Hungary
RHS	Royal Horticultural Society, United Kingdom
RICP	Research Institute of Crop Production, Prague-Ruzyne, Czech Republic
RIVC	Research Institute for Vegetable Crops, Skierniewice, Poland
SIA	Servicio de Investigación Agroalimentaria (Agricultural Research Service), Spain
SNES	Station Nationale d'Essais de Semences (National Seed Testing Station), France
UPOV	Union internationale pour la protection des obtentions végétales (International Union for the Protection of New Varieties of Plants), Geneva, Switzerland
UPV	Universidad Politécnica de Valencia (Polytechnic University of Valencia), Spain
USDA	United States Department of Agriculture
ARS	Agricultural Research Service (USDA)
VIR	N.I. Vavilov Research Institute of Plant Industry, St. Petersburg
WIEWS	World Information and Early Warning System of the FAO
WU	Wageningen University, the Netherlands

Appendix V. Agenda of the ECP/GR Vegetables Network meeting, 22-24 May 2003, Skierniewice, Poland

Wednesday 21 May

Arrival of participants
Focal persons: 18:00 – 20:00 and through dinner: closed session for meeting preparations

Thursday 22 May

Plenary session - Introduction

09:00 – 09:15 Opening of the meeting, welcome address and opening remarks
09:15 – 09:45 Information on ECP/GR and current international PGR events
09:45 – 10:15 Discussion
10:15 – 10.45 Coffee break

Parallel meetings

10.45 – 12.30
- **Leafy Vegetables**: see specific agenda
- **All other Working Groups**: Review of workplan progress and discussion on Working Group priorities for the future. Chairs/rapporteurs ensure that relevant items for plenary discussion are summarized in written form and reported to the plenary on the following day

12:30 – 14:00 Lunch
14.00 – 15.30 Parallel meetings – continuation
15:30 – 16:00 Coffee break
16.00 – 17.30 Parallel meetings – continuation
End of the first day

Friday 23 May

Plenary sessions – reporting and discussions at Network level

09:00 – 09:30 Reporting by the Working Group rapporteurs on issues of Network-wide interest, and discussion: Databases, Characterization, Evaluation, Regeneration, Safety-duplication, Conservation and management of wild relatives
10:15 – 10:45 Coffee break
10:45 – 12:30 Reporting - continuation
12:30 – 14:00 Lunch
14:00 – 15:30 Identification of priorities for the future at Network and Working Group level (ECP/GR end of Phase VI – Phase VII)
15:30 – 16:00 Coffee break
16:00 – 17:00 Planning for a collaboration between genebanks and the private sector for emergency regeneration (*introduced by IPGRI*)
17:00 – 17:30 Conclusions
End of the second day

Saturday 24 May

8:30 – 15:00 **Excursion**: Zelazowa Wola, Lowicz and Nieborow
9:00 – 12:30 *Drafting of the report (only focal persons, Chairs and Vice-Chairs are involved in the drafting)*
20:00 Social dinner

Sunday 25 May

Departure of participants

Appendix VI. List of participants

N.B. This list includes only participants having attended the meeting. The composition of the Working Groups is subject to changes and the latest update can be found on the ECP/GR Contacts Web page (http://www.ecpgr.cgiar.org/Contacts/ecpgr_contact.htm).

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