Report of a Working Group on *Allium*

Sixth meeting – 23-25 October 1997 – Plovdiv, Bulgaria

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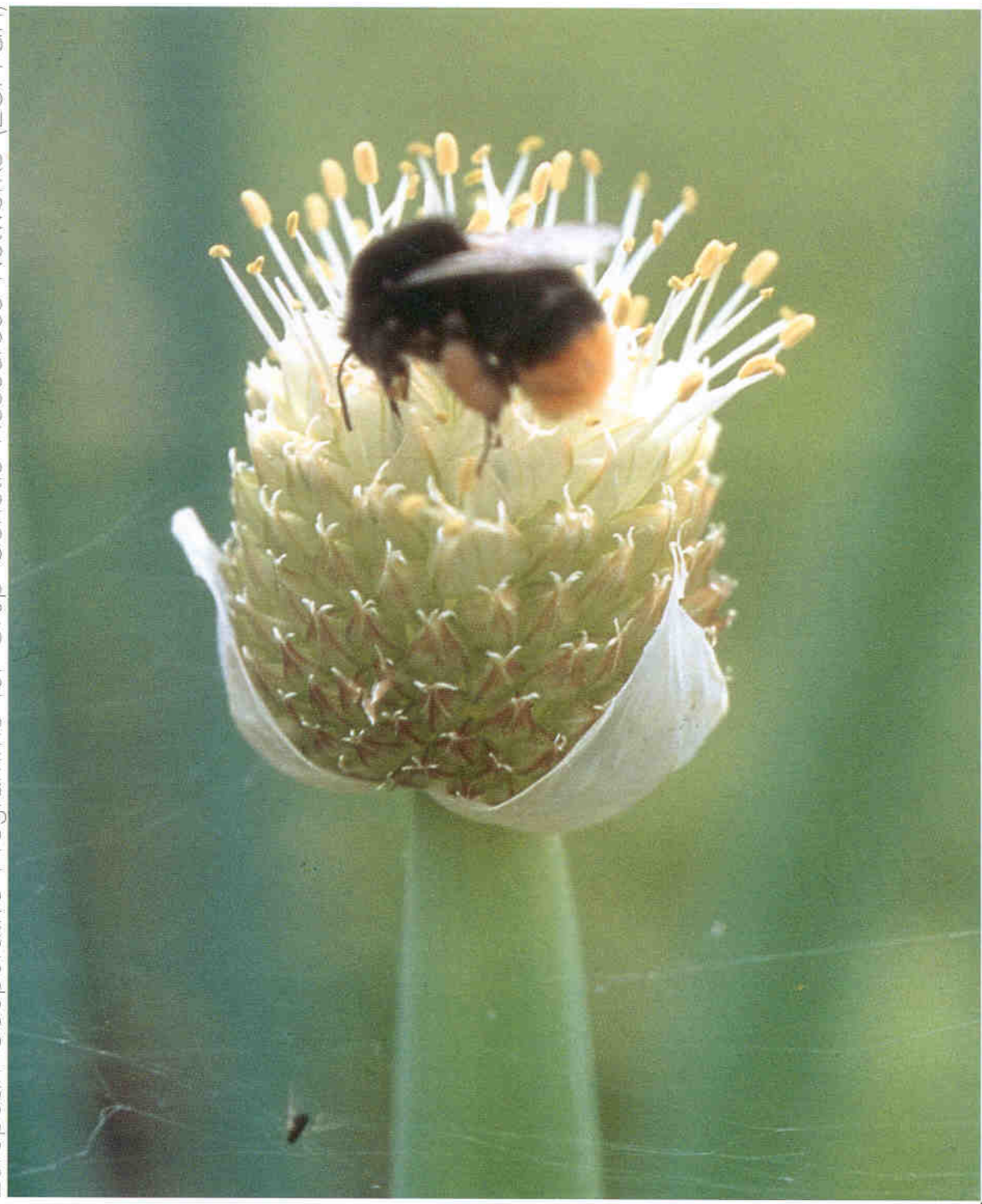
European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR)



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The European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) is a collaborative programme among most European countries aimed at ensuring the long-term conservation and facilitating the increased utilization of plant genetic resources in Europe. The Programme, which is entirely financed by the participating 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 ten broadly focused 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, vegetables, grain legumes, fruit, minor crops, industrial crops and potato) or general themes related to plant genetic resources (documentation and information, *in situ* and on-farm conservation, technical 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.

Cover: *Allium altaicum* Pallas. Courtesy P. Havránek, Olomouc Genebank, Czech Republic.

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Part I. Discussion and Recommendations

Introduction

Opening and Welcoming Address

Dr Dave Astley, Chair of the *Allium* Working Group, welcomed the participants to the sixth meeting of the Group and expressed his thanks for the privilege of being hosted in Bulgaria.

Dr Stanko Georgiev, vice-director of the Institute for Plant Genetic Resources (IPGR), Sadovo, welcomed the participants of the European Cooperative Programme to Bulgaria. He apologized on behalf of the institute director, Dr Rada Koeva, for her absence due to her attendance at a meeting in Switzerland. He then thanked all the staff of the Sadovo institute for their contribution in the organization of the present meeting, and he wished success and good health to all participants and their families.

Dr S. Georgiev then summarized the history of the IPGR, going back to the time when the first School of Agriculture was established in Sadovo in 1882. In 1902 it grew into an Agricultural Experimental Station and in 1977 it became what is now known as the Institute for Plant Genetic Resources with five independent programmes. The institute employs about 170 people, 40 of whom are scientists and 60 research assistants. The land available for experimental fields covers about 180 ha. The basic aim of the plant genetic resources programme is the collecting, study, conservation and use of the cultivated plants and their wild relatives. The accessions stored are mainly cereals and legumes. Collections are evaluated and data are computerized. The germplasm is freely exchanged with foreign countries. The other national programmes for which the institute is responsible are wheat breeding, peanut and sesame breeding, rice breeding and biotechnology.

Dr D. Astley thanked Dr Georgiev for this extremely warm welcome.

Information on ECP/GR

Lorenzo Maggioni, ECP/GR Coordinator, thanked IPGR for hosting this meeting, expressing special gratitude to Dr R. Koeva and Dr S. Neykov for the efforts they put into the excellent organization of the meeting. He also acknowledged the valuable contribution of other members of the institute's staff.

L. Maggioni welcomed all the participants on behalf of IPGRI and particularly those attending an *Allium* meeting for the first time, as well as the observers from Russia, Czech Republic and the various Bulgarian research institutes. He thanked those corresponding members who sent reports from the respective countries (Cyprus, Portugal, Romania and F.R. Yugoslavia) and invited the Group to establish contacts also with all the other full members of the Group, although they were absent here. The ECP/GR Coordinator mentioned also the receipt of a letter from FAO, in which interest for this meeting was expressed, although it was not possible to send a representative at this time. He forwarded to the Group very special greetings from Thomas Gass, director of the IPGRI Regional Office for Europe, who remembers with pleasure his involvement in the activities of this dynamic group.

Since the Group met for the last time in May 1995, L. Maggioni reported the objectives and the new structure of ECP/GR, defined during the Technical Consultative Committee

(TCC) meeting of September 1995 in Nitra, Slovakia.[1] He also summarized the activities of ECP/GR during Phase V, as implemented within its crop and thematic networks (see Appendix I). The various *ad hoc* actions as well as the support given to the participation of non-EU countries into EU-funded projects were also illustrated.

Chairperson's report

Dave Astley, Horticulture Research International, Wellesbourne, UK

The major task set out in the workplan of the fifth meeting of the *Allium* Group in Skierniewice was the development of a new European database. The other priority actions included: assess safety-duplication for collections; transfer safety-duplicates to participating base stores; assess characterization data and whether data were held in computer databases; review taxonomy of accessions in collections of wild taxa; prioritize material for regeneration programmes; assess *in situ* distribution of taxa in Section *Allium*. These tasks have been carried out with varying degrees of success over the last 2 years. There were also external influences that had a significant effect on the rate of progress in some of these work areas.

The European *Allium* Database (EADB) has been rebuilt at the Genetic Resources Unit, HRI (Wellesbourne, UK) using the Access software. However, there are some national data sets that have not been received and therefore are not included. The development of the EADB97 (1997 version of the database) was complicated by decisions taken in late 1996 at a meeting of the ECP/GR Documentation and Information Network.[2] This group reached a consensus agreement on a set of draft multicrop passport descriptors for use in the transfer of data within ECP/GR. Therefore the proto-EADB was reformatted to meet the agreed standards. An added complication was the need to reformat country data before inclusion in the EADB97. The discussion to develop a characterization database has not progressed. Characterization data from a few countries have been forwarded to HRI Wellesbourne. The *Allium* Working Group needs to decide how they wish to handle and present these data in relation to the EADB.

The slow development of the new database has had an effect on other areas of the workplan. It has been impossible to utilize the EADB to coordinate decisions on national regeneration programmes. Also many of the data sets received have no data recorded indicating whether accessions are safety-duplicated in a long-term store. ECP/GR have been encouraging discussion on the development of bilateral agreements for the maintenance of safety-duplicates. Model systems are already in operation. This is something the *Allium* Working Group needs to consider further. In addition, the Group has to reassess the question of a data field defining the availability of individual accessions. The meeting in 1995 recommended the inclusion of such information in the database[3], but most curators

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1 T. Gass, G. Kleijer, M. Waldman and E. Frison, editors. 1995. Report of the Technical Consultative Committee. Sixth Meeting, 21-23 September 1995, Nitra, Slovakia. European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR). International Plant Genetic Resources Institute, Rome, Italy.

2 E. Lipman, M.W.M. Jongen, Th.J.L. van Hintum, T. Gass and L. Maggioni, compilers. 1997. Central Crop Databases: Tools for Plant Genetic Resources Management. International Plant Genetic Resources Institute, Rome, Italy/CGN, Wageningen, The Netherlands.

3 T. Gass, D. Astley, H.D. Rabinowitch and E.A. Frison, compilers. 1996. Report of a Working Group on *Allium*. Fifth meeting, 25-27 May 1995, Skiernewice, Poland. International Plant Genetic Resources Institute, Rome, Italy.

have not provided the necessary data. With hindsight, the development of the new database has taken so long that such data would inevitably be out of date long before any practical use was made of them.

There have been several successful initiatives by Group members that have stimulated activities in areas of direct interest to the Group, such as the EU GEN RES *Allium* project, FAIR onion quality project, EU Biotechnology GALAHEAD project proposal, *in vitro*/cryo training and collecting.

The ECP/GR Group has a presence on the World Wide Web via the ECP/GR homepage, and also through the GEN RES project and national genebank homepages. As a Group we have not progressed in this area as rapidly as other ECP/GR Working Groups. Their experiences offer us the opportunity to progress more quickly over the next few years.

The European *Allium* Database (EADB) and the GEN RES 20 project

Introduction

Dave Astley reviewed the status of the European *Allium* Database (EADB) and explained the relationship between the activities of the EU GEN RES 20 *Allium* project and the ECP/GR *Allium* Working Group. The work defined in the Technical Annex of the GEN RES project encompasses the objectives outlined in the workplan of the ECP/GR Working Group. The complementarity of the actions, and the injection of funds by the EU promotes the overall objectives of the ECP/GR. This has been further enhanced through a training link between Germany and Poland for cryopreservation supported by Phase IV ECP/GR funds as a fully complementary action to the GEN RES 20 project. It is hoped that this collaboration will lead to the development of a cryopreservation laboratory at the Research Institute of Vegetable Crops (RIVC), Poland. Dave Astley agreed to forward copies of future GEN RES newsletters to members of the ECP/GR *Allium* Working Group to promote the flow of information.

The development of the new EADB has progressed only slowly, determined by the rate of receipt of the data from national programmes. Following the agreement by the ECP/GR Documentation Network and the ECP/GR database managers on a draft multicrop passport descriptor list, the initial EADB format was updated to conform to this format (see Part II, page 23). An important task for the Working Group to consider was the ratification of the multicrop passport descriptors and the definition of any additional crop-specific passport descriptors for the EADB.

The EADB currently includes data from 19 collections from 12 countries totalling 7527 accessions. This total is greater than recorded in the EADB92 (1992 version of the database), even though the data from several important national collections have not yet been received. Data from the Research Institute of Crop Production (RICP), Olomouc collection and updated data from Bulgaria were received during the meeting.

> *The Group agreed that every effort should be made to obtain additional data sets by the end of January 1998 and that the EADB be made available by end February 1998. D. Astley agreed to investigate the possibilities of the EADB being made available on-line on the Internet. Nevertheless the database will be distributed to national* Allium *coordinators on diskette to ensure access for those institutes without access to the WWW.*

IPGRI/FAO Multicrop Passport Descriptor List

L. Maggioni summarized for the Group the background leading to the compilation and approval of the *Multicrop Passport Descriptor List* during the meeting of the Central Crop Database managers in Budapest (October 1996). This list was accepted as a standard format for data exchange and was prepared to facilitate the documentation management, especially in cases of genebanks dealing with several crops. A final version of the list, including some descriptors suggested by FAO for its World Information and Early Warning System (WIEWS), was published by IPGRI in the report of the Budapest Workshop.[4] Since then the list was adopted by several ECP/GR Working Groups, to be used as the passport list for the respective European Crop Databases. The list was enriched with additional crop-specific descriptors by the *Prunus*, Forages, *Malus/Pyrus*, Barley and *Brassica* Working Groups.

[4] Appendix II. Pp. 75-78 *in* Lipman *et al.* (see footnote 2).

Considering that the same list was also accepted by the partners of the GEN RES 20 EU-funded project on *Allium* genetic resources, the ECP/GR *Allium* was invited to consider the adoption of the multicrop list for the EADB.

The Group agreed that the complete IPGRI/FAO Multicrop Passport Descriptor List should be adopted for use in the EADB.

Re-evaluation of the passport descriptor list

In a brief introduction D. Astley compared the *Multicrop Passport Descriptor List* with the list of passport descriptors used by the Group for the EADB up to the present. After a short discussion, the Group agreed on the following:

The Allium *passport descriptor list should include the following additional descriptors, identified as specific for the* Allium *passport by the prefix EA in the field name:*

Daylength requirement (EADAYLREQ)
Common name (EACOMMNAM)
Collecting institute (EACOLLINST)
Mode of reproduction (EAMODREP)

plus all WIEWS descriptors as defined as an addendum in the Multicrop Passport Descriptor List.

The descriptors AVAILABILITY and NEED_REG defined in the 1995 report were removed from the EADB file. The Group agreed that such information is very difficult to maintain sufficiently up-to-date to provide any practical benefit.

It was noted that the SAMPLE STATUS field states differ between the multicrop descriptors and old EADB. Dave Astley agreed to highlight this fact for all data donors with a request that all data forwarded to HRIGRU in the future should utilize the multicrop descriptors format.

The Group approved the above-mentioned recommendations (see Appendix II, Allium *Passport Descriptors).*

Opportunities to include characterization and evaluation data

The efforts of the GEN RES team to characterize collections of garlic and shallot had highlighted some anomalies in the ECP/GR minimal characterization descriptors. The onion descriptors were not adequate for the characterization of shallot. Joachim Keller outlined the problems for garlic in presentation on the morphology studies in garlic. The GEN RES project team requested that the ECP/GR Group consider the anomalies raised and review the minimal characterization descriptors for garlic and shallot.

The Group nominated two *ad hoc* subgroups of crop experts to consider these problems, as below:

- **Garlic:** E.R.J. Keller (Coordinator), H.D. Rabinowitch, P. Havránek, T. Kotlińska and possibly F. Mansilla (Cordoba).

This subgroup was defined after a presentation in which J. Keller reminded the Group how, in the course of the specific discussions of the GEN RES 20 Project, it became evident that there is a need to further develop the descriptors of the various *Allium* crops, in this case

those of garlic (see Keller and Senula, Part II, page 26). To support this process, a detailed analysis was performed on the most important morphological descriptors of the minimal descriptor list using the 51 accessions in the IPK part of the GEN RES 20 core collection of garlic. The scientific background of the core collection has been provided by a preliminary morphological classification, data of geographical origin and a detailed analysis of isozyme and DNA patterns.[5] The accessions have been split into subclones (maximum 6) with a sample size of 20 plants per subclone. The following descriptors have been analyzed:

- Ability to produce scape (G4.2.7)
- Number of whorls in bulb (G4.1.15)
- Bulb shape regularity (G4.1.16)
- Number of cloves per compound bulb (G4.1.14)

The analyses resulted in the following conclusions:

1. "Ability to produce scape" is a complex character, in which the formation of the inflorescence is mixed with the ability to form bulbils. It is suggested that the two characters be split into two different descriptors, making the bulbil (top sets) formation (bulbil weight) an independent character.
2. "Whorls" is not the appropriate description of the bulb structure, because the cloves are derived from collateral axillary buds, thus producing semi-circular overlapping formations.
3. The classification of scores for "Number of cloves" has to be discussed again.
4. "Pseudostem height" and "Pseudostem diameter" are proposed as new descriptors for garlic.

The above results will be integrated with the already published classification proposals of Messiaen and Burba.

- **Shallot:** H. Stavělíková (Coordinator), T. Kotlińska, K. Henriksen and H. Rabinowitch

The subgroup reviewed the descriptors sets used by the Nordic Gene Bank and RICP, Olomouc to develop a draft list of minimal characterization descriptors. Helena Stavělíková agreed to prepare a full draft of this list including descriptor states for further consideration by the subgroup (end December 1997).

A final proposal for the new garlic and shallot descriptors will be sent by the coordinators of the two subgroups to the ECP/GR Coordinator and to H. Rabinowitch by 31 January 1998.[6]

The Group reaffirmed the decision recorded in the 1995 report that all characterization data for the minimal characterization descriptors for crops should be forwarded to HRIGRU. This information will be stored in crop-specific files defined in 1995 with links to the EADB via INSTCODE and ACCENUMB. Therefore all data sets for characterization have to include complete data for these two fields.

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[5] H.I. Maass and M. Klaas. 1995. Intraspecific differentiation of garlic (*Allium sativum* L.) by isozyme and RAPD markers. Theor. Appl. Genet. 91:89-97.

[6] As of October 1998, work on the descriptors is in progress; advanced drafts for shallot and garlic have been discussed; final versions are not yet available.

Opportunities to produce a revised version of the Allium *IPGRI descriptors*

L. Maggioni informed that IPGRI is currently deciding which crop descriptors should be published in the next year or two. He said that the possibility exists that IPGRI will take into consideration the publication of revised *Allium* descriptors, if a well-coordinated network like the ECP/GR *Allium* Working Group can prepare a new version, as a result of a collaborative elaboration. Considering the importance of the *Allium* crops in several parts of the world and the age of the present IBPGR *Allium* descriptors, dating back to 1981 and amended several times, these descriptors could have a good chance to be included in the list of the next IPGRI publications. ECP/GR could partially contribute to the printing of the revised list of *Allium* descriptors, if the coordinating effort of the *Allium* Working Group was appropriately acknowledged. The necessary circulation to the other regions of an advanced version of the revised list of new descriptors could also be relatively quick, if the Group was able to adopt the revised list of descriptors formerly agreed upon (previous meetings of the *Allium* Working Group in Tápiószele, 1984; Gatersleben, 1991; and Skierniewice, 1995).

The Group reiterated the urgency and the necessity to produce a new version of the IPGRI Allium *descriptors, also considering that updated versions of some descriptors are published in different reports and should be compiled. The ongoing effort of the ECP/GR* Allium *Working Group to produce new specific descriptors for garlic and shallot, also in the context of the GEN RES 20 project, makes it natural to reach a conclusive compilation of an almost accomplished effort.*

The Group agreed that a subcommittee, composed of ***H. Rabinowitch****, J. Keller, D. Astley and S. Samaras, prepare an advanced draft of the* Allium *descriptors by 31 January 1998. These will be redistributed to the Group for comments, to be received by the end of March 1998. The revised draft will then be sent to IPGRI by the end of May, with the intention to receive comments from the regions by the end of September 1998. In order to facilitate the task of the subcommittee, the ECP/GR Coordinator will provide, by mid-November 1997, if available at IPGRI, an electronic version of the previous IBPGR* Allium *descriptors and of all the amendments published in the* Allium *meetings reports. The ECP/GR Coordinator will also try to make sure that the descriptors are included in the list of IPGRI publications for early 1999.*

A subcommittee made of ***D. Astley****, H. De Clercq, R. Theiler, I. Boukema, G. Poulsen and S. Neykov will develop specific descriptors for leek and send a draft proposal to the ECP/GR Coordinator and H. Rabinowitch by 31 January 1998.*

A subcommittee composed of J. Keller and the Nordic Group will review the chives descriptors list in full and send their draft revision to the ECP/GR Coordinator and H. Rabinowitch by 31 January 1998.[7]

Opportunities for an Internet presentation of the EADB

L. Maggioni presented the latest version of the Internet European Information Platform for Crop Genetic Resources <http://www.cgiar.org/ecpgr/platform>. He informed the Group that the development of this Internet site was recommended during the Budapest Workshop (October 1996) by the European database managers, as a site offering access to the on-line

[7] A final version of the chives descriptors has been submitted to the ECP/GR *Allium* Working Group for inclusion in the descriptor list.

central databases and to other sources of information and services of interest in the crop genetic resources field. He then showed examples of the model Entry Pages currently prepared in a common format for all the ECP/GR European Central Crop Databases. The Entry Pages, according to the recommendations of the Internet Advisory Group[8], include the ECP/GR logo and the logo of the institute managing the central database, the name and address of the database manager, a short description of the contents of the database and the type of software used. From the Entry Page, access is given to either an on-line searchable or an off-line downloadable database, as well as to more detailed information about the database. L. Maggioni mentioned the possibility of IPGRI preparing a similar Entry Page for the EADB, should the Group agree to present in this way on Internet the database under development.

The Group considered it very useful that the EADB be included in the list of databases accessible via the Information Platform and asked that IPGRI prepare an Entry Page for the ECP/GR Allium *Database, with the HRI and the ECP/GR logos. To this purpose, D. Astley will send to the ECP/GR Coordinator, by 15 November 1997, a short description of the contents of the database, for inclusion in the Entry Page and two files with the list of contributing institutes and their addresses and the list of species included in the database. These will be linked to the Entry Page as additional information. The Group agreed that an Entry Page for the EADB should be present on the Internet platform as soon as possible, for information purposes and in preparation for an imminent effective availability of the database itself on the Web. The Group agreed that an off-line downloadable version of the EADB should be made available as soon as possible and D. Astley will look into the possibility of uploading it onto a UK server.*[9]

[8] Established in January 1997, the Advisory Group is composed of Pierre Campo (GEVES, France), Theo van Hintum (CGN), Morten Huden (NGB), Daniel Jiménez Krause (ZADI, Germany), Kevin Painting (IPGRI) and Lorenzo Maggioni (ECP/GR Coordinator).

[9] At the time of publication of this report, the EADB Entry Page is accessible on the Information Platform for Crop Genetic Resources <http://www.cgiar.org/ecpgr/platform> linking to the site where the off-line downloadable EADB is available in two versions (MSAccess or MSExcel) <http://www.hri.ac.uk/research/wellesb/ecpgr/ecpgr.htm>, see p. 26.

Allium genetic resources collections in Europe

The European field collection of long-day Allium *species*

Following a detailed introduction on the history of the *Allium* genebank in Olomouc, Pavel Havránek (curator of the European Collection of vegetatively propagated long-day *Allium* species) informed the Group that the Institute of Vegetable Genetics (Olomouc) was merged with the local university. However, the collection remains under his supervision.

- **Garlic**: of the about 600 accessions, about 300 originate from the former USSR and Czechoslovakia, the rest coming from other European sources, e.g. Austria, Bulgaria, Poland and Portugal. Using meristem culture propagation technique, a number of clones were cleaned from viruses (checked for Onion Yellow Dwarf and Garlic Latent viruses) and are currently maintained in insect-proof net-houses. The virus-free plants are more vigorous and produce 40% higher yields than the infected ones.
  The collection suffered strong damages from the 1997 torrential rains and thus a duplicated collection is essential to guarantee the safe existence of this precious collection.
  The field collection has now reached its full capacity, thus furthering the maintenance and evaluation will require financial support.

- **Shallot**: Helena Stavělíková is in charge of this collection of 133 accessions. The main core of the collection is based on material received from Finland, and is currently under evaluation in accordance with IPGRI and UPOV lists of descriptors.

The European field collection of short-day Allium *species*

The collection is maintained by Haim D. Rabinowitch in Rehovot (coastal valley), at the experimental farm of the Faculty of Agricultural, Food and Environmental Quality Sciences, and is supported by the Israeli Gene Bank (IGB). The collection started in 1983 and currently contains 246 entries of garlic, 11 entries of *Allium longicuspis* Reg., 16 entries of great-headed garlic (elephant garlic), 50 entries of tropical and subtropical shallot and 20 additional entries of seven different species. In recent years, only a few entries were received from external sources. The majority of the new acquisitions were obtained by active collection work in Kazakstan and neighbouring countries (supported for a limited period by a private fund), and from sporadic purchases in local markets.

The collection in Israel includes material from southeast Asia, Africa (especially North Africa) and Central and South America. A few accessions from southern European countries and USA successfully grow in Israel, and are therefore maintained in the collection.

Support by IGB is very limited, and does not cover the minimum needs for preservation of the collection. It is essential to get additional support for the adequate maintenance of this unique (non-duplicated) collection.

> *The Group recognized the uniqueness of this collection of short-day vegetatively propagated* Allium*. The Group wishes to have information on the properties of the collected accessions and endorses the request for adequate support to guarantee the safety of this collection and for its evaluation in accordance with the recommended descriptors list.*

The taxonomic research collection of wild Allium *species at IPK*

The collection was established in 1983 in the Taxonomy Department of IPK in the course of a complex research project on the genus *Allium*, aiming to reinvestigate the phylogenetic relationship within this large taxon. The collection includes about 2000 accessions maintained as permanent field collections, with a back-up of seeds mainly derived from open-pollination, stored in seed storage chambers at –15°C. Running research projects on this collection are mentioned in Part II, page 40.

The Group underlines the importance of the taxonomic research collection of Allium *wild species at IPK as a reference collection for determination of any new and unknown material. The accessions in this collection represent an important genepool, the future maintenance of which should be supported.*

The Group appreciates that IPK is willing to support the taxonomic determination of Allium *material on the basis of bilateral agreements.*

The Group highlighted, yet again, the need for detailed ecogeographic information to be collected and collated on wild taxa to provide the basis for conservation and regeneration practices. There was a consensus that IPK develop a collaborative project proposal on this topic for submission to the ECP/GR Steering Committee.

Testing for virus infection at IPK

Further information was received from J. Keller on virus testing at IPK. Together with the characterization of a core subset of the Gatersleben garlic collection, work is under way to analyze the virus infection of the field collection, eliminate the viruses via meristem culture and/or thermotherapy, and establish a virus-free *in vitro* collection. From 5000 meristem explants cultivated initially, 18% developed into plantlets. So far, *in vitro* clones have been established in 47 of 50 accessions; 33 of them were finally found to be free of the onion yellow dwarf virus (OYDV), leek yellow stripe virus (LYSV), garlic common latent virus (GCLV), shallot latent virus (SLV) and mite-borne filamentous virus (MbFV). The tests for virus infection and virus-free conditions after meristem culture have been performed using the method of enzyme-linked immunosorbent assay (ELISA).

In vitro *duplicate collection at IPK*

J. Keller informed that *in vitro* maintenance of *Allium* clones was started in 1992 at IPK, with a collection of gynogenetic onion haploids and donor genotypes with haploid-formation ability. During the development of the *in vitro* collection the emphasis shifted to the garlic collection of IPK, which is now the main object of maintenance. The clones are maintained in cycles consisting of a cold storage and a warm multiplication phase. Improvement of the maintenance is a matter of technological investigations and physiological research closely connected to the activities within the FAIR and GEN RES projects.

Initiation of activities towards cryopreservation of Allium *germplasm*

In cooperation with the GEN RES Project, joint activities have been started in IPK, Gatersleben and RIVC, Skierniewice to develop cryopreservation methods. The very helpful support of IPGRI and the Istituto sperimentale per la Frutticoltura, Ciampino, Rome have to be emphasized. These institutions provided a 2-week training course in cryopreservation for

one researcher each of IPK and RIVC in September 1997. Immediately after this course, the cryopreservation activities started with a half-year research stay of a scientist of RIVC at IPK, financed by IPGRI. It is planned to test the main methods of cryopreservation (encapsulation-dehydration, vitrification and slow freezing) on various explants of garlic using also information of methods already established in Germany for other crops, such as for potato (an already completed special project of IPGRI/BMZ).

The Group expressed a broad interest in cryopreservation methods, stressing the need to put more efforts into this subject, since Allium *crops are supposed to have special features to be investigated for cryopreservation. The submission to the EU of a collaborative project proposal to make* Allium *cryopreservation a feasible technology would be strongly endorsed by the Group. J. Keller accepted to coordinate such a project.*

Updates of National Collections

This section briefly highlights the reports of participants. Full papers are given in Part II, section on National Collections.

Belgium

H. De Clercq indicated that *Allium* collections are maintained at the following institutes: the Conservatoire Botanique de Ressources Génétiques de Wallonie (55 non-edible, vegetatively propagated flowering *Allium* species); the National Botanic Garden of Belgium at the Faculté Universitaire des Sciences Agronomiques de Gembloux; the Department for Plant Genetics and Breeding (DvP) in Melle. The latter contains about 150 varieties of leek (*Allium ampeloprasum* L. var. *porrum*) including about 23 Belgian landraces.

Bulgaria

S. Neykov informed on the collections maintained in Bulgaria:

- the Institute for Plant Genetic Resources, Sadovo holds 258 accessions including 122 *Allium cepa* L., 12 *A. porrum* L., 94 wild species and 30 local wild and cultivated forms. The largest part of the collection (186 samples) was received from Germany and the United Kingdom.
- the Institute of Vegetable Crops "Maritsa", Plovdiv holds a collection of 315 breeding materials of *A. cepa* (53 accessions were introduced from HRI, Wellesbourne). The Institute also maintains 15 local varieties and 140 accessions of *A. sativum* L. (80 local and 41 breeding materials) mostly of subsp. *vulgare* and for a small part subsp. *sagittatum*, winter and summer forms (vegetative propagation in the field). For safety-duplication reasons 88 accessions of garlic were sent to the Olomouc Gene Bank, Czech Republic.
- the Experimental Station for Vegetable Crops, Gorna Oryahovitsa, holds a collection of *Allium cepa* of 285 accessions including 230 breeding lines, and 203 (180 local) forms of *A. sativum*, mostly subsp. *vulgare*.
- the High Agriculture Institute, Plovdiv maintains *ex situ* 15 wild species.

Cyprus

Before the meeting, A. Della had informed the ECP/GR Coordinator that there is currently no research work on *Allium* genetic resources at the Agricultural Research Institute in

Nicosia. However, collecting of *Allium* spp. is planned for 1998 in collaboration with the Greek National Genebank.

Germany

J. Keller indicated that the Gatersleben *Allium* collection includes a total of 1422 accessions comprising 348 *Allium cepa* L., 485 *A. sativum* L., 154 *A. proliferum* (Moench) Schrader, 91 *A. ampeloprasum* L., 18 *A. schoenoprasum* L., 78 *A. fistulosum* L. and 248 others. Seed-forming accessions are preserved as seed at –15°C cold storage rooms. The vegetatively propagated forms and wild species are maintained in a permanent field collection. The increase of the numbers documented in the previous report results from collecting missions, breeders and NGO donations, and transfer of garlic and wild species accessions from the taxonomic research collection to the genebank.

Greece

S. Samaras reported on the collecting missions undertaken by the Greek Gene Bank in various regions of Greece, both continental and in the islands, in the framework of the EU GEN RES 20 project "Protecting future European Community crops: a programme to conserve, characterise, evaluate, and collect *Allium* crops and wild species". In summer 1996, 108 accessions were collected and in summer 1997 another 114 accessions.

Hungary

B. Baji indicated that the *Allium* collection held at the Institute for Agrobotany, Tápiószele contains 417 accessions. Since the last ECP/GR meeting, emphasis was set on the regeneration of old national material. The regenerated accessions were evaluated according to ECP/GR *Allium* descriptor lists. The onion collection was checked for duplicates.

The Netherlands

I. Boukema reported on the CGN *Allium* collection, currently consisting of 242 accessions available for distribution. All material included in the CGN collection has been regenerated Another 184 additional accessions will be included after regeneration. Information on the collection can also be found on CGN's Web site <www.cpro.dlo.nl/cgn/collect>. Passport data have been included in the European *Allium* Database (EADB). The collection is safety-duplicated at HRI, Wellesbourne, UK, and holds safety-duplicates for HRI, RIVC and IPGR. Most of the material is characterized/evaluated for the minimum descriptors and more specific screenings are carried out in the framework of the GEN RES and FAIR projects.

Nordic Countries

G. Poulsen indicated that the NGB *Allium* collection consists of 204 accessions originating from Denmark, Finland, Iceland, Norway and Sweden (141 seed material, 63 clonal). The majority of the seed-propagated material is described using NGB descriptors. Further characterization and evaluation will take place within the GEN RES project. For all the new material accepted for NGB storage, UPOV descriptors are available. The clonal material of shallots and potato onion has been characterized using UPOV descriptors. The viability of the material will be secured through regenerations during the project period.

During NGB's presentation on vegetatively propagated forms of Allium cepa*, a question was raised about the difference between potato onions and shallots. No consensus could be found about the validity of a separate category "potato onion". The Group agreed to forward the question to the IPK Taxonomy Department, requesting molecular analysis on representative forms from NGB and other genebanks.*

Poland

T. Kotlińska provided a detailed report on the *Allium* collection held at the Research Institute of Vegetable Crops in Skierniewice (RIVC), which is part of the national programme coordinated by the Centre for Plant Genetic Resources of IHAR, Radzików. The collection contains 877 accessions, including 183 of onion, 72 of shallot, 259 of garlic, 349 of other cultivated and wild *Allium* species. The Botanical Gardens in Poland located in Kraków, Lublin, Wroclaw, Poznan, Warszawa, Warszawa-Powsin, Bolestraszyce also maintain collections of *Allium* species originating from Poland and abroad (total of 209 accessions representing 190 *Allium* species).

Portugal

A report was sent by R. Farias on the activities of the Banco Português de Germoplasma Vegetal (BPGV) for *Allium*: collecting missions of *Allium cepa* L. and *Allium* spp. (total of 378 accessions collected); a survey and collecting of wild *Allium* spp. were made in the Alentejo region in 1997; characterization and preliminary evaluation of some accessions of vegetatively propagated garlics - *A. ampeloprasum* L. (12), *A. sativum* L. (192) and *A. schoenoprasum* L. (1) (started in 1994); morphological characterization and preliminary evaluation of *A. cepa (*in 1997). Isozyme characterization of *A. sativum* was also started at the Minho University, Braga.

Romania

I. Scurtu sent information about the *Allium cepa* L. collection held at the Research Institute for Vegetable and Flower Growing (RIVFG), Vidra-Ilfov, consisting of 126 accessions including male sterile lines, maintainer lines for sterility, inbred lines, hybrids, Romanian and foreign varieties, and listed the other *Allium* species in the collection.

Russia

V. Perezhogina informed that the *Allium* collection held at VIR, St Petersburg, comprises 2035 accessions from 58 countries, including 982 accessions of common onion (*Allium cepa* L.), 398 accessions of leek (*A. porrum* L.), 325 of garlic (*A. sativum* L.) and 330 of perennial species. The collection is preserved in the National Seed Store at the Kuban Experiment Station, Krasnodar Region, and in refrigerators at the Institute in St. Petersburg. Regeneration is performed at the experimental stations of VIR. New germplasm materials received by VIR undergo quarantine testing at specialized quarantine nurseries. The *Allium* collection, which includes the whole intraspecific diversity of *Allium cepa*, is screened under different climatic conditions to identify useful traits, such as disease and pest resistance.

F.R. Yugoslavia

B. Lazic sent information on the national collection which contains 29 accessions of *Allium cepa* L., 46 of *A. sativum* L. and 6 of *A. porrum* L. Active collections are held at the Institute of Field and Vegetable Crops in Novi Sad, the Center for Vegetable Crops in Smederevska Palanka, and the Faculty of Agriculture in Pristina. Endangered old varieties have been collected in Kosovo and Metohija. In addition, the following activities have been conducted at the Institute of Field and Vegetable Crops in Novi Sad: collecting, characterization and partial evaluation of *A. sativum*; evaluation of garlic ecotypes for protein composition; collecting, characterization and evaluation of several wild *Allium* species from the Vojvodina Province.

Regeneration activities

Dave Astley outlined the objectives for regeneration from the 1995 report to direct the priorities for the regeneration of seed-propagated accessions within national programmes by using the EADB. This has not been successful owing to the delay in the development of the EADB, and because no data were received indicating the need for regeneration (NEED_REG) from national programmes.

> *The Group agreed that attempts to coordinate and prioritize regeneration centrally was not pragmatic. The priorities for regeneration within national programmes must be for material originating within their national boundaries. Where there is an interest in regenerating other material, the onus to check the availability of such accessions in the country of origin lies with individual genebanks. This can be done through the EADB or preferably by direct contact with national programmes. Such practices will minimize the duplication of effort in regeneration activities. The Group also recognized the benefit of bilateral links, which often provide the opportunity for the repatriation of germplasm back to the country of origin.*

The discussion on the priorities for regeneration highlighted the common problem of the seed production in wild taxa; all participants reported such difficulties. It was noted that many genebanks maintain the same accession of a wild taxon, such as *Allium roylei* Stearn.

> *The Group agreed that upon receipt of the EADB, individuals should assess their accessions of wild taxa for uniqueness in relation to other accessions in other collections and attempt to identify duplicates. The concept of "most original collection" as used in the European* Brassica *Database (Bras-EDB) would be a useful tool to apply in an attempt to provide a recognized source for each accession of a wild taxon.*

In the 1995 report the Group considered the taxa of the Section *Allium* as having a high priority for regeneration. Although this is certainly still true, the Group recognized that the increasing interest in the use of *Allium* taxa for decorative and medicinal purposes makes the choice of priority within, or even between, Sections increasingly difficult.

Individuals commented on the current institute / national policy for regeneration:

- IPK: decisions are made on the basis of the whole collection, based on the viability and seed quantity of each accession
- NGB: has the responsibility for Nordic material and works with a regeneration standard of 60%
- Greece: priority for national material and has particular problems with wild taxa
- Hungary: priority for national material
- Bulgaria: priority for national material
- Russia: material is stored under long-term conditions in Kuban and is monitored for seed quality and quantity with accessions transferred to VIR for regeneration.

Additional detailed information was received after the meeting on pollination systems used at IPK (J. Heller) and RIVC Skiernewice (T. Kotlińska). These papers are included in Part II, pages 65 and 66, respectively.

Safety-duplication

D. Astley introduced the subject of the importance of safety-duplicating the *Allium* collections and reminded the Group that this activity was originally recommended by the Technical Consultative Committee (now Steering Committee) of ECP/GR during its fifth meeting in Bulgaria (August 1993). He informed that duplication of seed *Allium* accessions is regularly made between HRI and CGN, with about 70% of HRI accessions safety-duplicated at CGN and about 85% of CGN accessions safety-duplicated at HRI. Seed accessions are occasionally safety-duplicated within the *Allium* Working Group, but this was always done as an informal exchange between genebanks (e.g. 40 accessions of *Allium* spp. were sent for safety-duplication from IPGR, Sadovo to CGN, Wageningen). Portuguese garlic was also safety-duplicated at the European field collection of Olomouc and Polish and Czech garlics were sent at IPK, Gatersleben for this same purpose. At present IPK is maintaining safety-duplicates of vegetatively propagated material (mainly garlic and shallot) for the genebanks at Olomouc (108 accessions), Cordoba (25 accessions) and Skierniewice (21 accessions). The safety-duplication of vegetatively propagated material is much more labour-consuming than the seed duplication and it has clearly different features (especially the need of annual reproduction of the material). However, a clear picture of which vegetative and seed material still needs to be safety-duplicated is not available.

L. Maggioni made a few comments about the concept of safety-duplication. He reminded the Group that the duplication of accessions for safety reasons should be considered essential both for sound long-term conservation and to facilitate the rationalization of many collections. He explained that the "safety" of the duplicates does not simply require the duplication of the accessions in a second long-term conditions storage. The formalization of the safety-duplication in a bilaterally signed agreement is an important additional trait of safety. A Memorandum of Understanding between the Nordic Gene Bank and the Institute of Biology of Latvia was shown as a practical example. The agreement is intended for the safety-duplication in the Nordic Gene Bank (NGB) of seed material of agricultural and horticultural crops originating in Latvia. Here the concept of safety-duplication as a 'black box' arrangement is formalized. This implies that the material to be safety-duplicated remains the property of the originating institute, which also maintains the responsibility for all seed-management activities. The safety-duplicate is deposited in the hosting institute, together with the respective accession data, but it is not intended for use or distribution without consent. The official nature of this kind of agreement is considered beneficial to secure the long-term continuation of the safety collaboration. This can also be perceived as a guarantee that, in a regional context, the responsibility for the maintenance of specific accessions of national origin is accepted and secured, ideally also for the benefit of third parties. The document can also be useful when presenting the activities undertaken by the genebanks to administrators and the public in general. L. Maggioni stressed the importance of placing the safety-duplicate preferentially in a different country, as an additional measure to safeguard against natural or human-caused disasters, unfortunately recurrent in the European history.

The Group endorsed the concept of safety-duplication by 'black box' arrangement[10] as the most satisfactory and cost-effective procedure. The importance of the formalization of

[10] The "black box" arrangement implies that the seed and related data will not be used or distributed, but simply stored for safety reasons.

safety-duplication bilateral agreements was also acknowledged by the Group and, in the case of seed samples, the genebanks were invited to undertake formal bilateral agreements, following a model similar to the Nordic Countries-Latvia example (a copy of this document, reproduced in Appendix III, was distributed to all the participants).

The Group acknowledged that the safety-duplication of vegetatively propagated material would also benefit from the establishment of formal agreements. However, the specific nature of this living material will require the development of a suitable model of agreement. The issue of the safe movement of phytosanitary controlled material and the definition of long-term safety storage of the accessions should be addressed. The possibility that cryopreservation becomes in the future an effective method for the safety-duplication of vegetatively propagated material should also be considered, although at the moment the technique requires development.

The Group was informed that a model of agreement is being prepared in the ECP/GR Malus/Pyrus *Working Group. Considering that this document should address similar problems, the Group is looking forward to seeing the draft and using it as a basis for revision and final adoption in the Group's context.*

The Group also stressed the importance of each national programme giving support to the existing national collection of vegetative material, on the basis of its specific interests, priorities and internationally agreed responsibilities. Efforts should then be made for the safety-duplications, in collaboration with another ECP/GR member country.

The genebanks of RIVC, Poland (–18°C); HRI, UK (–20°C); CGN, The Netherlands (-20°C); IPK, Germany (–15°C) and the Nordic Gene Bank (–5°C) offered to host safety-duplicates of seed accessions under bilateral agreements.

The Group stressed the need to support the broad application of already developed molecular markers, to characterize the collections, find duplicates and rationalize the collections.

Research activities related to *Allium* genetic resources

FAIR project

J. Keller reported on the EU FAIR Project CT95-465 "Tailoring the onion crop for the 21st century" which was started in March 1996. It is a complex research project planned for 5 years, aiming at using a broad genetic background and modern methods to improve onion breeding material. The participants are CPRO-DLO (The Netherlands) as the coordinator; HRI Wellesbourne (UK); IPK Gatersleben (Germany); COOPd'OR-INRA Dijon (France); Institut Supérieur d'Agriculture de Beauvais (ISAB) (France); University F. Rabelais, Tours (France); University Paris XI, UFR Pharmacie, Châtenay-Malabry (France), and University of Patras (Greece). The main tasks consist of:

- building a working collection of 100 accessions using material of all participating genebanks which differs in dry matter contents, flavour components and other characters
- establishing a genetic linkage map of onion using specific crosses, including several methods as analyses of chromosome addition lines, DNA microsatellites, etc.
- research on carbohydrate metabolism to improve the insight into the formation process of the main storage compounds (fructans) and to develop *in vitro* methods for storage of genotypes of special putative interest
- analysis of flavour components, pyruvate contents etc.
- developing analysis methods usable for onion processing.

The part of IPK was explained in detail. The development of microsatellite markers on a specific test cross resulted in the design of 17 usable primers which have been tested on 19 accessions of onion and shallot, giving a good basis for the further development of this subject. A test subset for carbohydrate studies has been created together with the partner in Dijon comparing long day vs. short day and high vs. low dry matter content forms. The clones have been micropropagated. A first long-term storage experiment on the influence of light and sucrose on storability of *in vitro* bulblets was started and morphological and biochemical analyses are currently running on the bulblet formation, energy metabolism and fructan contents on *in vitro* bulblets.

Decorative Allium *species of commercial interest*

H. Rabinowitch reported about the increased awareness, in recent years, of the potential decorative value of some *Allium* species, especially among those belonging to the *Melanocrommyum* subgenus. Rina Kamenetsky, from the Department of Floriculture of The Volcani Center, Israel, started in 1991 a collection of wild *Allium* species with the aim of studying floral induction and florogenesis mainly (but not exclusively) within the above taxon. This work is supported for 3 years by a Dutch-Israeli Binational fund and is carried out together with scientists from CPRO-DLO in Wageningen, The Netherlands. In addition, R. Kamenetsky evaluates the potential of the plants preserved in her collection as ornamental crops. The collection of about 200 entries is maintained in Bet Dagan (coastal plain), in a shaded screen-house, and so far has not been supported by public funds.

The Group acknowledges the importance of this collection and would like to have it as a complementary part of the ECP/GR field collection.

Recent or future collecting activities

Country representatives reported about the collecting activities planned by their respective institutes in the next 3 years.

Belgium

A survey of the remaining landraces of leek will be undertaken (December 1997 - March 1998).

Bulgaria

Collecting of wild species in the Bulgarian mountains and joint collecting missions in Greece and Turkey are planned in the next 2 years.

Greece

An expedition to Cyprus for collecting of *Allium* is planned in the near future in collaboration with the Agricultural Research Institute, Nicosia.

Israel

In the next 2 years it is planned to continue collecting of onion landraces and of other *Allium* spp. in Kazakstan.

Nordic Countries

Collecting of the few remaining shallot landraces and of *A. schoenoprasum* will be undertaken.

Poland

The exploration of the country will be extended to mainly the northern and eastern parts, with the purpose of collecting onion, garlic and shallot landraces. Collecting expeditions to Ukraine and Slovakia may also be planned.

Portugal

Expeditions for the collecting of *A. cepa* and *A. sativum* will continue.

Russia

After the expedition of the present year to the Altai mountains, future collecting will depend on the funds available, although collections from the northern part of Russia may be expected.

United Kingdom

Further collecting of *A. ampeloprasum* accessions by Worcester College will take place, although this activity is expected to come to an end.

Scientific presentations

This section briefly highlights the reports of participants. Full papers are given in Part II, Research Activities.

Leek breeding for thrips tolerance/resistance

R. Theiler reported on the breeding work carried out since 1992 at the Swiss Federal Research Station, focused on the investigation of leek resistance to thrips (*Thrips tabaci*), including their own, open-pollinated cultivar ZEFA Plus, as well as other commercially available varieties and different *Allium* species (*A. ampeloprasum* L., *A. commutatum*, *A. tuberosum* Rottl., *A. scorodoprasum* L. and others). From highly infested field trials, individual plants which were slightly (tolerant) or severely (highly susceptible) attacked by thrips were selected and self-pollinated to obtain inbreeding lines. In addition, bulbils were induced on the same plants for clonal propagation. Generative and vegetative progenies were grown and tested in the field again to confirm their tolerance or susceptibility. Those plants which were significantly less susceptible than the control plants were selected for further breeding.

Research activities at IPK

J. Keller gave an overview of the research activities in the genebank and taxonomy departments of IPK: hybrid analyses (the 'grey shallot', top onion, ornamental hybrids in subgenus *Melanocrommyum*), production and analysis of artificial hybrids of *A. cepa* with 17 wild species of subgenera *Rhizirideum* and *Allium*, molecular analysis in garlic by isozymes and RAPDs, seed storability records in onion and germination studies in 100 species of the genus *Allium*, studies on virus infection of the garlic collection and meristem culture for virus elimination. Furthermore, a broad spectrum of molecular analyses on the phylogenetic relationships within the genus *Allium* has been performed in the taxonomy department.

Research activity of the Allium *group of CPRO-DLO*

I. Boukema indicated that at CPRO-DLO, The Netherlands, a group of nine researchers is working on three main themes: genome organization, quality and resistance.

- The theme genome organization consists of several projects: a) development of an *Allium* AFLP molecular marker map based on the interspecific cross *A. cepa* x *A. roylei*, b) study of the genome organization of the bridge cross between onion and the hybrid *A. fistulosum* x *A. roylei* with GISH, c) genetic transformation of *Allium*, and d) the introduction of CMS in leek.
- The theme quality is carried out in an EU project analyzing the carbohydrate and sulphur pathways in onion in order to develop onions with added values.
- The resistance project includes projects together with Indonesia to develop shallots resistant to anthracnose and purple blotch and the introduction of beet army worm resistance into tropical onions and shallots using *Bt* constructs. In a project together with Israel, sources of resistance to *Sclerotium* species are being identified in ornamental *Allium*. A project on resistance to white tip disease in leek has been completed successfully. In the EU *Allium* GEN RES project, leek and wild relatives will be screened in field tests for resistance to white tip, rust and thrips.

*Protecting future European Community crops (*Allium *GEN RES 20)*

Kaj Henriksen presented preliminary results of the evaluation of 24 accessions of bulb onions for agronomic and other characters, according to the IPGRI Descriptor list and to UPOV guidelines, focusing especially on resistance to downy mildew (*Peronospora destructor*).

Biodiversity, distribution and preservation of Allium *spp. in Bulgaria*

Ilija Ceschmedziev highlighted the great diversity of the genus *Allium* in Bulgaria, represented by 44 species , 39 wild and five cultivated. Data on the florogenetic structure and ploidy levels of the wild species are presented. Some could be used as ornamentals. Cultivated onion species were also included in the investigations. *Allium proliferum* (Moench) Schrader and *A. cepa* var. *aggregatum* G.Don f. were reported for the country. The horizontal and vertical distribution of [wild] species is rather irregular. Some species not yet listed should be considered as rare / endangered, e.g. *A. nanum* (Asch. & Gr.) Ceschm., *A. thracicum* Halacsy & Gheorghieff, etc. The status of threatened populations should be evaluated and measures for their preservation urgently undertaken.

*Evaluation and use of the existing genetic resources of onion (*Allium cepa *L.)*

P. Suvandjieva presented the results of the evaluation of 116 samples originating from the whole world and tested under the conditions of the Experimental Station for Vegetable Crops, Gorna Oryahovitsa, Bulgaria. The following characters were evaluated: vegetation length, form, shape and colour of the bulb, productivity, dry matter and sugar content, resistance to *Peronospora*, and storage qualities.

Results of onion breeding and introduction in Bulgaria

Y. Todorov gave an overview of the history of onion breeding in Bulgaria, starting with the study of local forms and introduction of foreign varieties, and following with the description of the breeding methods used to obtain new varieties (individual selection; inbreeding; intervarietal hybridization – using foreign varieties which gave unsatisfactory results in direct introduction; heterosis). Research work is carried out for the use of cytoplasmic male sterility in hybrid seed production.

Quality of Bulgarian onion varieties

Y. Todorov also provided a detailed description of the Bulgarian varieties: 'Liyaskovski 58', 'Konkurent', 'Trimontsium', 'Plovdivski 10', 'Pioner', 'Jubilee 50', 'Asenovgradska 5', 'Ispanski 482', 'Plovdivski red', 'Liyaskovski 90', 'Uspeh 6 F1', including data on the planting method, vegetation period and bulb characteristics (weight, index, vegetation buds, dry matter content).

Conclusion

The draft report was presented to the Group and adopted with some modifications.

Dave Astley was elected to chair the Group until the end of next meeting, which would be scheduled pending the decisions of the Steering Committee meeting on a future Phase of ECP/GR.

The Working Group identified their priority action for the future as:

- the assessment of safety-duplicates already in long-term stores and the nature of the agreements between participants
- the transfer of additional material to safety-duplicate stores
- an assessment of the volume and nature of characterization data held by institutes (paper/computer database)
- a review of the wild taxa in collections
- an assessment of the *in situ* distribution of taxa in Section *Allium.*

The Bulgarian hosts were thanked by the Group for their very warm hospitality and for the very successful organization of the meeting.

Part II. Presented Papers

Current status of the European *Allium* Database (EADB)

Dave Astley

Genetic Resources Unit, Horticulture Research International, Wellesbourne, Warwick, UK

Number of accession data from donor institutes for EADB 97

BGRGORNA	203	EADB	GBRHRIGRU	1326	EADB
BGRIIPR	157	EADB	ISRVOLCANI	168	EADB
BGRPLOVDIV	99	EADB	ISRREHOVOT	606	EADB
CHERAC	33	EADB	NLDCGN	242	EADB
DEUGAT	2645	EADB	POLSKV	854	EADB
DEUBGRC	76	EADB	PRTBPGV	342	paper
ESPDGAZARA	96	EADB	PRTEAN	7	paper
ESPDGIFA	237	EADB	REGNGB	59	EADB
ESPPOLVAL	227	EADB	SVKNZAMKY	51	EADB
FINHELSIGU	99	EADB	**Total accessions**	**7527**	

Donor institute acronyms in the ECP/GR A*llium* database 97

BGRGORNA	Experimental Station for Vegetable Crops, Gorna Oryahovitsa, Bulgaria
BGRIIPR	Institute of Introduction and Plant Resources, 4122 Sadovo, Bulgaria
BGRPLOVDIV	Institute of Vegetable Crops 'Maritsa', 32 Brezovsko Shosse, 4003 Plovdiv, Bulgaria
CHERAC	Station Fédérale de Recherches Agronomique de Changins, 1260 Nyon, Switzerland
DEUGAT	Institut für Pflanzengenetik und Kulturpflanzenforschung, Correnstrasse 3, 06466 Gatersleben, Germany
DEUBGRC	Braunschweig Plant Genetic Resources Centre, Federal Centre for Breeding Research on Cultivated Plants, Bundesallee 50, 38116 Braunschweig, Germany
ESPDGIFA	Centro de Investigación y Desarrollo Agrario, C.I.F.A. Alameda del Obispo, Apartado 4240, 14080 Córdoba, Spain
ESPDGAZARA	Agricultural Research Service, Horticulture Department, Zaragoza, Spain
ESPPOLVAL	Departamento de Biotecnologia, Universidad Politécnica de Valencia, Camino de Vera 14, 46022 Valencia, Spain
FINHELSIGU	Department of Plant Breeding, University of Helsinki, 00170 Helsinki, Finland
GBRHRIGRU	Genetic Resources Unit, Horticulture Research International, Wellesbourne, Warwick CV35 9EF, Great Britain
ISRVOLCANI	Volcani Centre, 50250 Bet Dagan, Israel
ISRREHOVOT	The Hebrew University of Jerusalem, Faculty of Agriculture, Rehovot 76 100, Israel
NLDCGN	Centre for Genetic Resources, CPRO/DLO, PO Box 16, 6700 AA Wageningen, The Netherlands
POLSKV	Plant Genetic Resources Lab., Research Institute of Vegetable Crops, 96100 Skierniewice, Poland
PRTBPGV	Banco Português de Germoplasma Vegetal - DRAEDM, Braga, Portugal
PRTEAN	Estaçao Agronomica Nacional, 2780 Oeiras, Portugal
REGNGB	Nordic Gene Bank, 230 53 Alnarp, Sweden
SVKRIV	Research Institute for Vegetables, Andovská 6, 94001 Nové Zámky, Slovakia

Fields for use in the European *Allium* Database

Comparison between the FAO/IPGRI *Multicrop Passport Descriptor List* and the old European *Allium* Database passport list. As a result of the present meeting, a new *Allium* Passport Descriptor List based on the above FAO/IPGRI list has been adopted for the EADB (see Appendix II).

Multicrop Passport	old EADB equivalent
	ECNO
1. INSTCODE	BANK_CODE
2. ACCENUMB	ACC_NO
3. COLLNUMB	COLL_NO
4. GENUS	
5. SPECIES	SPECIES
6. SUBTAXA	SUBSPEC/BOT_VAR/CULT_GP
7. ACCNAME	CULT_NAME
8. ORIGCTY	COUNTRY
9. COLLSITE	PROV_STATE/LOCATION
10. LATITUDE	LATITUDE
11. LONGITUDE	LONGITUDE
12. ELEVATION	
13. COLLDATE (YYYYMMDD)	YR_COLL
14. SAMPSTAT	STATUS
1 wild	1 wild
2 weedy	2 weedy
3 trad. cultivar/landrace	3 breeders line
4 breeder's line	4 old cultivar
5 advanced cultivar	5 advanced cultivar
	6 landrace
0 unknown	
99 other (remarks)	7 other (please specify)
15. COLLSRC	
16. DONORCODE	DONOR
17. DONORNUMB	DONOR_NO
18. OTHERNUMB	OTHER_NO_1/OTHER_NO_2
19. REMARKS	
	STAT_OTHER
	DAYL_REQ
	1 short (0-32°N or S)
	2 medium (33-39°N or S)
	3 long (> 40°N or S)
	COMMON_NAM
	NO_REGENS
	AVAILABIL
	COLL_INST

The EADB Web site

The ECP/GR *Allium* Database

Genetic Resources Unit, Horticulture Research International, Wellesbourne, Warwick CV35 9EF United Kingdom
Tel: +44-1789 472023 Fax: +44-1789 472023

Database manager: Dave Astley

The *Allium* database was established at Wellesbourne, U.K., following the first meeting of the ECP/GR *Allium* Working Group in Tápiószele, Hungary in 1984. The database was rebuilt in 1996 and is maintained by the Horticulture Research International, Genetic Resources Unit (HRIGRU), funded by the Ministry of Agriculture, Fisheries and Food. Today the database contains 8273 accessions representing the 5 major *Allium* crops and a wide range of the wild taxa from 19 institutions in 12 countries and the Nordic Gene Bank. The development of the new database has been supported partly by the EU GenRes Allium project. The data are stored in ACCESS using the IPGRI/FAO Multicrop Passport Descriptors.

Database access		Further information
On-line - search		Contributors
Off-line - download	MS Access Version	Database description
	MS Excel V5 Version	
Off-line - hardcopy - disk or paper		

Page last updated by Philip Parker 30th September 1998.

<http://www.hri.ac.uk/research/wellesb/ecpgr/ecpgr.htm>

Morphological studies in garlic to support the discussion of a reformulation of the ECP/GR Minimum Descriptor List

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Introduction

In the framework of the running GEN RES project, the Gatersleben group concentrated particularly on the use of the existing minimum descriptors for garlic.[11] An attempt has been made to correlate this with the groups derived by the Gatersleben taxonomists by using isozyme and RAPD markers (Maass and Klaas 1995).

Materials and methods

A core collection of 51 accessions was selected from the 485 accessions of garlic recently present in the Gatersleben collection (Table 1). The plants were planted in rows and characterized after splitting the accessions into 2-6 subclones. Cloves were planted on 21 August 1996 and harvested 18-25 August 1997. During the cultivation phase, the sprouting behaviour and finally, the following characters were recorded: (1) number of cloves per compound bulb, (2) bulb structure (the intention was to count the number of whorls) and bulb shape regularity, (3) bulbil weight, (4) pseudostem height, (5) pseudostem diameter, (6) leaf erectness, (7) ability to produce scape.

Results and discussion

Number of cloves

The number of cloves varied between 2 and 27 in single plants; for averages of each clone see Table 1. It is a rather stable parameter. In some accessions this number was constant, especially in accessions with lower clove numbers. Groups could be found which, in several cases, clearly correlated with our isozyme/RAPD groups. Groups 1 and 4 posses lower clove numbers, group 3 was in the middle whereas group 2 had rather various, sometimes very high numbers (accession All 116 was the highest with 23 cloves per bulb on average). We characterized the accessions with five scores according to the minimum descriptor list of the ECP/GR database. However, in group 2, two clearly distinct subgroups were found correlating with the accessions: this was obvious within the clones but also between the isozyme/RAPD groups; in the group with lower numbers were 1b, 1c, 4b, 4e, 4d; in the other group 1a, 1d, 4a, 4c. We conclude that score 2 should be split into two scores, thus increasing the number of scores from 5 to 6. In Table 1, the scores assigned using the old (CO) and the proposed new (CP) scoring systems are compared.

[11] See:
- Appendix IV. Pp. 18-26 *in* Report of the Fourth Meeting of the ECP/GR *Allium* Working Group. European Cooperative Programme for Crop Genetic Resources Networks (IBPGR). 1992. International Board for Plant Genetic Resources, Rome.
- p. 6 *in* Report of a Working Group on *Allium*. Fifth meeting, 25-27 May 1995, Skiernewice, Poland (T. Gass, D. Astley, H.D. Rabinowitch and E.A. Frison, compilers). 1996. International Plant Genetic Resources Institute, Rome, Italy.

Table 1. Survey on the GEN RES 20 characterization core subset of the Gatersleben Genebank in the cycle 1996/97

Access. no.	Origin	IR†	CN	CO	CP	ST	BW	PH	PD	LE	AS
All 142	Bulgaria	1a	5.6	2	3	3	21.2	22.0	8.5	5	5
All 766	Georgia	1a	7.5	2	3	2	34.2	27.4	12.8	5	5
All 771	Georgia	1a	6.6	2	3	2	31.4	26.5	10.9	5	5
TAX 1337	Tajikstan	1b	3.0	2	2	3-4	60.6	23.4	8.7	5	5
All 1163	Tajikstan	1b	3.9	2	2	4	36.1	22.2	9.4	5	5
All 1174	Uzbekistan	1b	3.8	2	2	4	42.0	21.8	11.9	5	5
All 264	Germany	1c	4.1	2	3	4	37.4	33.0	11.5	3,5	5
All 684	Belarus	1c	3.9	2	2	(3)-4	34.9	34.3	12.3	3,5	5
All 1166	BG Hungary	1c	3.7	2	2	4	28.9	26.1	8.9	5-6	5
TAX 3213	Kyrgyzstan	1c	3.8	2	2	3-4	16.8	18.9	6.4	5	5
All 1161	BG Moscow	1d	5.3	2	3	3-4	26.3	30.4	12.3	6	5
All 116	China	2a	23.2	5	6	1	17.2	21.3	9.0	5	1(5)*
All 775	Georgia	2a	8.0	2	3	2	39.4	22.0	11.5	5	5
All 822	China	2a	3.9	2	2	3-4	84.8	21.2	6.8	5	5
All 685	Germany	2b	15.8	4	5	6	0.0	21.3	8.3	5	0
All 894	USA	2b	6.7	2	3	2-6	24.0	12.9	6.6	6-7	5
All 816	Romania	2b	8.9	2	3	6	18.4	17.1	5.8	5	1(5)*
All 893	USA	2b	5.6	2	3	3	32.9	20.6	13.8	5	5
All 781	Georgia	2c	15.1	3	4	6	530.0	22.0	10.2	5-6	1-2
All 846	Georgia	2c	7.7	2	3	6	1163.9	20.3	12.5	6-7	1-2
All 1254	USA	2c	7.1	2	3	6	401.4	22.7	10.0	6-7	1-2
TAX 1808	USA	2c	8.7	2	3	6	0.0	23.0	11.2	7	1
All 778	Georgia	2d	5.0	2	3	3	343.3	14.2	8.7	5	1-2
All 111	Czech Rep.	3	6.4	2	3	2-3	154.7	15.5	7.2	5	5
All 290	Germany	3	6.2	2	3	2	411.6	24.7	10.7	5	5
All 292	Slovakia	3	5.0	2	3	3	609.5	19.9	9.3	3	5
All 499	Germany	3	6.7	2	3	2-3	372.9	24.3	10.3	5	5
All 506	Germany	3	6.9	2	3	2-4	432.5	24.8	10.7	5	5
All 508	Germany	3	5.8	2	3	3	1092.7	28.1	13.5	5	5
All 522	Germany	3	5.4	2	3	3	384.1	20.5	9.0	5	5
All 523	Germany	3	6.6	2	3	2-3	259.5	21.0	9.2	5	5
All 525	Poland	3	5.4	2	3	3	391.0	22.7	11.5	5	5
All 814	Romania	3	5.4	2	3	2-3	211.7	19.9	9.3	5	5
All 815	Romania	3	5.0	2	3	3	130.3	19.6	7.2	5	5
All 824	Georgia	3	5.0	2	3	2-4	208.0	26.6	11.8	6	5
All 843	Georgia	3	5.5	2	3	2-(4)	381.0	24.7	11.9	6	5
All 844	Georgia	3	5.4	2	3	3-4	404.2	26.0	12.6	5	5
All 852	Georgia	3	5.1	2	3	2-3	255.6	25.7	11.7	5	5
All 1165	BG Netherlands	4a	5.8	2	3	2-(4)	40.5	30.6	11.6	3	5
All 937 [P]	Korea	4b	2.5	2	2	2-5	604.2	24.1	9.6	5	3
All 908 [P]	Korea	4b	3.0	2	2	4-5	741.3	27.5	9.7	5-6	3
TAX 1125	Uzbekistan	4b	4.2	2	2	3-4	71.9	34.1	10.6	6	5
All 1162	Tajikstan	4b	3.7	2	2	3-4	39.7	28.2	11.2	5	5
All 890	USA	4c	4.8	2	3	3-(4)	63.5	28.3	9.4	5	5
All 1171	Kazakstan	4c	4.7	2	3	3-4	77.8	31.6	9.6	5	5
All 1252	BG Alma-Ata	4d	3.6	2	2	(3)-4	24.0	15.9	6.4	3	5
All 130	Kazakstan	4e	2.6	2	2	4-5	56.3	26.8	11.5	3,5	5
All 877	Kazakstan	4e	2.4	2	2	(4)-5	79.4	25.2	11.6	3	5
All 1177	Kazakstan	4e	2.4	2	2	4-5	56.1	21.0	9.2	3	5
All 232	BG Brussels	?	3.5	2	2	4	109.7	34.6	9.8	6-7	5
All 1175	USA	1c	3.7	2	2	4	36.2	32.4	11.5	6-7	5

† IR = isozyme/RAPD group; CN = clove numbers, CO = cloves score old; CP = cloves score proposed; ST = structure type; BW = bulbil weight (mg); PH = pseudostem height (cm); PD = pseudostem diameter (mm); LE = leaf erectness; AS = ability to produce scape (scores); P = *pekinense* type.

* Rare flowering in individuals that do not usually produce a scape.

Bulb structure ("Number of whorls") and bulb shape regularity

In attempting to count the whorls of the garlic bulbs, we found that the structure cannot be described well by "whorls", because the structure is developed from collateral axillar buds of different leaves. The more leaves take part in axillar bud formation, the more complex the structure. The final appearance of the clove arrangement is rather a system of "shells" than one of whorls. Whereas in bulbs with larger numbers of cloves, a certain variability was found within one accession concerning the number of shells, this character is rather stable in bulbs with lower numbers of cloves. This is true for bulbs with four or two cloves. We suggest the use of a picture table for characterization of the types as structure types (Fig. 1). For type I, we found that there may be some overlapping of the subsequent shells. Because we can assume that there are many transient cases with more or less overlapping, we did not conclude that they should be separated into different types. The descriptor "Bulb shape regularity" should be combined with "Number of whorls". Especially the southern short-day types, which very often do not form a flower stalk, show an irregular structure (type VI). This can be connected also with incomplete bolting and an inflorescence hidden in the bulb. We should consider that despite the relative stability of the structure, there are always some deviating bulbs in one accession owing to physiological disorder or damage of the meristem in early developmental stages. Therefore to characterize an accession, at least 10 bulbs should be compared. In cases of variability, we gave more than one score to the characterization as shown in Table 1. It might also be possible that the score which is present only in rare cases can be put into parentheses.

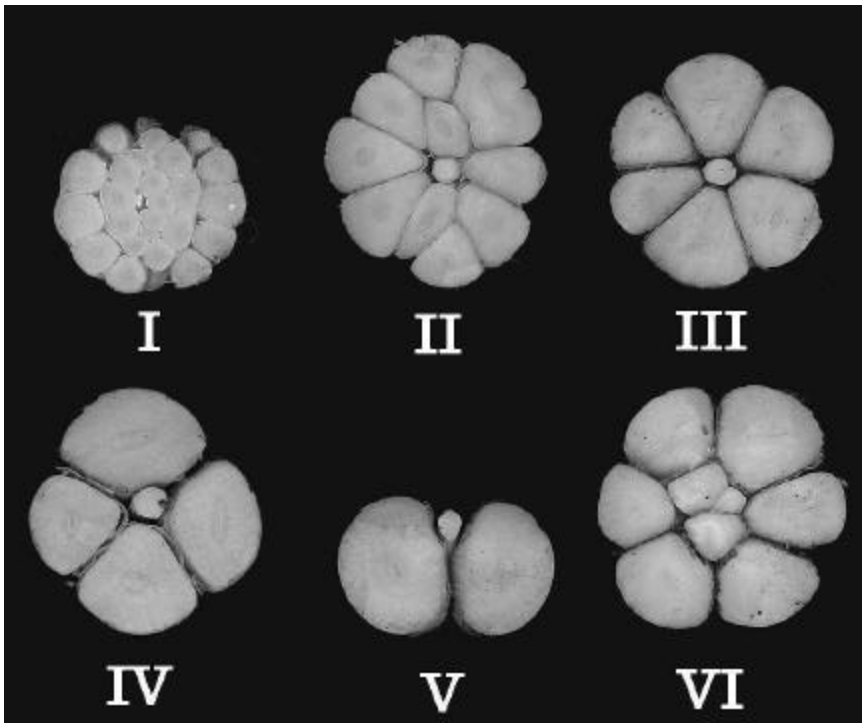

Fig. 1. Bulb structure types found in the garlic core subset 1996/97 of the Gatersleben gene-bank:
I - regular multi-shelled
II - regular two-shelled
III - regular multi-cloved radial
IV - regular quadruple
V - regular two-cloved
VI - irregular.

The weight of the bulbils

This parameter has been measured using 50 randomly selected bulbils after 14 days of dry storage of the ripe bulbils at ambient temperature. The differences between the bulbil weights are statistically highly significant and several groups can be distinguished. Thus, the isozyme/RAPD groups 1a, 2a,b, 4a, 4c-e possess small bulbils, groups 2c,d and 3 have large bulbils. Interestingly, in group 4b there are accessions with small and large bulbils. This corresponds to the distinctly different description of the accessions with large bulbils as *Allium sativum* var. *pekinense* by several authors. In Table 1, these accessions have been marked with [P]. Measuring the bulbil weight seems to be the quickest method to characterize the size of the bulbils. Examples of inflorescences with different bulbil sizes are given in Figure 2.

Fig. 2. Flower heads of some accessions. Upper row forms have small bulbils, lower row forms have large bulbils. Right, an example of incomplete bolting (Score 1 in "Ability to produce scape").

Pseudostem parameters

Heights and diameter of the pseudostem are parameters which are easy to measure. We used the distance between the soil surface and the uppermost lamina notch. The measurement of this distance has some advantages over the distance between bulb neck or bulb base, respectively, and the upper lamina notch because (1) it is not necessary to dig the plants out for characterization and (2) the part of the plant below soil surface is rather variable depending on the planting depth of the bulbs. We did not find any correlation of the pseudostem parameters with the isozyme/RAPD groups. Two groups exist, a weak one and a stronger one. Within these groups both "short and thick" and "tall and slender" types exist. The thicker types correspond to some extent to the types possessing additional bulbils between inflorescence and bulb (see parameter "Ability to produce scape").

Leaf erectness

The leaf erectness was scored as described in the minimum descriptor list. Very often, we found intermediate types. Consequently, we added the score "6" (semi-erect) as shown in Table 1.

Ability to produce scape

Studying the diversity of garlic in our core collection, we found that the structure of this descriptor is not consistent in its present form. Two different characters have been mixed: (1) the extent to which the inflorescence stalk is able to expand. It ranges from zero to maximal length. Additional bulbils may be formed between the top inflorescence and the bulb. (2) The flower head structure itself (flower bud formation, bulbil formation, numbers of these two organ types). Surely, there are some interrelationships between both sides of this parameter. However, they can unambiguously be separated from each other.

Further to this analysis and an intensive discussion with F. Mansilla Sousa (CIFA, Córdoba, Spain), we decided to accept his proposal for the parameter "Ability to produce scape" also for our accessions. Following his proposal, we suggest a new 5-score descriptor excluding the bulbil and flower bud formation which are dealt with in other descriptors:

0 Scape absent
1 Scape enclosed in the bulb but flower head visible outside
2 Scape shorter, equal to, or slightly longer than the pseudostem, bulbils in the inflorescence, additional bulbils between bulb and inflorescence
3 Scape shorter, equal to, or slightly longer than the pseudostem, bulbils in the inflorescence only
4 Scape clearly longer than the pseudostem, bulbils in the inflorescence, additional bulbils between bulb and inflorescence
5 Scape clearly longer than the pseudostem, bulbils in the inflorescence only.

Table 1 shows the characterization of the GEN RES 20 core subset using this descriptor. A footnote should be made to the types which usually do not develop a scape (scores 0 and 1). In several accessions, there are some individuals which form a scape; their score is given between parentheses in Table 1. This rare flowering might be caused by some physiological variation of daylength or cold requirement within the accession. In Table 1, this case has been marked by an asterisk. It has been found also by other garlic researchers.

Conclusions

An intensive study of the morphological characters in a core subset of garlic resulted in the conclusion that several descriptors of the ECP/GR minimum descriptor list have to be reviewed and reformulated after a detailed discussion among the garlic specialists. The descriptors should be changed as follows:

1. "Number of cloves": score 2 (2-10 cloves) should be divided into two scores.
2. "Number of whorls" and "Bulb shape regularity" should be combined and reformulated as "Bulb structure types".
3. "Weight of bulbils" is proposed as a new descriptor.
4. The pseudostem parameters "Height" and "Thickness" should be used.
5. "Leaf erectness" should be completed by an additional score 6 (semi-erect).
6. "Ability to produce scape" should be entirely reformulated using the proposal of F. Mansilla Sousa, Spain (1997, pers. comm.).

Reference

Maass, H. I. and M. Klaas. 1995. Intraspecific differentiation of garlic (*Allium sativum* L.) by isozyme and RAPD markers. Theor. Appl. Genet. 91:89-97.

The European field collection of long-day *Allium* species

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The germplasm collection of vegetatively propagated *Allium* species with long-day requirements has existed in Olomouc (Czech Republic) for nearly half a century. It was established in 1950 by F. Mareček with the introduction of some 60 Russian garlic landraces, and the collection continued its existence in the Vegetable Research Institute (VRI) under the guidance of J. Moravec for more than 30 years. There the distinguished Czech scientists Prof. Frimmel, Prof. Kabelík, Dr O. Konvička (Konvička 1955, 1973) and Dr F.J. Novak (Novak 1990) all used this germplasm collection as a source for their experimental models.

In 1986, the Olomouc collection joined the European network by sending data to the European *Allium* database. Since that time the collection has been functioning as the European field collection for long-day *Allium* spp., in a partnership with the European field collection for short-day *Allium* spp., which is maintained in Israel.

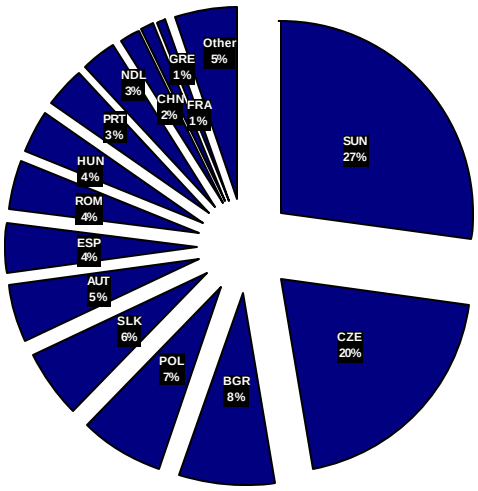
From 1986 to 1990 we increased the number of garlic accessions to nearly 300, participated in two international expedition missions (Central Asia 1988 and West Siberia 1990) (Kotlińska *et al.* 1990), and expanded the collection of another vegetatively propagated *Allium*, shallot.

The Vegetable Research Institute was abolished in 1990 as a consequence of radical economic transformations in our country, and the existence of our collection started to be uncertain. This difficult period (1990-93) ended after the vegetable germplasm collections of the former VRI were included in the Research Institute of Crop Production, Prague and continued in Olomouc as a separate station with close links to the Botany Department of Palacký University. The financial support received from IBPGR was very helpful, as well as the newly formulated governmental National Programme for Conservation of Crop Germplasm.

Unfortunately the unexpected extensive flooding affected our *Allium* collection this summer (1997). Further to this recent disaster we strongly feel the importance of safety-duplication measures for sustainable conservation of genetic resources.

Our **garlic** germplasm collection now contains 600 accessions (Fig. 1). An important part of our collection represents the old Czech garlic landraces, collected in the White Carpathia Mountains and South Moravia, as well as primitive and wild garlics from Central Asia and Siberia with various important properties such as pollen fertility and resistance to frost. In recent years we accepted responsibility for maintaining safety-duplicates of garlic collections from Portugal, Poland, Austria and recently from Bulgaria. We continue to maintain a specialized collection of virus-free garlic based on material from former VRI which needs to be multiplied in isolation cages. These accessions have been used for breeding three new garlic cultivars.

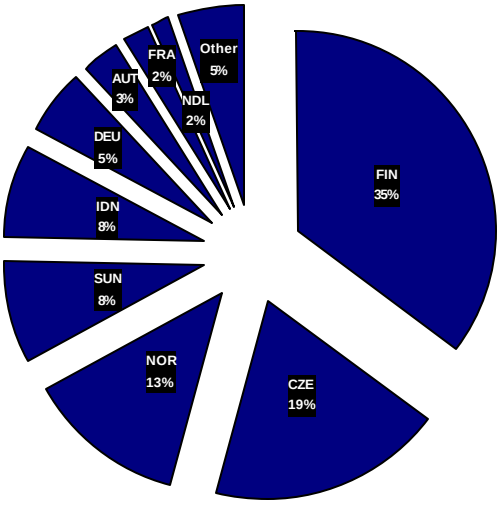
The germplasm collection of **shallot** was originally assembled and maintained by J. Moravec at the former Vegetable Research Institute in Olomouc and is currently under the responsibility of H. Stavělíková. The Gene Bank at Olomouc now contains 133 accessions (Fig. 2). A very interesting part is represented by shallot of Scandinavian origin (Norway, Finland) maintained as safety-duplicates for the Nordic Gene Bank. Czech landraces are also held there.



Garlic 1997/1998

Country	*No. access.*
SUN	163
CZE	121
BGR	48
POL	42
SLK	35
AUT	28
ESP	26
ROM	24
HUN	22
PRT	21
NDL	18
CHN	10
FRA	6
GRE	5
Other	32
Total	**601**

Fig. 1. *Allium* field collection, Olomouc – garlic, 1997/98.



Shallot 1997/1998

Country	*No. access.*
FIN	47
CZE	25
NOR	17
SUN	11
IDN	10
DEU	7
AUT	4
FRA	3
NDL	2
Other	7
Total	**133**

Fig. 2. *Allium* field collection, Olomouc – shallot, 1997/98.

Some shallots from Siberia belong to intermediate types between shallot and onion, connected with the great morphological diversity of bulb shapes, skin colour, plant habitus as well as reproduction behaviour.

Owing to the prevailing vegetative multiplication of shallot, virus contamination frequently leads to degeneration of shallot clones. Similarly to garlic, we maintain the virus-free state of a small part of shallot clones (10 accessions) under protective sheets .

An essential part of the work carried out on the shallot collection is the morphological and reproductive characterization of accessions. A specific descriptor list was first created on the basis of available lists (UPOV 1976; Astley *et al.* 1982).

Table 1. Characterization of the shallot collection in Olomouc

Descriptor	Descriptor state	Frequency in the collection (%)	Descriptor	Descriptor state	Frequency in the collection (%)
Foliage colour	light green	7.8	**Uniformity of shape**	irregular	22.6
	medium	75.6		uniform	77.4
	dark green	16.6			
Leaf waxiness	absent or		**Bulb skin colour**	white	1.7
	[redacted]			[redacted]	9.6
				[redacted]	26.1
	strong	20.0		brown	7.8
Leaf erectness	prostrate	3.4		dark brown	0.9
	medium	58.2		red	11.3
	erect	34.4		yellow to light brown	23.5
Height growth	low	18.3		reddish brown	19.1
	medium	52.2	**Average number of bulbs to cluster**	very low	6.3
	high	25.2		low	34.8
	very high	4.3		medium	44.6
Plant growth habit	weak	6.1		high	8.0
	medium	63.5		very high	6.3
	strong	27.8	**Retention of the common tunicate scales**	absent	53.9
	very strong	2.6		present	46.1
Shape of full grown bulbs	flat	0.9	**Ability to flower**	absent	8.7
	flat globe	18.3		present	91.3
	globe	12.2	**Widened flower stem**	absent	64.3
	high globe	1.7		present	35.7
	spindle	25.2			
	cylinder	4.3			
	rhombic	36.5			
	elliptic	0			

The evaluation includes 12 parameters: foliage colour, leaf erectness, presence of leaf wax, height growth, plant growth habit, shape of full grown bulbs, uniformity of bulb shape, bulb skin colour, average number of bulbs to cluster, retention of the common tunicate scales, ability to flower and widened flower stem. The results of 3-year observations are summarized in Table 1.

The collection of **wild *Allium* species** is a subject of collaboration with students and postgraduates of Palacký University. It contains 63 accessions of different long-day species with potential of apomictic strategy (some types of *A. angulosum* L.), both facultative or obligate vegetatively propagated species (*A. scorodoprasum* L., *A. carinatum* L., *A. oleraceum* L.) from our flora as well as from Central Asia and Siberia (*A. nutans* L., *A. altaicum* Pall.). We maintain an original collection of cytotypes of *A. schoenoprasum* L. subsp. *riparium* (Čelak.) Hayek with B-chromosomes, based on the work of Dr R. Fialová (Fialová 1995). In the last 2 years this collection has been subject to taxonomic redetermination in cooperation with specialists from IPK Gatersleben.

For the future of our working *Allium* field collection, which has now reached its maximum size limit, continued financial support and scientific interests are very important factors. More than new accessions, we now need new skilled people and new solutions for some old problems with long-term conservation, phytosanitary measures, plant tissue

cultures (Fellner and Havránek 1992, 1994; Havránek 1972), taxonomic determinations, evaluation of genetic diversity, etc. We highly appreciate the activity of the *Allium* Working Group as a proper step on this way.

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National collections

The status of Allium *collections in Belgium*

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This collection contains 55 non-edible, vegetatively propagated flowering *Allium* species (Table 1).

Table 1. *Allium* genetic resources at the Conservatoire Botanique de Ressources Génétiques de Wallonie, Belgium

Allium aflatunense B. Tedtach
Allium albopilosum Becker
Allium altaicum Pall
Allium atropurpurens Waldst
Allium baeticum Boiss
Allium bucharicum Regel
Allium carinatum L. subsp. *pulchellum* (Bonn et Lay)
Allium carolinianum D.C.
Allium cepa proleferum L.
Allium christophii Trauv.
Allium cilicium Boiss.
Allium cyaneum Regel
Allium cyatophorum Bur. et Franchet
Allium ebusitanum Sanchez
Allium ericetorum Corbeld
Allium gultschense B. Fedtsch
Allium hymenorrhizum Turkman
Allium iliense Regel
Allium insubricum Boiss. et Reuter
Allium kansuense Regel
Allium karataviense Regel
Allium ledebourianum Schult
Allium lusitanicum Lam.
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 paezoskianum Fuzs
Allium pskemense B. Fedtsch
Allium pulchellum Meyer
Allium ramosum L.
Allium roseum Favios
Allium rosenbachianum Reg.
Allium sativum ophioscorodon L.
Allium senescens L. subsp. *montanum* Fries
Allium sibiricum L.
Allium scorzonerifolium L.
Allium sphaerocephalon L.
Allium stipitatum Regel
Allium strictum Serach
Allium suaveolens Jaq.
Allium textile L.
Allium tricoccum Feldt
Allium triquetrum L.
Allium tuberosum Rottl.
Allium tuberosum odorum L.
Allium ursinum L.
Allium victorialis L.
Allium vineale L.
Allium yunnanense Diek
Allium zebdanense Boiss & Noë

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Allium ampeloprasum L. subsp. *ironicum* Wendelbo	NPB 19761065 / Source: Iran, Tehran, H.B.
Allium atroviolaceum Boiss.	NPB 19761066 / Source: Iran, Tehran, H.B.
Allium carinatum L.	NPB 19630640 / Source: Belgium, Gent, H.B.U.
Allium carinatum L. subsp. *pulchellum* (G.Don) Bonnier & Layens	NPB 19890384 / Source: Netherlands, Haarlem, M.H. Hoog Nursery, Origin: Romania, Transsylvania NPB 19891893 / Source: Italy, Pavia, H.B.U., Origin: Italy, Sasso Malascarpa
Allium carinatum L. subsp. *pulchellum* (G.Don) Bonnier & Layens 'Album'	NPB 19880147 / Source: Netherlands, Lisse, van Tubergen
Allium carolinianum DC.	NPB 19760298 / Origin: India, Garhwal, Dras
Allium cepa L. var. *viviparum* (Metzg.) Alef.	NPB 10000056 NPB 19691820 / Source: Italy, Torino, H.B.U.
Allium cernuum Roth	NPB 19831581 / Source: United Kingdom, Bristol, H.B.U. NPB 19862098 / Source: Belgium, Brussels, I.R.S.N.B - K.B.I.N.
Allium christophii Trautv.	NPB 19906142 / Source: Netherlands, M.H. Hoog Nursery
Allium cyathophorum Bureau & Franch.	NPB 19702388 / Source: Austria, Wien, H.B. Alp.
Allium fistulosum L.	NPR 19841897 / Source: Netherlands. Leiden, H.B.U.
Allium flavum L.	NPB 19880148 / Source: Netherlands, Lisse, van Tubergen
Allium karataviense Regel	NPB 19672745 / Source: Germany, Wurzburg, H.B.U.
Allium moly L.	NPB 19673286 / Source: Germany, Köln, H.B.
Allium oleraceum L.	NPB 10000057 NPB 19580258
Allium oreophyllum C.A.Mey.	NPB l 9890385 / Source: Netherlands, Haarlem, M.H. Hoog Nursery
Allium paradoxum (M.Bieb.) G.Don	NPB 19630341 / Source: Belgium, Gent, H.B.U.
Allium porrum L.	NPB 19580259
Allium ramosum L.	NPB 19682054 / Source: United Kingdom, Egham Hill, H.B.U. London
Allium sativum L.	NPB 10000058 NPB 19806083 / Source: Hungary, Budapest, H.B.U. Hungariae, Origin: Hungary
Allium schoenoprasum L.	NPB 10000059 NPR 19630343 / Source: Belgium, Gent, H.B.U.
Allium schoenoprasum L. var. *sibiricum* (L.) Hartm.	NPB 19580261
Allium schubertii Zucc.	NPB 19880554 / Source: Netherlands, Lisse, van Tubergen
Allium scorodoprasum L.	NPB 19841943 / Source: Hungary, Vacratot, H.B. Acad. Sc., Origin: Hungary, SE of Great Hungarian Plain
Allium senescens L.	NPB 19693827 / Source: Hungary, Budapest, H.B.U. Soroksariensis
Allium sphaerocephalon L.	NPB 19801799 / Source: France, Besançon, H.B.U. & H.B., Origin: France, Jura, Mont Poupet
Allium tuberosum Rottler ex Spreng.	NPB 19911172-79, Source: United Kingdom, Woking, H.B. Royal Hort. Soc. Wisley
Allium ursinum L.	NPR 19790117 / Origin: Belgium, Vlaams-Brabant, Meise
Allium victorialis L.	NPB 10000060 /
Allium vineale L.	NPB 19810424/ Origin: Belgium, Oost-Vlaanderen, Mariakerke
Allium zebdanense Boiss. & Noë	NPB 19906061 / Source: Netherlands, Lisse, van Tubergen

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Allium ascalonicum L.	*Allium fistulosum* L.
Allium ampeloprasum L.	*Allium sativum* L.
Allium ampeloprasum L var. *porrum* Gay	*Allium schoenoprasum* L.
Allium cepa L.	*Allium scorodoprasum* L.

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The collection contains about 150 varieties of leek (*Allium ampeloprasum* var. *porrum*). About 23 of them are Belgian landraces of leek. A survey of the remaining landraces has been undertaken (Dec. 97 - March 98).

Status of the Bulgarian Allium *National Collections*

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Three stages can be distinguished in the research carried out on *Allium* L. in Bulgaria: floristic up to 1925, taxonomic up to 1964 and biosystematic since 1965 (Ceschmedziev 1989). The genus *Allium* in Bulgaria includes 39 wild species and five cultivated species.

Allium collections in Bulgaria (see also Table 1).

- At the **Institute for Plant Genetic Resources**, Sadovo, the *Allium* collection consists of 258 accessions, including 122 *Allium cepa* L., 12 *A. porrum* L., 94 wild species and 30 local wild and cultivated forms. The largest part of the collection (186 samples) was received from Germany and the United Kingdom.

- The **Institute of Vegetable Crops "Maritsa"**, Plovdiv, holds a collection of 315 breeding material of *A. cepa* with the following distinctive traits: high dry matter content (113 lines), cytoplasmic male sterile forms (64), lines with white skin colour (35), level lines from direct cultivars (37) and F_1 materials (66). Fifty-three accessions were introduced from HRI, Wellesbourne, UK. The Institute also maintains 15 local varieties and 140 accessions of *A. sativum* L. (80 local and 41 breeding material), mostly of subsp. *vulgare* and for a small part subsp. *sagittatum*, winter and summer forms (vegetative propagation in the field). For safety-duplication reasons 88 accessions of garlic were sent to the Olomouc Gene Bank.

- At the **Experimental Station for Vegetable Crops**, Gorna Oryahovitsa, the collection of *Allium cepa* contains 285 accessions including 230 breeding lines, mostly for annual growing, and 55 introduced and local accessions with long-day, short- and semi-short day requirements. There are also 203 forms of *A. sativum*, mostly subsp. *vulgare* (180 local).

- The **High Agriculture Institute**, Plovdiv maintains *ex situ* 15 wild species.

In IPGR most accessions (240) were evaluated (Neykov 1988; Neykov *et al.* 1992) for morphological, biological and economical characters.

At ESVC (Suvandjieva and Suvadjiev 1995) and IVC (Todorov 1985; Manuelyan *et al.* 1995) collections were evaluated with limited characterization data.

For seed multiplication, 195 samples have been regenerated and 115 are kept in storage at the IPGR, Sadovo Genebank.

Table 1. *Allium* collections in Bulgaria

Species	Collected	Landraces	Wild	Breeding material	Stored	Regen-erated	Safety-duplicated
IPGR, Sadovo							
Allium spp.	258	30	94	–	115	195	32
IVC, "Maritsa" Plovdiv							
A. cepa L.	383	15	–	315	–	383	–
A. sativum L.	140	80	–	41	field	field	88
ESVC, Gorna Oryahovitsa							
A. cepa	285	3	–	230	–	285	–
A. fistulosum L.	8	–	–	–	–	8	–
A. sativum L.	203	184	–	–	field	field	–
High Agricultural Institute, Plovdiv							
Allium spp.	15	–	15	–	*ex situ*	15	–

Future activities

- Collecting, evaluation of the whole collection and multiplication of some accessions.
- Regeneration of accessions with low germination (1998-99).
- Send safety-duplicates of *A. sativum* to the Genebank in Olomouc and *Allium* spp. to HRI, Wellesbourne (1997-99).
- Joint missions planned to Turkey and Greece, aiming at the collecting of local landraces, will be implemented during the next 2 years.

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The Allium collection at IPK Gatersleben[12]

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Species	No. of accessions	Type of collection	Long-term storage
Allium cepa s.l.	348	136 in permanent vegetative propagation; 212 seed-propagated	185
A. sativum	485	permanent field collection	–
A. proliferum	154	permanent field collection	–
A. ampeloprasum	91	40 in permanent vegetative propagation; 48 seed-propagated	44
A. schoenoprasum	18	permanent field collection	9
A. fistulosum	78	permanent field collection	20
Others	248	permanent field collection	18
Total	**1422**		

[12] Taxonomic collection not included, see Fritsch *et al*., page 76.

Collecting activities of the Greek Gene Bank

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In the framework of the EU GEN RES 20 project "Protecting Future European Community Crops: a programme to conserve, characterise, evaluate, and collect *Allium* crops and wild species", the Greek Gene Bank organized and carried out several collecting missions for *Allium* wild species.

During summer 1996, three collecting missions were carried out (Table 1)

- The first mission covered Euboea Island and a part of Central Greece, where 38 accessions of wild *Allium* were collected. The collecting team consisted of Stelios Samaras, Deputy Curator of the Greek Gene Bank and Prof. Dimitrios Tzanoudakis from the Biology Department of Patras University.
- The second collecting mission covered a part of the Pindos mountain range, starting from the Albanian borders and going southward to West Macedonia and Epirus. In this expedition, 32 accessions were collected.
- The third collecting mission covered a part of the Dodecanese Islands, near the coasts of the Middle East, and a part of Crete. In this mission 39 accessions were collected.

During summer 1997, three other collecting missions were carried out (Table 2).

- In the first mission, the collecting team visited Lesvos island in the Dodecanese, where 22 accessions of wild *Allium* were collected.
- The second expedition collected 45 accessions of *Allium* in the Cyclades islands: Andros, Tinos, Mykonos, Syros, Naxos and Paros.
- During the third collecting mission, Stelios Samaras was joined by project member Willem Wietsma, whose travel was supported by the British Council. The team collected 36 accessions of wild *Allium* on the Sporades islands, Skopelos and Skiathos and in the mainland on Olympos and Voras mountains.

Prof. Tzanoudakis will assist the Greek Gene Bank to identify taxonomically some of the accessions and carry out the characterization. All the collected accessions were planted in pots for ease of maintenance, characterization and multiplication.

Table 1. *Allium* species collected in 1996 (Euboea, Pindos Mt., Dodecanese Islands, Crete)

Section *Allium*	
A. ampeloprasum L.	16
A. guttatum Steven	20
A. sphaerocephalon L.	9
A. vineale L.	10
A. commutatum Guss.	2
A. amethystinum Tausch.	2
A. integerrimum Zahar.	1
A. bourgeaui Rech. f.	1
A. rubrovittatum Boiss. et Heldr.	1
A. proponticum Stearn et šzhatay	1
A. chamaespathum Boiss.	1
A. dilatatum Zahar.	1
Section *Codonoprasum*	
A. flavum L.	8
A. dentiferum Webb. et Berthelot	4
A. paniculatum L.	3
A. staticiforme Sibth. et Sm.	2
A. pallens L.	2
A. dodecanesi E. Karavokyrou et D. Tzanoudakis	1
A. tardans Greuter et Zahar.	1
Section *Molium*	
A. subhirsutum L.	2
A. neapolitanum Cyr.	2
A. phthioticum Boiss. et Heldr. ex. Boiss.	1
A. roseum Favios	1
Section *Scorodon*	
A. lagarophyllum S. Brullo, P. Pavone et D. Tzadounakis	1
A. goulimyi Tzanoud.	1
Section *Melanocrommyum*	
A. nigrum L.	2
A. cyrilli Ten.	1
Section *Brevispatha*	
A. callimischon Link	1
Allium spp.	7
A. caristanum	1
A. achoides	1
A. achaium Boiss. et Orph. ex Boiss.	1
Total	**108**

Table 2. *Allium* species collected in 1997 (Lesvos, Cyclades islands, Sporades islands, Olympus Mt., Voras Mt.)

Section *Allium*		**Section *Codonoprasum***	
A. ampeloprasum L.	18	*A. straticiforme* Sibth. et Sm.	1
A. proponticum Stearn et šzhatay	4	*A. flavum* L.	1
A. sphaerocephalon L.	15	*A. candargyi* E. Karavokyrou & D. Tzanoudakis	1
A. sphaerocephalon L. subsp. *aegaeum*	1	**subtotal**	**3**
A. guttatum Steven	15		
A. vineale L.	1	*Allium* spp.	55
A. cepa L.	1	**subtotal**	**55**
A. sativum L.	1		
subtotal	**56**		
		Total	**114**

Current status of the Allium *collection in Hungary*

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Since the last ECP/GR meeting, emphasis was set on the regeneration of old national material. The regenerated accessions were evaluated according to ECP/GR *Allium* descriptor lists. We checked the onion collection for duplicates. The number of accessions in different groups is as follows:

Species	Number of accessions
Allium cepa L.	305
Allium cepa L. var. *aggregatum*	10
Allium fistulosum L.	24
Allium porrum L.	6
Allium schoenoprasum L.	13
Allium sativum L.	51
Allium angulosum L.	1
Allium scorodoprasum L.	1
Allium montanum F.W.Schm.	2
Allium tuberosum Rottler ex Spr.	2
Allium odorum L.	1
Allium narcissiflorum Vill.	1
Total	**417**

Current status of the CGN Allium *collection*

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The collection

As of October 1997, the CGN *Allium* collection consists of 242 accessions available for distribution. An overview of the collection is given in Table 1. Another 184 additional accessions have not yet been included in the collection, but will be after regeneration. The collection was reduced considerably by bulking near-duplicates from both onion and leek. This reduction of redundancy was reported at the ECP/GR *Allium* Working Group Meetings in 1991 and 1995.

Information on the collection is available in various forms (printed, as computer files), or can be found on our Web site <www.cpro.dlo.nl/cgn/collect>. Passport data have been included in the European *Allium* Database (EADB).

Regeneration

All material included in the CGN collection has been regenerated and fulfils our standards for quality and quantity (germination over 80%, more than 4500 seeds). Of the material not yet included, about 30 accessions have been regenerated and will be available soon, depending on the results of the germination tests. About 75 accessions are being regenerated and will become available in the next 2 years. The rest of the material will be regenerated in the following years. Constraints in regeneration are still faced for cultivated onion from Pakistan as reported during the meeting in 1995. Regeneration of the wild material also caused difficulties. It will be several years before enough seed is produced to fulfil our standards.

For regeneration, 60-120 plants are used. After onion bulbs have been harvested, dried and potted, they are placed in an unheated glasshouse for overwintering. Because of problems with *Fusarium* attack, seedlings of leek are planted directly in pots and overwintered from November on in a glasshouse at 5-10°C. As soon as flowers appear the plants are transferred to isolation rooms and pollinated by blowflies.

Storage

The seeds are dried until a seed moisture content of about 5% is reached. The seed samples are packed in laminated aluminium foil bags and stored at –20°C for long-term storage. User samples are stored at 4°C.

Safety-duplication

About 85% of the material included in the CGN collection is duplicated at the Genetic Resources Unit of HRI, Wellesbourne, UK. The rest will be duplicated before January 1998.

CGN stores safety duplicates of HRI and of the Research Institute of Vegetable Crops, Skierniewice, Poland. Duplicates of IPGR, Sadovo, Bulgaria will be stored within a few months.

Table 1. *Allium* accessions in the CGN collection per species and cultivar group

Cultivated	
A. ampeloprasum group kurrat	11
A. ampeloprasum group leek	56
A. ampeloprasum, wild	4
A. cepa gr. common onion, dry bulb onion	114
A. cepa gr. common onion, silverskin onion	4
A. cepa gr. common onion, spring onion	2
A. fistulosum, japanese bunching onion	29
A. cepa x *fistulosum*, japanese bunching onion	1
A. tuberosum, chinese chive	3
Wild	
A. altaicum Pall.	5
A. flavum L.	1
A. galanthum Kar. et Kir.	2
A. guttatum Steven	1
A. schergianum Boiss.	1
A. senescens L.	1
A. sphaerocephalon L.	3
A. vavilovii M. Pop. et Vved.	2
A. vavilovii x *cepa*	2
Total	**242**

Characterization/evaluation

Most of the onion and leek material (including kurrat) has been characterized for, respectively, 19 and 15 different traits, as reported during the meeting in 1995 according to CGN descriptor lists (partly derived from UPOV and ECP/GR descriptor lists). During 1996 and 1997 about 50 accessions of onion were characterized for the minimum descriptors as agreed in the 1995 meeting except for storage life. These data will be included in the CGN information system and subsequently sent to the EADB.

Part of the leek material will be screened by CPRO-DLO for resistance to rust (*Puccinia allii*), thrips (*Thrips tabaci*) and white tip (*Phytophthora porri*) in the EU *Allium* GEN RES programme. A small part of the onion collection has been screened for dry matter, reducing sugars and pyruvate content in an EU FAIR project. Results will become available soon.

Utilization

In recent years about 80 accessions per year have been distributed to users. The most requested material are the wild species, especially *A. roylei* because of its resistance to diseases. Onion, leek and kurrat accessions from Egypt are also often requested.

Collecting

In August 1997 CGN organized a multicrop collecting expedition to Uzbekistan in cooperation with VIR, St. Petersburg and the Uzbekistan Research Institute of Plant Industry. During this expedition about 60 accessions of *Allium* were collected. Most accessions are wild species belonging to the section *Molium*, some to the section *Rhiziridum*. Also some landraces of *A. cepa* were collected. The passport data will be made available as soon as possible. The material will be regenerated in the near future.

Status of the Allium *collection in the Nordic Gene Bank*

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The Nordic Gene Bank holds a relatively limited number of *Allium* accessions because its mandate comprises conservation and documentation of crop germplasm of Nordic origin only, and with potential value for agriculture. The material originates from Denmark, Finland, Iceland, Norway and Sweden.

Since the last meeting we have received two big donations of primarily modern varieties from variety-testing agencies in Denmark and Sweden. The new samples have increased the *Allium* collection by about 50%. For most of the new accessions the NGB responsibility has not yet been established, hence they still have pending status.

The majority of the seed-propagated material is described using NGB descriptors, further characterization and evaluation will take place within the GEN RES project. For all the new material accepted for NGB storage, UPOV descriptors are available. The clonal material of shallots and potato onion has likewise been characterized using UPOV descriptors. The viability of the material will be secured through regenerations during the project period. Regeneration of *Allium* material takes place in NGB when germinability drops below 60%.

Table 1. Status of *Allium* material in the Nordic Gene Bank

	Number of accessions			
	Accepted	**Pending**	**Temporary**	**Total**
Seed material				
Allium cepa var. *cepa* L.	20	11	18	**49**
Allium cepa var. *solaninum* Alef.	0	0	50	**50**
Allium porrum L.	20	19	0	**39**
Allium schoenoprasum var. *schoenoprasum* L.	0	0	3	**3**
subtotal	**40**	**30**	**71**	**141**
Clonal material				
Allium cepa var. *solaninum* Alef.	10	0	36	**46**
Allium cepa var. *ascalonicum* Backer	17	0	0	**17**
subtotal	**27**	**0**	**36**	**63**
Total	**67**	**30**	**107**	**204**

Safety-duplicates of accepted seed material are stored in an abandoned coal mine in Svalbard. Only 10 accessions of *A. cepa* var. *cepa* and one *A. porrum* are presently safety-duplicated. All of the accepted clonal material is safety-duplicated in the Czech genebank at Olomouc. Additionally the *A. cepa* var. *solaninum* clones are grown and stored in two separate locations in Finland.

Allium *germplasm in Poland*

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The collection

The conservation of *Allium* germplasm is conducted within the vegetable genetic resources conservation programme at the Research Institute of Vegetable Crops (RIVC) in Skierniewice. It is part of the national programme coordinated by the Centre for Plant Genetic Resources of IHAR, Radzików.

In the *Allium* collection 877 accessions are registered, including 183 of onion, 72 of shallot, 259 of garlic, 349 of other cultivated and wild *Allium* species. The current status of *Allium* germplasm is given in Table 1.

Table 1. Present status of *Allium* germplasm. Skierniewice, 1997

Species	Total	Passport data	Evaluation/ Charact.	Seed in long-term storage	Field collection	Duplication	Regeneration 1995-97
A. cepa L.	183	183	62	183		57	69
A cepa L. var. *aggregatum* G. Don.	72	72	58	20	65	10	8
A. sativum L.	259	259	259		192	78	28
A. porrum L.	14	14		14			
Other *Allium*	349	349	129	106	234		57
Total	**877**	**877**	**508**	**323**	**491**	**145**	**162**

Characterization and evaluation

The passport data are nearly complete for the collected accessions and most passport data are included in the European *Allium* Database (EADB), but an update is needed because new material has been added.

Passport data are stored in dBase files and a copy is maintained in the Polish genebank in Radzików. Evaluation data are stored in separate dBase files according to type of evaluation, year and experiment. In most cases data contain the results of a 3-year evaluation of yield-forming traits, quantitative and qualitative characters. The field trials were usually conducted over three growing seasons in 3-4 replications by the method of randomized blocks.

Characterization and evaluation of the morphological and agronomic traits and other parameters are conducted according to the descriptor lists elaborated by IPGRI, UPOV, USDA and RIVC.

The collected materials are stored at the Centre for Plant Genetic Resources in Radzików or maintained in field collections and include: onion (*A. cepa*), shallot landraces (*A. cepa* var. *aggregatum*), garlic (*A. sativum*), edible and wild *Allium* species.

The onion collection (*A. cepa *L.)

The collection of *A. cepa* maintained at RIVC Skierniewice consists of 183 accessions, including 48 advanced cultivars, 69 breeding lines and 66 landraces. Landraces originate from Poland, Russia, Tajikstan, Kazakstan, Kyrgyzstan, Uzbekistan, Ukraine, Slovakia and Albania. Minimum characterization (14 traits) for 62 accessions of onion from the genebank has been prepared and included in the EADB. Characterization covers 46 morphological and economical traits following the descriptor lists developed by IPGRI, and partly established by UPOV and RIVC.

The shallot collection (*A. cepa *L. var.* aggregatum*)

The collection of shallot landraces was established at RIVC in 1991, based on landraces originating from Poland and neighbouring areas. In Poland, there are no advanced cultivars of shallot; landraces are grown in home gardens.

Currently, 65 accessions (57 from Poland) are maintained in the collection. All collected accessions of shallot are documented for passport data and 58 accessions have been evaluated for 40 traits according to IPGRI, USDA and UPOV descriptor lists.

The garlic collection (*A. sativum *L.)

No garlic cultivars were bred before 1993, but various local garlic populations selected by individual growers called "types", were grown in Poland. The introduction of new Polish cultivars can lead to elimination of old garlic populations.

The garlic collection established in 1986 is located in the southern part of Poland (300 km south of Skierniewice) in the old centre of garlic cultivation. In 1996 the garlic collection included 259 accessions (159 for winter cultivation and 100 for spring cultivation) after 3-year trials, and 58 accessions in multiplication and preliminary evaluation. In 1997 the collection contains 192 accessions. Part of the material froze totally or was partly damaged at the beginning of winter. In December 1996 frost went down to –37°C without any snow cover. After winter it appeared that 192 accessions had survived.

Forty-eight garlic accessions collected in Ukraine and Slovakia and multiplied for the first time are totally lost. Some accessions from the collection also require regeneration. During the 1997 season, 28 accessions were regenerated from topsets. Part of the accessions need to be regenerated by using duplicates from other collections (Olomouc, Moskow, Madison, Rehovot).

After multiplication the accessions are included in 3-year trials (3-4 replications) to evaluate their economic value. After a 3-year research cycle, the accessions are maintained in a field collection in one replication (100 plants of each accession). Evaluation is conducted according to the descriptor lists elaborated by IPGRI and RIVC.

The accessions maintained in collection are documented for passport data. Minimum characterization of 14 traits has been prepared for 259 garlic accessions and sent to EADB.

In addition, with IPGRI's financial support, computerized documentation was prepared for:

- 259 accessions of garlic, documented for 31 characters from the IPGRI list of descriptors
- 170 accessions of garlic from the collection, covering the results of 3-year field trials. The results of evaluation data of 39 characters regarding the economic value of garlic show a great variability in the collected materials. On the basis of these results, several accessions of garlic have been selected for a breeding programme

- 259 accessions of garlic and 10 *Allium longicuspis* Regel – the variability of six enzyme systems was analyzed and also the content of alliine, dry matter, sugars and Vitamin C
- 15 accessions of garlic and 9 accessions of *Allium longicuspis*, which have been studied to determine the variability of 13 morphological traits between populations and within population. The observations were made on 25 plants of each accession.

Edible and wild species

The collection held at Skierniewice contains 234 accessions collected in Central Asia, Siberia and wild species occurring in Poland. Nearly all accessions are documented for passport data and included in the EADB. Characterization and evaluation, according to IPGRI and USDA descriptor lists, are complete for 129 accessions and cover 49 traits. The evaluation data are included in the computerized database.

Native* Allium *species

According to investigations conducted at Jagielonian University in Kraków, 11 wild *Allium* species grow under natural conditions in Poland (Table 2). The distribution of eight of these species on the Polish territory is shown on Figure 1.

The most common are *Allium vineale* and *A. oleraceum*. The distribution of native wild *Allium* species and details of their occurrence are contained in a computerized database created by Prof. B. Zajac at Jagielonian University.

Table 2 . Wild *Allium* species of the Polish native flora

Species	Polish name	Occurrence
A. angulosum L.	Czosnek k·towy	C
A. carinatum L.	Czosnek grzebieniasty	VR
A. oleraceum L.	Czosnek zielonawy	VC
A. montanum Schmidt	Czosnek skalny	R
A. sphaerocephalon L.	Czosnek gÓówkowaty	VR
A. scorodoprasum L.	Czosnek wÄüwy	R
A. strictum Schrad.	Czosnek sztywny	VR
A. sibiricum L.	Czosnek syberyjski	VR
A. ursinum L.	Czosnek niedüwiedzi (babny,psi)	C
A. victorialis L.	Czosnek siatkowaty	R
A. vineale L.	Czosnek winnicowy	VC

VR -very rare; R - rare; C - common; VC - very common

The Botanical Gardens located in Kraków, Lublin, Wroclaw, Poznan, Warszawa, Warszawa-Powsin and Bolestraszyce maintain collections of *Allium* species originating from Poland and abroad. In total, 209 accessions representing 190 *Allium* species are held in the above-mentioned Botanical Gardens (Table 3). The detailed list of species is given in Table 4.

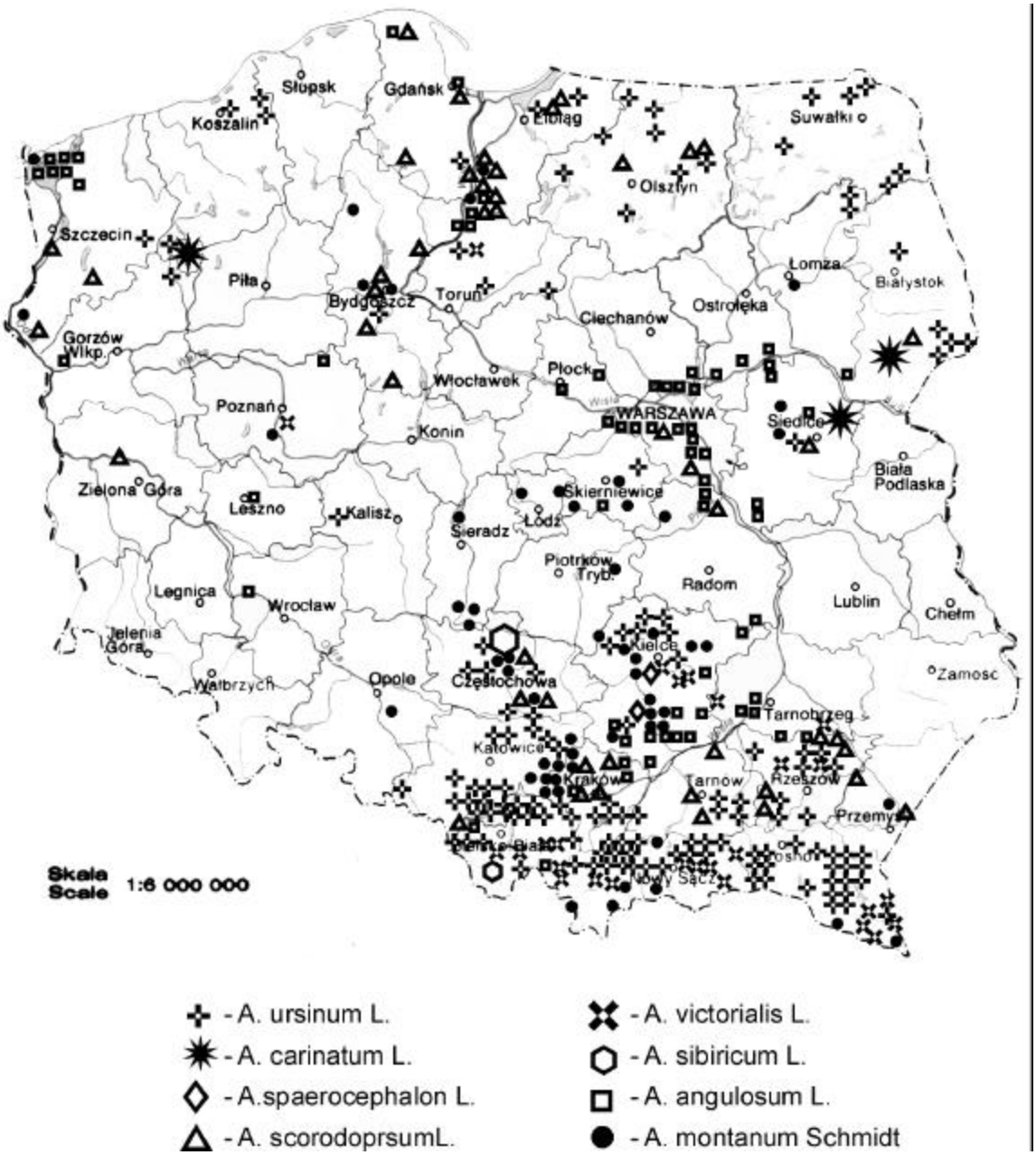

Fig. 1. The distribution of eight *Allium* species in Polish territory.

Table 3. *Allium* species in Polish Botanical Gardens

Botanical Garden	Number of species	Number of accessions
Bydgoszcz	4	4
Kraków	17	17
Lublin	33	41
Poznan	45	54
Wroclaw	36	36
Warszawa	17	17
Warszawa-Powsin	34	34
Bolestraszyce	4	6
Total	**190**	**209**

The *Allium* collections currently maintained at the Botanical Gardens need to be documented electronically. It is necessary to develop a documentation system which allows us to record and include the existing data in the database of the Polish genebank and the EADB.

Storage and safety-duplication

The collected materials are stored in the Central Gene Bank storage, in twist-type glass jars. Seed samples are dried until a seed moisture content of about 5-7% is reached. The seeds are stored at –18°C for long-term storage and 0°C for short-term storage.

Currently, 57 seed samples of onion and 10 samples of shallot are deposited in CGN, Wageningen, and also 78 accessions of garlic in Olomouc as safety-duplicates.

Regeneration

The first seeds of Polish advanced cultivars were deposited in the genebank in 1982 for storage. Most of these cultivars are still used in production. The accessions taken from storage for evaluation are also regenerated. Each year limited numbers of accessions from the genebank storage or from different donors are regenerated and multiplied under isolation.

The weather during the reported period was rather favourable, but in July 1997 there were extremely heavy rains, and for a few days the collection fields were under water. It was possible to evaluate the reaction of wild *Allium* species and shallot on extremely wet soil. Most of the accessions from transplants, seeds and old plants in the collection survived that time in good condition. Slight damage was observed on the leaves of some accessions.

This year an atypical behaviour of early flowering *Allium* species was noticed. Some of the accessions were flowering much earlier and for a significantly shorter period (in some cases 2 or 3 weeks shorter than in other years).

In spite of unusual vegetation conditions, it was possible to increase successfully the seeds of 45 accessions of *Allium*. The pollinators used were honey bees or puparia of wild bees (*Osmia rufa* L.) and flies (*Musca domestica*).

During the period 1995-97, 162 *Allium* accessions were regenerated (69 accessions of onion, 8 of shallot, 57 of wild species of *Allium* and 28 garlic accessions from topsets).

Table 4. *Allium* species in the Botanical Gardens in Poland, 1997

Species	Botanical Garden							
	Bydgoszcz	Lublin	Poznan	Wroclaw	Warszawa	Powsin	Kraków	Bolestras-zyce
acuminatum Hook.				1				
aflatunense B. Fedtsch.		1			1	1		
aflatunense B. Fedtsch. var. Purple Sensation				1				
albidum Fisch.ex Bieb. subsp. *caucasicum* (Rgl.) Stearn						1		
albidum Fisch.			2					
altaicum Pall.		1		1		1		
altissimum Rgl.			1			1		
ampeloprasum L.							1	
amphibolum Ledeb.						1		
angulosum L.		2				1		
ascalonicum L.		1						
atropurpureum W.et K.		1	2	1				
besianum W.W. Sm.				1				
bucharicum Rgl.			1					
caeruleum Pall.		1						
caeruleum Pall. var. *bulbiferum*				1				
caesium Schrenk.			1					
canadense L.			1					
carinatum L. subsp. *pulchellum* Bonnier et Layens		1	1		1	1		
cepa L.				1	1			
cepa var. *proliferum* Rgl.			1					
cernuum Roth		1	1	1		1		
christophii Trautv.		1	2	1		1		
cyaneum Rgl.				1	1			
cyathophorum Bur. et Franch. var. *farreri* Stearn			2			1		
fistulosum L.	1	1	1	1	1	1	1	
flavum L.		1	1		1	1		
giganteum Rgl.		1				1	1	
hymenorhizum Ledeb.		1						
kansuense Rgl.		1						
karataviense Roem. et Schult			1	1	1	1	1	
ledebourianum Roem. et Schult		1	1			1		
lineare L.		1				1		
macranthum Bak.			1					
moly L. var. *bulbiferum* Rouy		1	1	1				
moly L.		1		1	1	1	1	
moly f. *viviparum*			1					
montanum Rchb. non F.W. Schmidt nec Sibth	1		1	1	1			
narcissiflorum Vill.					1			
neapolitanum Cyr.						1		
nutans L.		1	2					
obliquum L.		1					1	
odoratum L.			1					
odorum L.			1		1			
oleraceum L.		1				1	1	1
oreophilum C.A. Mey			1	1		1		
ostrowskianum Rgl.			1	1			1	
paradoxum G. Don			1					
polyphyllum Kar. et Kir.			1					
porrum L.		3	1				1	
pskemense B. Fedtsch.			2			1		

Species	Botanical Garden							
	Bydgoszcz	Lublin	Poznan	Wroclaw	Warszawa	Powsin	Kraków	Bolestras-zyce
pulchellum Don			1	1			1	
pulcherimum "Alians"			1					
pyrenaicum Costa et Veyr.						1	1	
ramosum L.		1		1		1		
rosenbachianum Rgl.				1		1	1	
sativum L.				1	1	1	1	
saxatile Bieb.						1		
schoenoprasum L.	1		2	1	1	1	1	
schoenoprasum L. subsp. *sibiricum* Celak			1				1	
scorodoprasum L.		1	1	1				1
scorodoprasum L. subsp. *Jajlae* (Vved.) Stea		2						
senescens L.		1	1				1	
senescens L. subsp. *montanum* (F.W. Smidt)		1	1	1	1	1		
senescens "Glaucum"			1					
senescens L. subsp. *calcerum (*Wallr.) Hyl.		1						
senescens Miq.	1							
shuberti Zucc.				1				
siculum Ucria				1				
sphaerocephalon L.		1	1				1	
stellatum Fraser			1	1				
stipitatum Rgl.			1	1	1	1		
suaveolens Jacq.		1						
tenuiflorum Ten.						1		
tibeticum Rendle = *sikkimense* Bak.			2					
tuberosum Rottl. ex Spreng.		1	1	1		1		
turkestanicum Rgl.				1				
ursinum L.		2	2	1	1	1		1
victorialis L.		4	1	1	1			1
vineale L.				1				
winklerianum Rgl.						1		
zebdanense Boiss. et Noe.			1					

Collecting explorations

Explorations within Poland are organized each year to collect indigenous germplasm. This includes visits to local markets and small isolated villages, particularly in the southern, eastern and northern regions of Poland and neighbouring countries, where farmers still maintain local cultivars of various vegetables. Eight explorations between 1995 and 1997 have resulted in the collecting of 175 accessions among which are 43 accessions of onion, 34 of shallot, 92 of garlic, 2 of chive, 3 of leek, 1 of other *Allium* (Table 5). Each seed sample collected is split in two parts: one part is added to the base collection, the other is used for multiplication and preliminary evaluation.

Table 5. *Allium* germplasm collected during explorations since 1995

Year	Organization	Area	No. of accessions
0ct. 1995	POLSKV, Skierniewice, Poland	Province Biaóa Podlaska, Poland	Onion -10 Garlic - 10 Shallot - 7 Leek - 1
Sept.1995	POLIHAR - Radzików, Poland, VURV, Piesťany - Slovakia	Tatra, Poland - Slovakia	Garlic - 7 Shallot - 4 *Allium* sp.- 1
Aug. 1996	POLIHAR - Radzików, Poland,	Klodzko region, Poland	Onion - 2 Shallot - 2 Garlic - 3
Sept. 1996	POLIHAR - Radzików, Poland, VURV - Piesťany, Slovakia	Ukraine, Slovakia, Poland	Onion - 11 Shallot - 7 Garlic - 26 *A. schoenoprasum* - 1
Sept. 1997	POLIHAR-Radzików,Poland, VURV - Piesťany, Slovakia	Javorniky, Horna Orava region, Slovakia	Onion - 1 Garlic - 9
Sept. 1997	POLIHAR-Radzików, Poland, Ukraine	Lwow province, Ukraine	Onion -11 Shallot - 9 Garlic - 21
Sept. 1997	POLIHAR-Radzików, Poland, VUVR-Piesťany, Slovakia	Zarnovica, Banska Stiavnica region, Slovakia	Onion - 6 Shallot - 2, Garlic - 7
Oct. 1997	POLIHAR - Radzików POLSKV - Skierniewice	Bielsko-Biala province, Zywiec	Garlic - 9 Onion - 2 Leek - 2 Shallot - 3 Bunching onion - 1

Utilization and perspectives

During 1995-97, the following *Allium* accessions were introduced in the genebank: 30 accessions from Poland, 175 from explorations and 137 from abroad (Table 6).

Table 6. Number of accessions of *Allium* introduced in the genebank since 1995

	Breed. comp., Inst., Univ.			Explorations					Abroad		
Year	Onion	Shallot	Garlic	Onion	Shallot	Garlic	Leek	Others	Onion	Shallot	Other
1995	–	–	23	10	11	17	1	1	7	–	–
1996	–	4	–	13	9	29	–	1	6	29	87
1997	3	–	–	20	14	46	2	1	8	–	–
Total	**3**	**4**	**23**	**43**	**34**	**92**	**3**	**3**	**21**	**29**	**87**
	Total 30			**Total 175**					**Total 137**		

Between 1995 and 1997, we distributed to users in Poland 582 seed samples of *Allium*: 54 of onion, 78 of shallot, 416 of garlic, 6 of leek, 28 of other *Allium*. Since 1995 we have sent to users abroad 164 seed samples: 89 of onion, 21 of shallot, 54 of garlic (Table 7).

Table 7. Number of accessions of *Allium* distributed since 1995

	Breed. comp., Inst., Univ.					Abroad		
Year	**Onion**	**Shallot**	**Garlic**	**Leek**	**Others**	**Onion**	**Shallot**	**Garlic**
1995	7	32	156	5	12	21	10	–
1996	23	28	260	1	2	57	11	54
1997	24	18	–	–	14	11	–	–
Total	**54**	**78**	**416**	**6**	**28**	**89**	**21**	**54**
	Total 582					**Total 164**		

The most requested materials are those that provide new sources of resistance to diseases and pests and tolerance to environmental stresses. More often, the breeders prefer cultivars to wild or primitive populations as sources of these characteristics and of various economic traits. Landraces of onion originating from Central Asia and Siberia are used as source of dry matter content and also, quality of dry skin, source of sterility, earliness, good storability, adaptation to different environmental conditions.

Allium germplasm has been used in research conducted in the Institute of Vegetable Crops (biochemical study on different *Allium*, i.e. querticine content in shallot landrace range from 256 to 393 mg/kg of fresh matter, in onion cultivars 75-109 mg/kg and in wild species from 1 mg/kg (*A. ledebourianum* Schult, *A. ampeloprasum* L., *A. caesium* Schrenk, *A. nutans* L.) to 185-232 mg/kg (*A. vavilovii* M. Pop. et Vved., *A.* x *proliferum* (Moench) Schrader, *A. galanthum* Kar. et Kir.).

Our research in plant genetic resources is directed toward improving the availability of useful germplasm. The following are additional recommendations in this perspective:

- to collect native germplasm; to accumulate data on important characteristics of the conserved germplasm; to further develop the database management system; to publish the catalogues of *Allium* germplasm collection in the country
- to supplement morphological and economic evaluation of variability with modern techniques like isozyme electrophoresis, and the application of molecular markers to help identify duplicates within the collected material, search, and classify the marker genes for beneficial characters
- to establish *in vitro* conservation of the garlic collection with the collaboration of IPGRI and IPK
- to carry out taxonomic identification of unrecognized species of *Allium*
- to try developing *in situ* and on-farm conservation of selected wild species and landraces, old cultivars (for example in cooperation with the Forestry Gene Bank)
- to gather information about *Allium* spp. maintained in Poland (Botanical Gardens, Universities, National Reserves, other institutions) and related research programmes dealing with the genus *Allium;* continuation of investigation on chemical, biochemical and nutritive composition of some *Allium* species which can be introduced as new plants for food or ornamental use
- to safeguard more materials from collections as duplicates, particularly those vegetatively propagated
- to determine viruses in the garlic and shallot collections.

Collecting, evaluation and conservation of Allium *germplasm in Portugal*

Rena Martins Farias

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Collecting missions

Systematic collecting missions of *Allium cepa* L. were carried out for the first time from 1990 to 1994 by the staff of the Branco Português de Germoplasm Vegetal (BPGV), Direcção Regional de Agricultura de Entre Douro e Minho (DRAEDM) Advisory Services, together with Dave Astley, Coordinator of Conservation of Genetic Resources, Horticulture Research International, Wellesbourne, UK.

Further to observations made during the field missions we decided to start with the collecting of *Allium cepa* L. and also to collect *Allium* spp. in Portugal. Several collecting missions were carried out throughout Portugal and one small collection was made in Madeira island. Species collected are listed in Table 1.

Table 1. *Allium* species collected, 1990-94

Species	Type	Number collected
Allium ampeloprasum L.	Wild	4
	Landrace	12
Allium baeticum Boiss.	Wild	3
Allium cepa L.	Landrace	140
Allium sativum L.	Landrace	210
Allium schoenoprasum L.	Cultivated	4
Allium sphaerocephalon L.	Wild	5
Total		**378**

The participants in these collecting missions were: Rena Farias, Head of Branco Português de Germoplasm Vegetal (BPGV), (DRAEDM) Merelim, Braga and Estação Nacional de Melhoramento de Plantas" (ENMP), Elvas, Portugal; Dave Astley, Genetic Resources Unit, Horticulture Research International (HRI), Wellesbourne, UK; Takeomi Etoh, University of Kagoshima, Japan; M. Tavares de Sousa of ENMP, Portugal; E. Varandas, (DRAEDM), Braga, Portugal; Cecilia Cheung So Mui, Parque de Seac Pai Van, Macau; Francisco Pina Madeira, Estação Nacional de Melhoramento de Plantas, Elvas, Portugal.

A survey and collection of wild *Allium* spp. was made by Rena Farias and Francisco Pina Madeira from ENMP in the Alentejo region in 1997. Next year we will continue this work in this region and in the whole of Portugal.

Duplication of the material

Twenty-two duplicates of *Allium* spp. were sent to Pavel Havránek, Olomouc, Czech Republic. In 1996, 13 accessions were collected in the Minho and Alentejo regions together

with Takeomi Etoh, from the University of Kagoshima, Japan, where these accessions are duplicated.

Evaluation

Characterization and preliminary evaluation

In 1994 we started the evaluation and characterization of some accessions of vegetatively propagated garlics: *Allium ampeloprasum* (12), *A. sativum* (192) and *A. schoenoprasum* (1). Multiplication has been carried out in BPGV by Rena Farias and Pina Madeira in two different regions of the country and maintained in a field collection, to protect the collection against disasters or genetic erosion. The collection is kept in field collections in Quinta de São José, São Pedro de Merelin, Braga and in the Estação Nacional de Melhoramento de Plantas (ENMP), Elvas, Alentejo.

The minimum list of descriptors has been used for the characterization of *A. ampeloprasum, A. cepa* and *A. sativum* (IBPGR 1992; Gass *et al.* 1996). The results will be published next year.

Morphological characterization and preliminary evaluation of Allium cepa *L.*

One hundred and forty agronomic ecotypes of onion collected in Portugal and kept in a -20°C chamber in the BPGV were characterized morphologically in the field and in the laboratory in 1997. The bulbs will be planted in 1997-98 for multiplication.

For characterization the minimum characterization descriptors recommended by IBPGR (1992) were followed; the growing techniques recommended in Seabrook (1976) and Biggs (1980) were also followed.

This work, with the title of 'Morphological Characterization and Preliminary Evaluation of the Agronomic Ecotypes species of *Allium cepa* L.' is being carried out by Carla M.R. Silva as her dissertation for the degree of Engenheira Técnica Agrária. This study, using Portuguese onion landraces, is an original one regarding the genetic resources. After the second year of cultivation of the material (1997-98) the results will be published.

Isozyme characterization

Isozyme characterization was started with some accessions of clones of *A. sativum* at the Minho University, Braga by Ana Vincente (DRAEDM).

Next year molecular characterization of *Allium* spp. collected in Portugal will begin.

Allium spp. database

The database of *Allium* spp. has been established by Filomena Marcelino, responsible for the Information and Documentation of the BPGV. Part of it has already been sent to Dave Astley.

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The Allium *collection at the Research Institute for Vegetable and Flower Growing, Romania*

Ion Scurtu
Research Institute for Vegetable and Flower Growing (RIVFG), Vidra-Ilfov, Romania

Allium cepa collection

Male sterile lines	7
Maintainer lines for sterility	7
First generation inbred lines (C1)	18
Second generation inbred lines(C2)	24
Third generation inbred lines (C3)	12
F_1 hybrids	36
Romanian and foreign varieties	22
Total	**126**

Romanian varieties	**Foreign varieties**	
Diamant	Banco	Amposta
Aurie de Buzau	Macau	Copra F1
Rosie de Aries	Spanish	Moldavski
Rosie de Gagaras	Aronea	Owa
	Density	Progres
	Crasbow	Turbo
	Walika	Sentinel
	Zittaser	Rocket
	Stuttgart	Valenciana

Other species of *Allium*

- **Sect. *Rhizirideum* (G.Don ex. Koch. ind. Sect. *Oreiprason* F. Herman. Sect. *Petroprason* F. Herman)**

Bulbs narrowly conical to cylindrical, usually clustered on short rhizome. Leaves flat, not fistular.

A. angulosum L.	Botanicus University Tartuensis, Norway
A. angulosum L.	Botanicus Garden, Berlin Dahlem, Germany
A. angulosum L.	Hortus Botanicus Osloensis, Oslo, Norway
A. angulosum L.	Institut Komarovii, St. Petersburg, Russia
A. snaveolens Jacq (Syn. *A. angulosum* L.)	G.B. Vacratot, Hungary
A. montanum Schmidt	Halle/S.
A. montanum Schmidt	Wroclav, Poland
A. fallax L. (Syn. *A. montanum* Sch.)	Wroclav, Poland
A. senescens L. (Syn. A. *montanum* Sch.)	Berlin Dahlem, Germany
A. senescens L.	Barcelona, Spain
A. narcissiflorum Will.	H.B.Tartuensis, Norway
A. narcissiflorum Will.	Halle/S.

- **Sect. *Schoenoprasum* Dumart (Sect. Schoenoprason F. Herman L.)**

Bulbs cylindrical or very narrowly conical on a short rhizome. Leaves cylindrical fistular.

A. schoenoprasum var. Sibiricum (L.) Garcke	Berlin Dahlem, Germany
A. schoenoprasum L.	Humboldt Berlin, Germany
A. schoenoprasum L.	Whiteknights, United Kingdom
A. schoenoprasum L.	Liverpool, United Kingdom
A. schoenoprasum L.	Manchester, United Kingdom
A. schoenoprasum L.	Wroclav, Poland

- **Sect. *Cepa* (Miller) Prokh (incl. Sect. *Phyllodolon* (Salisb.) (Prokh.)**

Bulbs cylindrical to subglobose, usually clustered on a short rhizome. Leaves fistular.
A. cepa L. - (incl. *A. ascalonicum*)

A. altaicum Pall	H.B. Tartuensis, Norway
A. altaicum Pall	B.G. Berlin Dahlem, Germany
A. altaicum Pall	Institutul Botanic Komarovii, St. Petersburg, Russia
A. fistulosum L.	Berlin Dahlem, Germany
A. fistulosum L.	G.B. Halle/S.
A. fistulosum L.	G.B. Bucharest, Romania
A. fistulosum L.	Cuba

- **Sect. *Molium* G. Don ex Koch (incl. Sect. *Rhodoproson* F. Herman. Sect. *Xanthoprason* F. Herman)**

Bulbs ovoid or subglobose; not rhizomatous. Leaves flat.

A. neapolitanum Cyr.	H.B. Vacratot, Hungary

- **Sect. *Allium* (sect. *Alliotypus* Dumart, Sect. *Porrum* (Milles) C. Don ex Koch).**

Bulbs ovoid, or subglobose; not rhizomatous. Leaves linear, flat or fistular.

A. sativum L.	
A. pyrenaicum Costa and Vayr	Bucharest, Romania
A. scorodoprasum L.	Halle/S.
A. scorodoprasum L.	Wroclaw, Poland
A. porrum Elegant L.	Wroclaw, Poland
A. pskemense	Wroclaw, Poland

- **Sect. *Melanocrommyum* Welb. & Berth (sect. *Melaprason* F. Herman)**

Bulbs subglobose or broadly ovoid; not rhizomatous

A. decipiens	Fischer ex. Schulte, Poland

Interspecific hybrids - amphidiploids and diploids

H.b (*A. cepa* × *A. fistulosum*)	H.b.6 (*A. cepa* × *A. pyrenaicum*)
H.b (*A. galanthum* × *A. cepa*)	H.b.7 (*A. cepa* × *A. roseum)*
H.b.5 (*A. cepa* × *A. altaicum*)	

The collection of Allium *L. in Russia*

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The collection of *Allium* L. dates back to 1926 when the first onion accessions were registered at the Institute of Plant Industry (VIR). These were samples received from French plant breeding companies and also landraces from western China, Syria, Ukraine and Russia. At present the collection of onion germplasm comprises 2035 accessions from 58 countries, including 982 accessions of common onion (*Allium cepa* L.), 398 accessions of leek (*A. porrum* L.), 325 of garlic (*A. sativum* L.) and 330 of perennial species.

The collection contains the whole intraspecific diversity of *Allium cepa*, which according to the classification of Dr A.A. Kazakova is represented by the Southern, European and Northern subspecies, while the diversity of cultivars is represented by 30 varietal types. The basic collection of *Allium porrum* includes the following varietal types: 'Karantansky', 'Brabantsky', 'Elephant', 'Bolgarsky', 'American Flag' and summer types. There are also perennial species in the collection of VIR, such as *Allium fistulosum* L., *A. nutans* L., *A. odorum* L., *A. schoenoprasum* L., *A. altaicum* Pall., *A. ursinum* L., *A. subulosum* L., *A. angulosum* Lour. and others. Welsh onion is represented by the samples of Japanese, Chinese and Russian subspecies.

Studies of the collection under different climatic conditions revealed a very wide variability of commercial and biological traits in the varieties of *Allium cepa* and other species, depending on geographic and ecological environments of onion cultivation. As a result, varieties of the Spanish group and a number of samples from the United States, Canada, the Netherlands, Denmark, Japan, Kazakstan and Ukraine were identified as promising by a complex of characters: yield, market quality, storability and disease resistance. Unmatched in earliness were the Spanish varieties 'Valenciana Tardia' and 'Morada de Amposta' as well as accessions from Japan. It became possible to identify heat-resistant varieties among landraces and local varieties from Russia and Kazakstan as well as Japanese samples.

In Russia the harmful diseases of *Allium* are downy mildew (*Peronospora schleidenii* Ung.) and neck rot (*Botrytis alii),* while the most active pests are onion fly (*Hylemia antiqua* Meig.) and onion nematode (*Ditylenchus allii).*

Immunological analysis showed that most of the accessions of common onion were severely affected by *Peronospora* strains. As for diseases, onion varieties demonstrated great differentiation.

The onion collection is preserved in the National Seed Store at the Kuban Experiment Station, Krasnodar Region, and in refrigerators at the Institute in St. Petersburg. Regeneration of seed is performed at the experiment stations of VIR. New germplasm materials received by VIR undergo quarantine testing at specialized quarantine nurseries.

New accessions are studied with respect to their morphological, biological and commercial characters in the major agricultural areas of Russia. On the basis of the analysis of experimental data, genetic sources are identified for plant breeding practice.

VIR sent out 230 onion samples in 1996 and 261 samples in 1997 upon request to various research institutions in Belgium, The Netherlands, Czech Republic, Israel, the Republic of Korea, India, Mongolia, Bulgaria, Belarus, Lithuania, Ukraine, Moldova, Uzbekistan, etc. In 1996-97 the Institute received 81 onion samples from abroad.

By using materials from the collection of VIR, over 40 onion cultivars and hybrids have been commercialized in Russia. They are now being cultivated both in Russia and in adjacent countries.

One of the present priorities is to finalize the passport database of garlic. It is also necessary to develop a database for evaluation data. For this purpose we need to carry out a series of experimental studies and summarize the results of many years of research.

Activities in Allium *genetic resources in F.R. Yugoslavia since 1992*

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Although F.R. Yugoslavia has not been involved in ECP/GR activities for some time, the establishment of the Federal Department for Plant and Animal Genetic Resources of Yugoslavia, the continuation of the building of the Gene Bank of Yugoslavia, and the participation of new members in the ECP/GR working groups are the signals that the work on genetic resources in Yugoslavia, including the work on *Allium* sp., is returning to normal.

Suggestion regarding the future programme of the *Allium* Working Group

The increasing medicinal importance of the genus *Allium* places emphasis on further collecting, especially of *Allium sativum* L. and wild *Allium* spp. (antioxidants), evaluation of collected samples, and preparation of recommendations similar to those in the programme 'Decorative *Alliums* of Commercial Interest' (D. Astley - Plovdiv).

National collection

In the framework of the project "Forming Gene Fund for the Needs of the Yugoslav Gene Bank (YUGB)" (1989-1991), the following samples are included in the national collection:

Species	No. of accessions (passport data)	No. of samples in the YUGB collection
A. cepa L.	29	16
A. sativum L.	46	35
A. porrum L.	6	0

In the period 1995-97, 16 *Allium cepa* samples were multiplied and a programme of collecting, characterization and evaluation of *A. sativum* samples from the territory of F.R. Yugoslavia was continued. All samples are in active collections at the Institute of Field and Vegetable Crops in Novi Sad (70 *A. cepa* and 60 *A. sativum* - curator Jelica Gvozdanovic-Varga; 10 wild *Allium* - curator Branka Lazic), the Center for Vegetable Crops in Smederevska Palanka (62 *A. cepa* and 20 *A. sativum* - curator Z. Markovic), and the Faculty of Agriculture in Pristina (3 *A. cepa* and 2 *A. sativum* - curator Zoran Ilic).

Of particular importance is the collecting of new samples of endangered old *Allium* varieties, especially on the territory of the Province of Kosovo and Metohija. The following materials have been collected during three expeditions organized in Kosovo and Metohija:

- three *A. cepa* populations derived from a very old variety, 'Prizrenski pogacar' (index 0.5-0.6; dry matter content 14-21%; stores well)
- two *A. sativum* samples (a spring type and var. *sagittatum*); one *A. porrum* sample from an old variety, 'Prizrenski kalus' (thin stem, up to 60 cm long)
- cataloguing, sample collecting (herbarium material), *in situ* site labeling and storing of the following wild *Allium*: *Allium flavum* L. - a European endemic; *A. ursinum* L., *A. oleraceum* L., *A. sphaerocephalum* L., *A. moschatum* L. - a southern European endemic; *A. carinatum* L.,

A. pulchellum Don. f. *parviflorum* Beck., *A. melanaterum* Pancic - a Balkan endemic; *A. cuppani* Raf., *A. sibiricum* L., *A. saxatile* M.B., *A. victorialis* L. and *A. vineale* L.

The following activities have been conducted at the Institute of Field and Vegetable Crops in Novi Sad:

- collecting, characterization and partial evaluation of *A. sativum* (22 winter ecotypes and 27 spring ecotypes)
- evaluation of garlic ecotypes for protein composition. Fractions with relative molar masses of 34 000 and 36 000 can be used to distinguish between spring and winter garlic ecotypes, since the latter lack the 34 000 fraction completely
- collecting, characterization and evaluation of several wild *Allium* spp. from the Vojvodina Province (northern Yugoslavia). Recommendations on how to grow them and use them for food have been issued. The following species have been recorded: *A. vineale* L., *A. scorodoprasum* L., *A. sphaerocephalon* L., *A. rotundum* L. subsp. *waldsteinii* (Don) Soó, *A. atroviolaceum* Boiss., *A. paniculatum* L., *A. oleraceum* L., *A. carinatum* L. subsp. *pulchellum* (G. Don.) Bonnier et Layens, *A. flavum* L. and *A. flavescens* Besser. All of them are important decorative species; the leaves of *A. vineale* have high contents of ascorbic acid (1-117 mg/100 g) and carotenoids and a high level of lipid peroxidation, indicating its importance in diet as an antioxidant.

Regeneration activities

The use of hover flies and solitary bees for Allium *pollination in the Gatersleben genebank*

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The seed-forming species of the genus *Allium* are outbreeders. Therefore, pollination measures have to be accompanied by a careful separation of the different accessions. We do it usually by growing the accessions in isolation greenhouses in a system consisting of the *Allium* accession together with a set of other outbreeding crops (e.g. carrots, cabbages, chicory, etc.), or by covering the field plot with isolation cages. Consequently, pollination needs to be done either by hand or by insects, the latter being much more efficient if done properly.

An insect breeding and research programme has been running for many years at IPK. For *Allium* the main pollinators were found to be flies and bumble bees, and to a lesser extent also the red mason bee (*Osmia rufa* L.).

The hover fly (*Eristalis tenax* L.) belongs to the family Syrphidae. The larvae have a very characteristic form, called rattail larvae. They leave the eggs 2 days after the clutch has been laid. In natural conditions, the larvae live in mud or muddy water. They can be maintained in a substrate made of soaked oats placed in a 10-cm layer in a container. When the larvae come to the maturation phase they begin to migrate, and can be collected into a pupating vessel. The pupae rest for 8-15 days depending on the breeding temperature. The imagines have a lifespan of about 4 months. Hover flies have been used for pollination of many different crops.

The red mason bee (*Osmia rufa*) can also be used for pollination of *Allium*, but, in sets with other species, it will not prefer the *Allium*. This is especially true for the white (onions) or greenish (bunching onions) flowering species, which are pollinated by these bees only if they are the only plants in the isolation cages. In comparison with honey bees, solitary bees have the advantage that they can be used in lower numbers, which is especially sensible in small isolation cages where populations of honey bees would starve and die very soon after the beginning of their activities. The solitary bees are maintained in hives as for honey bees. Various easily exchangeable nesting supports are added to the hives, e.g. pieces of reed stalks or paper tubes. The bees require a supply of wet loam-containing soil which they use to build their nests. It is possible to store the cocoons in cold temperatures of 0-3°C for durations up to 1 year. An area of 10 m² is sufficient for one couple of bees. In natural conditions in Germany, the bees fly between April and June. This can be extended until November if the cocoons are stored in cold conditions. The user should take care of eventual parasites (especially mites) and remove the infested material and animals.

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Osmia rufa *L. (Apoidea, Megachilidae) as a pollinator of cultivated and wild* Allium *species*

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To obtain good-quality seeds under isolation it is necessary to use effective pollinators. In Poland honey bees (*Apis mellifera* L.) or home flies (*Musca domestica* L.) are usually used as pollinators for onion, shallot and other *Allium* species. Observation shows that conditions in isolation cages are not very favourable to honey bees, and the home fly is not so tolerant to unfavourable weather conditions (especially low temperature) during flowering time. Therefore, it is necessary to conduct investigations on the breeding and introduction of other species of pollinating insects.

This study deals with the use of wild bees (*Osmia rufa* L.) for the pollination of cultivated and wild *Allium* species for different sizes of isolation cages, and a comparison of the pollination effect with honey bees and home flies.

The wild bee *Osmia rufa* (*O. bicornis* L.), a small insect belonging to the family Megachilidae (Wojtowski 1979), is the most common species of solitary bees that forage in the spring and occur all over Poland. The female is covered on the dorsal side with dense hair, rusty or ginger-red coloured. On the ventral side, the hair is bristly, yellowish-brown, and forms a so-called abdominal brush to gather nectar and pollen eventually used for pollination. The length of the body is 10–12 mm and that of the mouth organ 4.8 mm.

Solitary bees of *O. rufa* start foraging in the first 10 days of April and continue until the end of June. Following the swarming period, female bees make their nests in natural conditions, i.e. look for shelter in cracks of buildings, dry–rot trees or empty stems of dry plants.

For pollination under a controlled environment, solitary bees are easily available from rearing under trap nests (Wojtowski and Wilkaniec 1969; Wilkaniec 1991). Housed trap nests ought to be maintained at 1-3ºC to restrain the bees from emergence and coordinate their foraging with the flowering period of plants. There is considerable opportunity to adjust and control the flights of *O. rufa*. This insect is polyphagous and gathers nectar and pollen from blossoms of fruit trees, bushes, cultivated plants, etc.

The insects used for pollination of *Allium* species were obtained through controlled breeding in nest traps on reed stalks. Inhibited traps were stored in refrigeration at 1-3ºC in order to synchronize flight of the bees with the blooming of the flowers. Before the flowers began to bloom, the reed stalks were cut open and the cocoons removed. The cocoons were put into plastic boxes covered by cotton net and stored in a cool room at 1-3ºC and 65% RH, to keep inhibited bees (Wilkaniec and Kotlińska 1998).

The cocoons in plastic boxes were counted and placed in the isolators with the plants whose flowers had started to bloom. The isolators made from nylon net were 3 x 6 x 1.80 m, or 3 x 3 x 1.80 m or 3 x 2 x 1.80 m.

The insects (male and female) which emerged (were set free) from cocoons flew out from the boxes through holes in the walls and began to work on flowers. After 2-3 hours the first

male forms emerged from cocoons, followed the next day by female forms. After 2-3 days all insects had emerged. If the period of flowering was very long, cocoons were added.

The average number of cocoons per flower stalk depended on the number of flower stalks and varied from 0.5 to 4.0.

The number of blossoms (flower stalks in isolation cage) ranged from 7 to 380 depending on the *Allium* species.

Osmia rufa worked effectively under isolation cages, in greenhouses and plastic tunnels for about 1 month.

The advantage of these solitary bees in comparison with honey bees and bumble bees (*Bombus hypnorus* L.) is that their cocoons can be stored in controlled conditions for more than half a year (from January to August). During that time it is possible to set the bees free from cocoons for pollinating, at the time and in the amount selected.

These solitary bees do not sting, do not need food or drinks during the pollination period if the plants produce nectar even in very small quantities, and are also very tolerant to bad weather condition.

Observations show that *O. rufa* is easy to manage and very effective for the pollination of many different *Allium* species blooming from May to September. It is a promising insect for controlled pollination in the genus *Allium*.

Osmia rufa was used for the pollination of 30 *Allium* species (onion, shallot, *A. victorialis, A. ochotense, A. nutans, A. galanthum, A. pskemense, A. altaicum, A. obliquum, A. ledebourianum, A. fistulosum, A. flavum, A. tuberosum, A. ampeloprasum, A. alyncolicum, A. hymenorhizum, A. montanum* and others) and also for carrot, parsley and radish.

The effectiveness of the pollination and germination ratio obtained with *O. rufa* was at the level of those with honey bees and home flies, and in many cases much better.

These solitary bees are very useful, because it is possible to prepare the pollinators at a suitable time, and the costs of production are much lower than in the case of other pollinating insects.

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Research activities

Leek breeding for thrips resistance

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Introduction

Thrips (*Thrips tabaci*) have become a severe problem throughout the northern European countries (Germany, the Netherlands, Belgium, France, Switzerland) during the past decade, owing to the lack of pesticide effectiveness. According to C. Mollema, CPRO-DLO, The Netherlands (pers. comm.), Dutch growers spray leek plantations more than 20 times during the growing season against thrips with limited effect. Similar observations were reported from other countries. Therefore alternatives for thrips control are being investigated, such as different cultural methods (cover crops, use of nets, intercropping, etc. (Imhof *et al.* 1996)) and the search for resistant plants. At the SFRS, a breeding programme was initiated in 1992 to select and maintain thrips tolerance in our own cultivar ZEFA Plus. Progeny from inbreeding lines from low susceptible plants showed a significantly lower attack by thrips, compared with those plants obtained from inbreeding lines of highly susceptible plants (Theiler and Buser 1996). On the basis of these results it was concluded that there is a genetical base for thrips resistance in leek. Further experiments revealed that field selection could be misleading with respect to thrips-tolerant plants. To avoid such problems, the selection system was modified: after field selection, inbreeding of tolerant leek plants is forced as well as the formation of clones by bulbils. The following year, these clones are tested again in the field and only those which clearly show a significant lower attack by thrips than control plants are included in further breeding programmes. In addition, different planting schemes were compared with respect to thrips infestation and severity on leek. This report summarizes results obtained during 1997.

Material and methods

Cultivars, breeding lines and clones (bulbs) used are listed in Table 1 and were either grown at high densities in nursery beds (100-500 plants / m^2) or replanted in the field (16-20 plants / m^2). Seeds were sown in April in a nursery bed and partially replanted in June. Investigations on thrips incidence started in the middle of September until the middle of October, or just before harvesting time (October / November).

Thrips infestation occurred naturally at high population densities (e.g. >100 adult thrips per blue trap per week during summer 1997) and were evenly distributed throughout the experimental trials. Leaf damage caused by thrips could be recognized clearly on susceptible plants from July onwards.

Thrips infestation on individual plants was recorded using a classification system introduced by Püntener (1981) which distinguishes five classes: C-1 = no attack; C-2 = <10% of leaf area attacked; C-3 = 10-25% of leaf area attacked; C-4 = 26-50% of the leaf area attacked; C-5 = >50% of the leaf area attacked.

Results

Until 1996, the evaluation of thrips infestation and selection of low-susceptibility plants was made on and from field-grown plants, planted at a density of 16-20 plants / m^2. With such a selection scheme, the total number of plants (and numbers of cultivars and breeding lines) to be evaluated is limited by space (available land) and labour. During 1997, using seeds from ZEFA Plus, a comparison of different planting schemes was made with respect to thrips infestation: field-grown plants (FGP); plants sowed in rows at high density (HD); leeks grown in quick-pots at 500 plants / m^2 (QP) and densely planted leek at 100 plants / m^2 (DP). The results showed that plant density had only a minor effect with respect to the percentage of plants graded in classes 2 and 3 and led to an increased percentage of the most infected plants (class 5) (Fig. 1).

Additionally, different *Allium* spp., inbreeding and breeding lines were tested mainly at dense plantation (DP). Plants from *Allium scorodoprasum* subsp. *jajlac* (A.s) were the least susceptible progeny tested and showed the highest percentage of plants classified in class 2, followed by the progeny of *A. tuberosum* (A.t) of which >90% of the plants were scored in class 2 and class 3. From the two sources of *A. ampeloprasum* tested, that from Egypt (A.a-80) clearly showed a higher percentage of plants in class 2 and class 3 than that from the UK (A.a-81) which was comparable to the control ZEFA Plus (ZP). Thrips incidence on plants from *A. commutatum* (A.c) varied considerably but showed >20% of plants in class 2 (Fig. 2).

One inbreeding line (ZP-R.21), obtained from a self-pollinated ZEFA Plus plant (low susceptibility, thrips infestation class 2), showed a higher proportion of plants in classes 2 and 3 than that of the control ZEFA Plus (ZP) and the two other tested progenies, obtained from crosses of low-susceptibility plants (thrips infestation class 2) from cv. Arial (AL-R) and Paragon (PA-R) respectively (Fig. 3).

Table 1. Plant material used and number of plants evaluated for thrips resistance

Abbrev.	Plant material	No. of plants evaluated
	ZEFA Plus, open pollinated cv. from SFRS	
HD	sown plants at high density (>500 plants/m²)	263
QP	plants grown in quick pots (500 plants/m²)	
DP	densely planted leek (100 plants/m²)	
FGP	field-grown plants (16-20 plants/m²)	
A.s	*Allium scorodoprasum* subsp. *jajlac*	81
A.a-80	*A. ampeloprasum* [Egypt]	50
A.a-81	*A. ampeloprasum* [UK]	79
A.c	*A. commutatum*	63
A.t	*A. tuberosum*	36
ZP	*A. porrum* ZEFA Plus	1004
ZP	ZEFA Plus	1004
AL-R	cv. Arial resistant, seed from 3 cross-pollinated plants, class 3	291
PA-R	cv. Paragon resistant, seed from 6 cross-pollinated plants, class 3	50
ZP-R	ZEFA Plus resistant, seed from 51 crossed or selfed plants, classes 2&3	989
ZP-R.21	ZEFA Plus resistant, seed from 1 inbred plant (No. 21), class 2	75
B-1	cloned plants (raised from bulbils) from one ZP plant, class 5	22
B-7	cloned plants (raised from bulbils) from one ZP plant, class 2	27
B-14	cloned plants (raised from bulbils) from one ZP plant, class 2	77
B-15	cloned plants (raised from bulbils) from one ZP plant, class 2	82
B-17	cloned plants (raised from bulbils) from one ZP plant, class 2	160
ZP	ZEFA Plus, seed (control)	279

Bulbils (clones) were induced on flowering plants selected as resistant to thrips infestation (class 2: B-7, B-14, B-15, B-17) in 1996 and further cultivated in the greenhouse during winter and spring before planting in the field in June 1997. As control, bulbils from a highly susceptible plant (class 5: B-1) and seedlings from ZEFA Plus (ZP) were used (Fig. 4).

Plants from B-1 were severely infested by thrips (>95.5% of plants in class 5), resembling the high susceptibility of the donor plant, whereas more than 75% of the cloned plants of B-14 and B-17 were recorded in class 3, similar to their donor plants and regarded as more tolerant. This was not the case for the cloned plants derived from B-7, which were infested in the same proportion as the plants from ZEFA Plus (ZP), and regarded as susceptible. Plants grown from bulbils from the donor plant B-15 varied considerably in their susceptibility to thrips infestation, but showed the highest ratio of plants in class 2.

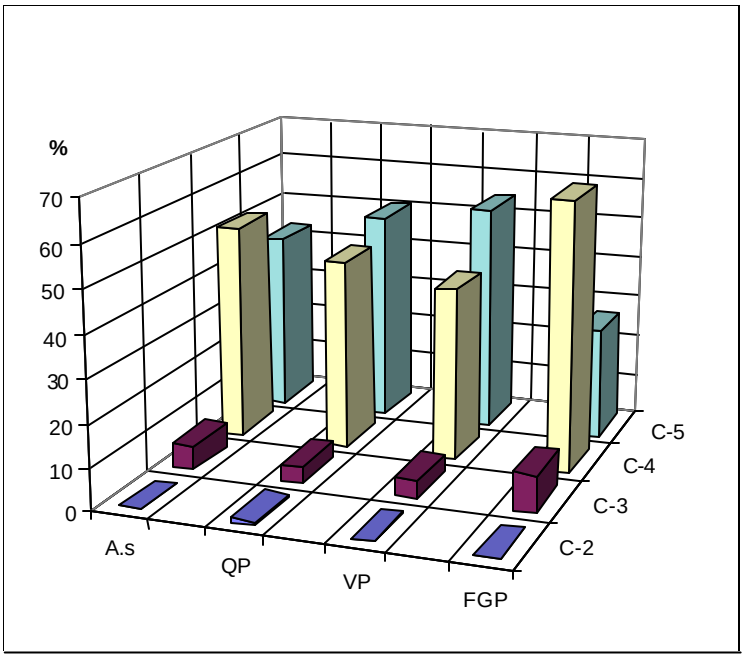

Fig. 1. Thrips infestation on ZEFA Plus: number of plants in % per class 2-5 (C-2 to C-5), 1997, comparison of planting schemes. A.s, QP, VP, FGP – see Table 1 for explanation of abbreviations.

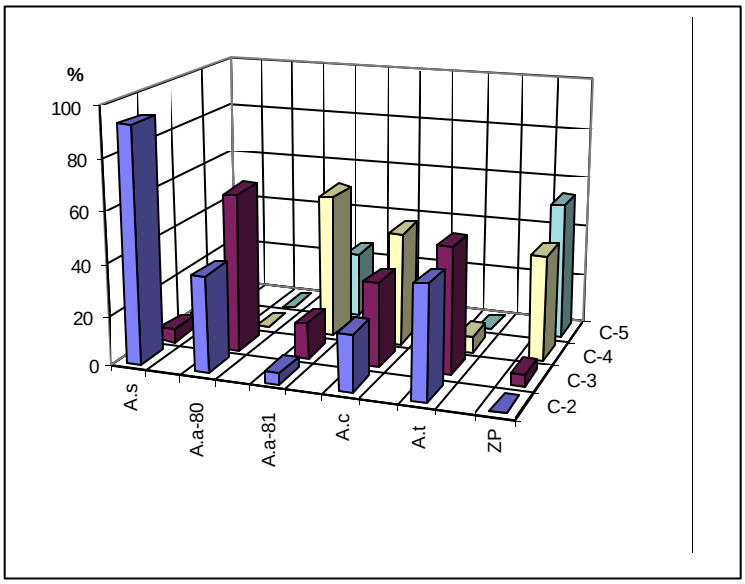

Fig. 2. Thrips infestation on ZEFA Plus and different *Allium* spp.: number of plants in % per class 2-5 (C-2 to C-5), 1997. A.s, A.a-80, A.a-81, A.c, A.t, ZP – see Table 1 for explanation of abbreviations.

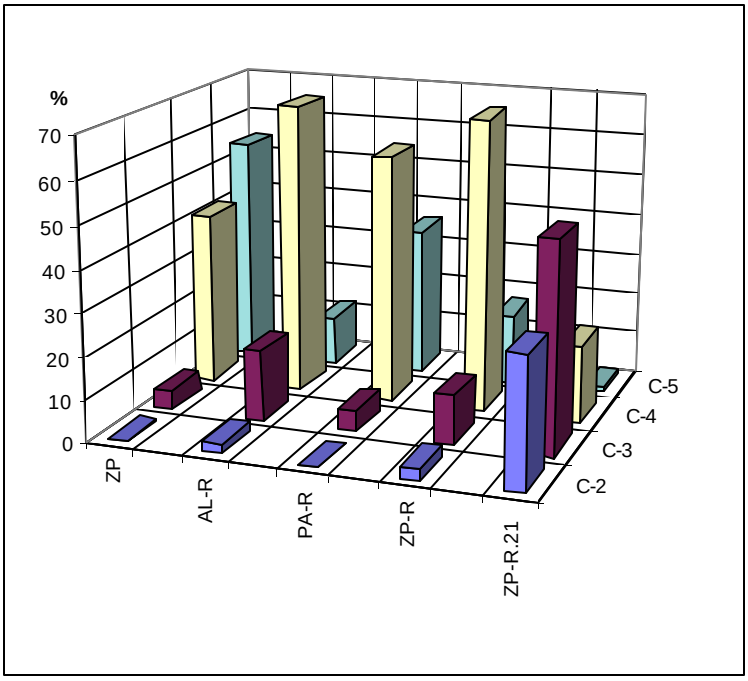

Fig. 3. Thrips infestation on ZEFA Plus and resistant lines: number of plants in % per class 2-5 (C-2 to C-5), 1997. ZP, AL-R, PA-R, ZP-R, ZP-R-21 – see Table 1 for explanation of abbreviations.

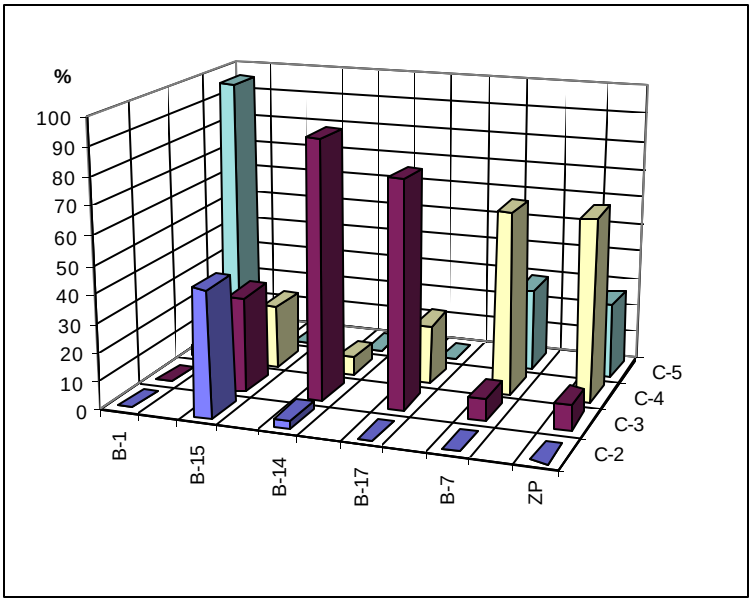

Fig. 4. Thrips infestation on ZEFA Plus plants derived from bulbils: number of plants in % per class 2-5 (C-2 to C-5), 1997. B-1, B-15, B-14, B-17, B-7, ZP – see Table 1 for explanation of abbreviations.

Conclusion

The results from 1997 on leek susceptibility to thrips infestation (presented here) confirmed those from previous years (Theiler and Buser 1996) and indicated a considerable variation of susceptibility in leek cultivars and related *Allium* species. Breeding for thrips resistance seems possible, but should include testing of cloned plants, obtained from selected donor plants and further inbreeding. In addition, it could be demonstrated that the selection of thrips-resistant plants is possible at high density planting scheme as described for other plant species (Panda and Khush 1995). Plants scored in classes 2 and 3, grown either from seed (e.g. ZP-R.21, or *Allium ampeloprasum* Egypt) or from bulbils (e.g. B-15, B-14, B-17), were selected for further breeding.

Acknowledgement

I thank all colleagues of the horticultural division at SFRS, involved in growing, harvesting and evaluating the leek plants.

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Overview of the research carried out by the Allium *group of CPRO-DLO*

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The *Allium* group of CPRO-DLO currently consists of nine researchers working on different aspects of *Allium* genetics. The three main themes are genome organization, quality and resistance.[13]

Genome organization

This theme consists of several projects.

- The first is concerned with the development of an *Allium* AFLP molecular marker map. We have constructed a map of 110 markers spread over 10 linkage groups with a total length of 650 cM. This map, which covers about 80% of the genome, is based on an interspecific cross between *A. cepa* L. and *A. roylei* Stearn (Kik *et al.* 1996).
- The next project studies the genome organization of bridge crosses between onion and the interspecific hybrid between *A. fistulosum* L. and *A. roylei*, via genomic *in situ* hybridization (GISH). The results obtained so far suggest that there is a fair chance that the 'gap' between *A. cepa* and *A. fistulosum* can be bridged using *A. roylei* as an intermediate (Krustaleva and Kik 1998).
- Another research project in this theme is genetic transformation of *A. cepa*. We have established a reliable tissue culture system by optimizing callus induction from mature and immature embryos and plant regeneration from suspension cultures (Zheng *et al.* 1998). At the moment we are trying to establish a reliable and quick transformation protocol.
- The last research project in this theme concerns the introduction of CMS into leek. In the past a reliable protoplast regeneration protocol was developed (Buiteveld *et al.* 1993; Buiteveld and Creemers-Molenaar 1994; Buiteveld and Fransz 1994) and this enabled us to carry out protoplast fusions between leek and CMS onions. By means of somatic hy(cy)bridization we have obtained plants from which the nuclear DNA consists mostly of leek and the mitochondrial (mt) DNA consists mostly of onion. Analyses of the mtDNA variation in leek and its wild relatives showed that there is very little variation in leek but enormous variation in its wild relatives. Furthermore we observed that crosses between leek and its wild relatives from the *A. ampeloprasum* L. programme complex are possible. This research showed that introduction of alloplasmic CMS in leek via interspecific crosses might be feasible (Kik *et al.* 1997).

Quality

In this theme we have been carrying out research, since 1996, in the framework of an EU project coordinated by CPRO-DLO[14] which analyzes the carbohydrate and the sulphur

[13] See also our Web site at <http://www.cpro.dlo.nl/vfc/allium>.

[14] EU FAIR CT95-465: Tailoring the Onion Crop for the 21st Century - The Development of High Quality Fresh and Processed Onions.

pathway in onions. The ultimate goal of this project is to develop onions with added value (van Raamsdonk and Kik 1997). Our task in this project is to map keygenes on an onion AFLP / microsatellite marker map for dry matter content and reducing sugars on the one hand, and pyruvate content on the other hand. The mapping research is carried out in close cooperation with IPK in Gatersleben.

Resistance

Together with the Research Institute for Vegetables (Lembang, Indonesia) we are trying to develop shallots which are resistant to *Colletotrichum gloeosporioides* (anthracnose) and *Alternaria porri* (purple blotch). For *Colletotrichum* we developed a reliable and quick biotest and identified sources of resistance. Furthermore we analyzed the resistance present in *A. roylei* to a Brazilian isolate of *C. gloeosporioides* and we found that it is most probably determined quantitatively (Galvan *et al.* 1997).

Since 1996 we have been carrying out with the Volcani Center (Israel) a project in the framework of a bilateral agricultural research programme between our countries. The project is partly concerned with resistance breeding to *Sclerotium* species (white rot) in ornamental *Allium*. We observed that two *Sclerotium* species are active in The Netherlands, namely *S. cepivorum* and *S. perniciosum*. We found that *S. perniciosum* is more aggressive than *S. cepivorum* and showed that interactions in virulence are present between *Allium* and *Sclerotium* species. Furthermore we identified sources of resistance in ornamental *Allium* to both *Sclerotium* species.

The research project on *Phytophthora porri* (white tip disease) in leek, analyzing epidemiological and resistance breeding aspects, has been completed succesfully (Smilde *et al.* 1995, 1996, 1997). Material with a high level of resistance has been issued to several plant breeding companies who are currently using it in their leek improvement programmes.

In the framework of a genetical resources project financed by the EU, which started in 1996, we are carrying out disease resistance testing for *Phytophthora porri* (white tip disease), *Puccinia porri* (rust) and *Thrips tabacci* (thrips) in leek and its wild relatives. The ultimate aim of this project is to develop a well-documented *Allium* database.

The final project in this theme is the introduction of resistance to *Spodoptera exigua* (beet army worm) into tropical onions and shallots. Together with our Indonesian counterparts we are trying to introduce the resistance to this pest via genetic transformation (see genome organization) using *Bt* constructs and via marker-assisted breeding (MAB). For the MAB part we have developed a reliable biotest for the identification of sources of resistance in *Allium cepa* and its wild relatives. The next step will be to develop a population in which the resistance segregates, which allows us to link the resistance gene(s) to molecular markers.

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Research activities in the Department of Taxonomy, IPK Gatersleben

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The department maintains a large living *Allium* collection of more than 300 species (more than 1800 determined accessions) supplemented by about 25 species of closely related taxa.

This collection is under permanent taxonomic supervision (P. Hanelt, R. Fritsch, N. Friesen, J. Kruse, K. Pistrick) and has been enlarged by accessions collected in Central Asia and Turkey (R. Fritsch, N. Friesen).

This material formed the basis for a broad array of special investigations: seed testa structures (J. Kruse), phenological data (K. Pistrick), anatomical structure of roots, leaves, scapes and flower parts (R. Fritsch), ontogenetic studies of flower differentiation (J. Kruse, K. Pistrick), karyotyping and chromosome counts (N. Friesen, R. Fritsch), and for systematic studies of subgenera *Rhizirideum* (N. Friesen) as well as *Melanocrommyum* (R. Fritsch) for which also herbarium specimens from Tashkent, Ashkhabad, Bishkek and St. Petersburg were involved. The collection also has been used by visitors from abroad for special investigations on the taxonomy of subgenus *Allium* (F. Khassanov, Tashkent) and on the embryology of Central Asian species (O.A. Ashurmetov, Tashkent).

The distribution and taxonomy of Middle Asian *Allium* species were studied during joint field work in Middle Asia (R. Fritsch and F. Khassanov). At Olomouc, the greater part of still undetermined *Allium* accessions were determined during a visit in 1996 (R. Fritsch). The collection of herbarium vouchers was permanently enlarged (K. Pistrick) and has been used by several visitors from abroad. Voucher specimens were determined for other institutions (P. Hanelt, N. Friesen).

Molecular analysis: isoenzyme analysis of the *A. cepa* alliance was used to study the question of origin of some minor crop species (Helga Maass). More than 60 species were investigated by PCR-sequencing of plastid (rbcL-atpB intergenic spacer) and nuclear (ITS) markers for a phylogenetic analysis of the genus *Allium* (Manfred Klaas). A phylogenetic analysis of genus *Allium* was made based on RFLPs of PCR products from non-coding chloroplast regions; as many species are to be included in the final analysis (Ted Mes, Sven Pollner). The hybridogenic origin and the relatedness of important and minor crop species as well as ornamentals of genus *Allium* was investigated with RAPD and GISH (Nikolai Friesen, Manfred Klaas). Microsatellite markers in *Allium cepa* were developed for purposes of cultivar identification using a novel pre-cloning di- and trinucleotide enrichment method. The obtained markers will be integrated into an existing AFLP map of *A. cepa* which has been established by Dutch cooperation partners at CPRO-DLO, Wageningen (Dirk Fischer).

GEN RES 20: "Protecting Future European Community Crops - a programme to conserve, characterise, evaluate and collect Allium *crops and wild species"*

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Task: Characterization and evaluation of bulb onions

Disease resistance

Downy mildew (*Peronospora destructor*) is one of the most common leaf diseases in onions and may cause losses of yield and quality in most years. It is an airborne disease in which infection very often begins with early transplanted onion sets. Not only does the disease cause serious damage by itself, it also opens avenues for further damage by *Alternaria* and *Stemphylium*. As growth management systems change toward environmentally safer systems (IPM, organic) there is an increasing interest in resistant varieties.

Genetic resources material will be field-tested for resistance to downy mildew. Test accessions are grown in field plots with cultivars known to be susceptible to the disease ('White Lisbon' or 'Albion'), thus promoting infection in the plots and acting as inoculum sources for test plants. Field tests have been shown to be a useful method of evaluating resistance.

The initial evaluation will be carried out using a randomized complete block design with eight blocks, each block consisting of individual accessions in plots of 20 plants. This design is necessary to carry out comparisons between varieties on an equal level of infestation. Plants will be evaluated for resistance at regular intervals beginning with the first attack in the trial.

Field experiment 1997

Nineteen NGB accessions were sown in March and April, propagated in a glasshouse, and planted to field in May or June. Three accessions of *A. fistulosum* L. and a sample of the downy mildew resistant *A. roylei* Stearn received from CGN, Wageningen were included in the experiment. For details see Annex 1.

Test for resistance to Peronospora

Plants of the susceptible cultivar 'Albion' were transplanted to all plots with a density of 2 plants per m^2. If no accession was infected naturally by *Peronospora*, infected leaves from other fields were placed in each plot.

Assessment of sporulation of Peronospora

For each plot/accession 2-4 observations were made in the field to assess the attack of downy mildew. The total number of infected plants as well as the percentage of infected leaf area on individual plants were assessed on a 0 to 10 scale, where 0 = no sporulation and 10 = completely diseased plants.

Characterization

All 19 NGB accessions will be described for agronomic characters according to the "Minimum Characterization Descriptors" recommended by the ECP/GR *Allium* Working Group (see Annex 3).

Annex 1. *Allium* GEN RES 20. Evaluation of resistance to downy mildew (*Peronospora destructor*), details of field experiment 1997.

Experimental design	Randomized complete block, 8 replicates
No. of accessions	24 (see Annex 2)
Row distance	50 cm
Plant density	20 plants per m of row ~ 40 plants per m^2
Plot size	0.5 m^2 (20 plants)
No. of plants to be recorded	8 x 24 x 20 =3840
Sowing time (glasshouse)	Week 15
Planting date, seedlings	2 June
Assessment of downy mildew	11, 15, 18 and 29 August

Annex 2. *Allium* GEN RES 20. Evaluation of resistance to downy mildew (*Peronospora destructor*), accession designation.

1	NGB	535	BRUNSWIGER "RODO"
2	NGB	7771	BRUNSWIGER "WIMO"
3	NGB	1915	OWA
4	NGB	1917	RIJNSBURGER "IDOL"
5	NGB	1918	RIJNSBURGER "RIMA"
6	NGB	574	RIJNSBURGER "ROAR"
7	NGB	9244	RIJNSBURGER "ROBOT"
8	NGB	7774	RIJNSBURGER "VIGO"
9	NGB	1919	RONDEX
10	NGB	538	STUTTGARTER RIESEN "DISKOS"
11	NGB	1914	STUTTGARTER RIESEN "PLANO"
12	NGB	537	VERTUS VERTON
13	NGB	1913	ZITTAUER "ZIRIUS"
14	NGB	536	ZITTAUER "BENO"
15	NGB	1912	ZITTAUER "LUNA"
16	NGB	7773	HAMUND
17	NGB	4537	LAFORT
18	NGB	4538	LASKALA
19	NGB	4571	LAVA
20	CGN	16416	"WHITE LISBON"
21	CGN	14766	A. FISTULOSUM "MINSK"
22	CGN	16378	A. FISTULOSUM "MATSUMOTA" (TAKII)
23	CGN	18740	A. FISTULOSUM "RUSSIA"
24	CGN	926699	A. ROYLEI

Annex 3. Bulb onion - minimum characterization.[15]

ON 3.4 Sowing date

ON 3.5 Harvest date

ON 4.1.10 Shape of full-grown bulbs[16]

ON 4.1.11 Uniformity of bulb shape
- 1 Homogeneous
- 2 Variable
- 3 Highly variable

ON 4.1.12 Bulb skin colour
- 1 White
- 2 Yellow
- 3 Light brown
- 4 Brown
- 5 Dark brown
- 6 Red
- 7 Green
- 8 Yellow and light brown
- 9 Light violet
- 10 Violet
- 11 Mixed populations (specify)

ON 4.1.14 Uniformity of bulb colour
- 1 Homogeneous
- 2 Variable
- 3 Highly variable

ON 6.1.8 Storage life of storage organs

ON 6.2.4 Daylength requirement

[15] See p. 6 *in* Report of a Working Group on *Allium*. Fifth meeting, 25-27 May 1995, Skiernewice, Poland (T. Gass, D. Astley, H.D. Rabinowitch and E.A. Frison, compilers). 1996. International Plant Genetic Resources Institute, Rome, Italy.

[16] See Figure 1, p. 7, *in* Report of a Working Group on *Allium*. Fifth meeting, 25-27 May 1995, Skiernewice, Poland (T. Gass, D. Astley, H.D. Rabinowitch and E.A. Frison, compilers). 1996. International Plant Genetic Resources Institute, Rome, Italy.

Biodiversity, distribution and preservation of Allium *spp. in Bulgaria*

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The biosystematic investigations on the genus *Allium* L. carried out in Bulgaria for more than 20 years provided new scientific data in the fields of taxonomy, anatomy, karyology, etc., and over 90 new localities of already known species were found.

The biological diversity in the genus is represented in the Bulgarian flora by 44 species (five cultivated), organized in five subgenera, 13 sections and five subsections:

Subg. *Rhizirideum* (G.Don f.ex Koch) Wendelbo	9 spp.
Subg. *Melanocrommyum* (Webb & Berth.) Rouy	5 spp.
Subg. *Ophioscorodon* (Wallr.) Ceschm.	1 sp.
Subg. *Allium*	11 spp.
Subg. *Codonoprasum* (Reichenb.) Zahar.	18 spp.

The 39 wild species spread in the country have the following florogenetic structure: Mediterranean 54%, Euroasian 32%, Mediterranean-Pontic 7%, and endemics 7%. Balkan endemics are *A. melanantherum* Pancic and *A. rhodopaeum* Velen., and Bulgarian endemics *A. thracicum* Halacsy & Gheorghieff. This structure reflects the migration paths in the geological past, as well as the leading role of the Mediterranean element.

The karyological investigations showed that 56.25% of species are diploids, 12.50% are triploids, 18.7% tetraploids, 7.81% pentaploids and 4.69% hexaploids, thereby suggesting polyploidy as a main evolutionary mechanism. In 15 species, B-chromosomes (1 to 6) were found, in others different chromosome changes and polyploid series were observed (e.g. *A. rotundum* L.:- 2*n* = 16, 16+1-3B, 24, 32, 33+1B, 40, 41, 44, 48+1B). This pattern seems to indicate *Allium* populations as a source of rich variability.

A scanning electron microscopic study of the spermoderm showed the predominance of the convex test type, the tabular and concave types being less frequent (Terzijski and Ceschmedziev 1994). The analysis of the morphological traits and the anatomical structure of vegetative and reproductive organs, as well as the data from the phytoncide characteristics of species, allowed the elucidation of a number of problems concerning the systematics and evolution in *Allium* (Ceschmedziev 1989; Ceschmedziev and Karova 1990; Neykov *et al.* 1992). The evaluation of the decorative characters allowed the majority of species to be recommended as ornamental plants. Unfortunately, we have no traditions in this respect. Only *A. sphaerocephalon* L., *A. atropurpureum* Waldst. & Kit. and *A. ursinum* L. are rarely used.

The only species used for food are *A. ursinum* (fresh and processed) and *Nectaroscordum siculum* (Urcia) Lindley (= *A. siculum* Urcia) as a spice (for preparation of green table salt).

Cultivated onion species were also included in the investigations. *Allium proliferum* (Moench) Schrader and *A. cepa* var. *aggregatum* G.Don f. were reported for the country. The economic characters of the common Bulgarian and foreign *A. cepa* cultivars were studied and a key for their identification was developed (Ceschmedziev *et al.* 1987).

The horizontal and vertical distribution of species is rather irregular. Their distribution in the 20 floristic regions is the following: Stara Planina mountain (27), Rhodope mountains

(24), Black Sea coast and Thracian plain (20 each). The poorest in species are the Mesta valley (5) and Belasica mountain (4 species). The vertical distribution is as follows: up to 500 m asl (26 species), up to 1000 m (18), up to 1500 m (9), up to 2000 m (9) and over 2500 m (5 species), which shows that the highest specific diversity is concentrated in the plains and the lower mountain zone. Most common are: *A. flavum* L., *A. sphaerocephalon* L., *A. rotundum*, *A. scorodoprasum* L., *A. vineale* L. and *A. paczoskianum* Tuzson (found in 15 or 16 floristic regions). *Allium victorialis* L., *A. schoenoprasum* L., *A. senescens* L., *A. melanantherum* and *A. thracicum* are spread in the Alpine zone. Most tolerant to the altitude range are *A. vineale* and *A. ursinum*, which are found from 160 to 2000 m, while others like *A. angulosum* L. and *A. pallens* L. grow up to 300 m.

In the Red Data Book of Bulgaria (Dakov 1984-1985, vol. 1) the species *A. angulosum, A. cupani* Rafin. and *A. stojanovii* I. Kowatschev (= *A. amethystinum* Tausch) are included in the category "rare", and *A. senescens* is categorized as "threatened". The investigations proved that *A. amethystinum* is more common than the Red Data Book of Bulgaria shows and, in our opinion, it might be removed from the book. The same species has been included in the List of Rare, Threatened and Endemic Plants in Europe (Council of Europe 1982), as well as in the European Red List of Globally Threatened Animals and Plants (Economic Commission for Europe 1991) in the category "rare". There are other species in the country which could be categorized as rare or threatened (*A. nanum* (Asch. & Gr.) Ceschm., *A. thracicum*, etc.).

The intensive anthropogenic activities have disturbed the balance in the populations of a number of species. For example, in the locality Ostrova near Plovdiv, the cutting down of poplars disturbed the ecological balance and the population of *A. ursinum* is strongly damaged. It should be pointed out that this population is one of the two in the Bulgarian flora where this species grows at the lowest altitude (160 m). Especially alarming is the situation in the Black Sea coast, where, due to intensive resort construction and mass visits in summer, whole populations are threatened with extinction and a sharp decrease in density. It should be emphasized that this floristic region is inhabited by about 53% of the species, including some rare ones.

Evaluation of the status of threatened populations and measures for their *in situ* and *ex situ* conservation should be undertaken urgently in the country to preserve its valuable *Allium* genetic resources.

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*Evaluation and use of the existing genetic resources of onion (*Allium cepa *L.) in Bulgaria*

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The basic aims of the scientific and applied research on onion during recent years are the creation and introduction of onion varieties and hybrids for different purposes. The existing local material for initial selection is limited. Therefore it was necessary to test and evaluate foreign collections under the climatic conditions of Bulgaria, with the aim to select genotypes adapted to the local conditions, including daylength requirements.

Materials and methods

One hundred and sixteen foreign accessions were tested under the conditions of the Experimental Station for Vegetable Crops, Gorna Oryahovitsa.

- The major part (76) consists of annual samples, planted in spring
- Twenty-seven samples were tested for shorter daylength by late planting (sowing date 5-15 September)
- Thirteen samples were tested for biennial cultivation by sets.

The plants tested were examined and evaluated for vegetation length, form, shape and colour of the bulb, productivity, dry matter and sugar content, resistance to *Peronospora*, and storage qualities.

Classic selection methods were used, aiming at the development of new starting material for breeding.

Results and discussion

Research results of selection for economic and biological traits are given in Table 1.

The annual early and middle-early accessions are distinguished by their high productivity and good storage.

Selected biennial accessions which have globular, thick bulbs with high dry matter content (18-20%) have a practical value.

From selection for cytoplasmic male sterility, varieties 1713 and 1770 were created; they are adapted to our conditions and have good economic quality. Line 1713-B is resistant to *Peronospora* R0.

Table 1. Characteristics of the best selections of onion in Bulgaria

			Economic indicators				
Catalogue no.	Origin	Method of growing	Vegetation period (days)	Product-ivity[†]	Storage	Dry matter (%)	Other
3 -97	Bulgaria	annual	100-105	**	very good	13-14	globular bulb
17-97	Netherlands	annual	110-115	***	good	10-12	
40-97	Russia	annual	110-115	**	excellent	10-12	
1760	Netherlands	annual	110	***	very good	10-12	
1743	Bulgaria	annual	110-115	***	–	6-8	violet shells and globular bulb
1731	Hungary	annual	110-115	**	good	12-14	white skin colour
1720	USA	annual			–	–	brown seeds
1776	Bulgaria	annual	100-105	**	v. good	14-15	line with CMS
1713	USA	annual	110-115	**	v. good	10-12	line with CMS, resistant to *Peronospora*
1770	Japan	annual, late summer sowing	early	***	–	–	
1716	Japan	annual, late summer sowing	early	***	–	–	
1671	Bulgaria	biennial	85-90	***	excellent	18-19	globular bulb
104-97	Bulgaria	biennial	90	***	excellent	19-20	globular bulb

[†] *** = High; ** = Medium.

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Results of onion breeding and introduction in Bulgaria

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Onion is a traditional and basic vegetable crop in Bulgaria. It is used almost every day and is versatile throughout the year, consumed early in the spring as green onion, from the beginning of summer as fresh bulbs, and during fall and winter as stored bulbs. Onion is very important for the canning industry, for drying.

In terms of cultivated area, the most important are varieties of pungent onion from sets. Therefore breeding is focused on the improvement of varieties from this group, known as varieties for biennial cultivation.

A pioneer in research and breeding work with onion from 1937 was Acad. Pavel Popov. Later onion breeding was continued by Prof. Zhechka Zhecheva (1938-73), Prof. Iliya Minkov (1952-82), Prof. Dr Stefan Buchvarov (1953-87) and Prof. Dr Y. Todorov from 1967 (Todorov 1985).

The achievements of onion breeding and introduction are summarized below.

Study of local forms and introduction of foreign varieties

During the first stage of research work, the resources and diversity of local forms derived by Bulgarian farmers were studied. Simultaneously with local varieties and forms in the collection, over 250 onion varieties and accessions coming from foreign seed companies and research institutes from Hungary, USA, France, Germany, Russia, The Netherlands, Poland were tested.

These studies established that foreign varieties from more northern or more southern origin respectively prolong or accelerate their vegetation under Bulgarian conditions because of the photoperiodic reaction; they have more vigorous or weaker growth and do not form high-quality bulbs. Comparatively better results with 1-year cultivation are obtained with some American onion varieties (‘Early Yellow Globe’, ‘Southport Yellow Globe’, ‘Texas Grano’) which, however, do not exceed the developed local varieties (Zhecheva *et al.* 1977). These results direct breeders’ attention to genetic resources of local origin. Therefore the most valuable foreign varieties are used in breeding for hybridization.

From a study of local populations, Acad. Pavel Popov describes (Daskalov and Popov 1941):

a) Set onions

- ‘Lyaskovski’ (synonym Bulgarian arpadzhik) – the most well-known and widespread local variety in the whole country
- ‘Slivenski’ – with more globe-shaped bulbs than those of ‘Lyaskovski’
- ‘Starozagorski’ – with flatter shape
- ‘Asenovgradski zhult’ – with the highest transportability, shaped like ‘Slivenski’
- ‘Melnishki’ – strongly flattened shape of the bulbs, with yellow skin and good storability.

b) Water onions

- 'Samovodska kaba' (synonym Bulgarska kaba, Kantar topuz) – bulbs with conical shape, sweet taste, average winter storability
- 'Shumenska burzitsa' – earlier than 'Samovodska kaba'
- 'Gyumyurdzhinska kaba' – bulb shape is flat, with good storability and firmness, resistant to downy mildew
- 'Asenovgradska' – the most widespread red salad variety for South Bulgaria.

Breeding by individual selection and inbreeding

The great heterogeneity typical of local populations imposed from the start that improvement work in the Maritsa Vegetable Crops Research Institute be directed toward the creation of more uniform varieties with improved economic properties, high and stable yield.

As a result of group-family selection from local onion populations the following varieties were bred (according to Daskalov and Atanasov 1966):

- 'Lyaskovski 58' from population Lyaskovski
- 'Plovdivski 10' from population Asenovgradski
- 'Slivenski 34' from population Slivenski
- 'Samovodski podobren' from population Samovodski luk
- 'Gyumyurdzhinski 11' from population of local onion from Yambol region
- 'Asenovgadska 5' from population Asenovgradski cherven
- 'Samovodska 9' from population Samovodska kaba
- 'Ispanski 482' from onion coming from USA
- 'Lyaskovski 90' - new variety developed as a result of continuous breeding by inbreeding method and selection for dry matter content from 'Lyaskovski 58'. It is suitable for growing by sets and direct sowing.

Intervarietal hybridization

Intervarietal hybridization was used for the development of varieties with new, more valuable economic properties, resulting in the creation of onion varieties 'Trimontsium', 'Pioner', 'Konkurent', 'Yubilei 50' and 'Plovdivski cherven'.

- 'Trimontsium' is created by crossing the varieties 'Plovdivski 10' and 'Ispanski 482' and selection
- 'Pioner' is a result of hybridization between Bulgarian and American varieties
- 'Konkurent' is a result of hybridization between the Hungarian variety 'Makoj' and the Bulgarian var. 'Plovdivski 10'. It possesses valuable economic properties of both parent varieties. It is suitable for cultivation by sets and direct sowing.
- 'Yubilei 50' is created by crossing of the Hungarian variety 'Makoj' and the Austrian 'Bernsteinfarbige'. Semi-pungent, with almost globe bulbs, well stored during winter.
- 'Plovdivski cherven' is developed by selection in a cross between 'Red Wethersfield' from Burpee Seed Co. and 'Red Flavour' received from the Netherlands. Its bulbs are purple red, semi-pungent, with good storability.

Use of the heterosis method

Research work for the use of cytoplasmic male sterility (CMS) in the breeding of hybrid onion varieties started in 1957-58 by Zhecheva *et al.* (1970) who discovered male-sterile plants in almost all onion varieties. They started intensive and large work for the development and study of male-sterile lines. From 1962 to 1974, 1925 male-sterile lines of different varieties and accessions were studied. The successful breeding work for development of CMS maintainer lines was performed with the varieties 'Lyaskovski 58' (Zhecheva *et al.* 1972), 'Makovski' (Buchvarov and Trifonov 1976) and 'Ispanski 482' (Todorov 1977).

The comparative analysis between the results theoretically expected and those obtained in the breeding of male sterility maintainer lines show that CMS is of a classical type in varieties 'Lyaskovski 58' and 'Ispanski 482' (Todorov 1976). Besides, we studied some problems of hybrid seed production, variation and inheritance in F_1 of vegetation period, yield and a number of morphological and quality characters of the bulbs.

Simultaneously with the breeding of maintainer lines, the general and specific combining abilities of male-sterile lines are also tested. Out of the 305 combinations tested during 1966-74 a number of F_1 hybrids proved to be very promising. The State Variety Comission registered for growing in Bulgaria two hybrids, 'Uspeh 6', created in the Maritsa Vegetable Crops Research Institute, Plovdiv, and 'Rekord 2', bred in the Experiment Station for Vegetable Crops, Gorna Oryahovitsa. Their practical use is still limited for economic reasons and low introduction of direct sowing.

Conclusions

- The local onion forms and over 250 foreign varieties and accessions were tested. Foreign varieties gave unsatisfactory results in direct introduction and practical application. Therefore, the most valuable of them were used for hybridization.
- The following onion varieties were developed by the method of individual selection: 'Lyaskovski 58', 'Slivenski', 'Samovodski podobreni', 'Gyumyurdzhinska 11', 'Asenovgradska No. 5', 'Samovodska' and 'Ispanski 482'.
- The new variety 'Lyaskovski 90' was created by the inbreeding method and selection for dry matter content.
- The varieties 'Trimontsium', 'Pioner', 'Konkurent', 'Yubilei 50' and 'Plovdivski cherven' have been developed by intervarietal onion hybridization.
- Research work is carried out for the use of CMS in hybrid seed production. The developed hybrids are used on a small scale for economic reasons and restricted use of growing onion by direct sowing.

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Quality of Bulgarian onion varieties

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Onion is a basic vegetable crop in Bulgaria, which covers about 10 000 ha. Onion production uses Bulgarian varieties, mainly by sets and less by direct sowing. Ripe onion consumption is about 10 kg per capita. A brief description of the Bulgarian onion varieties is given below.

Lyaskovski 58
Widespread variety, suitable for growing by sets. Bulbs 60-80 g, flat-round with 15-18% dry matter content. High keeping quality, allowing extension of consumption and processing periods.

Konkurent
Bulbs flat-round, 100-120 g. Inner flesh scales milky white; dry matter content 16.5-17.5%; disaccharides 8.80% and monosaccharides 2.73%. Good keeping quality. Vegetation period 90-100 days when grown by sets and 105-120 days by direct sowing. Average yield 20-35 t/ha.

Trimontsium
Suitable for growing by sets and direct sowing. Bulbs flat-round with good chemico-technological qualities for continued consumption and processing. Average yield 20-35 t/ha.

Plovdivski 10
Bulbs mostly flat-shaped, index 0.5-0.6 and 14-15% dry matter content. Good keeping quality. Suitable for growing by sets.

Pioner
Bulbs almost round with very good inner structure, semi-hot flavour and good storability. Suitable for direct sowing. Production for export and domestic market.

Jubilee 50
Suitable for direct sowing. Bulbs 90-120 g, almost round, with good inner structure. Dry matter content 11-13%. Very high keeping quality to the end of February.

Asenovgradska 5
Red, salad, high-yielding variety for direct sowing or growing by seedlings. Bulbs flat-round with specific hollow around the neck. Keeping quality not satisfactory after January.

Ispanski 482
Highest yielding variety. Suitable for direct sowing or grown by seedlings. Comparatively late. Bulbs large, 150-300 g, almost round.

Plovdivski Red

Bulbs medium-large, 80-115 g, almost round, with excellent inner structure. Taste mid pungent. Dry matter content 10-11%. Average standard yield 25-35 t/ha. Suitable for direct sowing, but can be grown by seedlings or sets.

Lyaskovski 90 (New)

Suitable for growing by sets and direct sowing. Bulbs 80-100 g, flat-round, with 16-19% dry matter content and high keeping quality. For long storage and processing.

Uspeh 6 F1

Highest yielding F_1 hybrid combination between Lyaskovski 7710A and Ispanski 482, registered for growing by direct sowing. Bulbs are flat-round with good chemico-technological qualities for continuous consumption and processing.

Quality of Bulgarian onion varieties

			Bulbs					
Variety	Method of growing†	Vegetation period (days)	Weight (g)	Index (H/D)	Vegetation buds	Dry matter content (%)	Storage to end of Feb.	Average yield (t/ha)
Liyaskovski 58	2	90-110	60-80	0.6-0.7	2-3	15-17	85-90	15-25
Konkurent	2	85-100	100-120	0.7-0.8	2.5-3.5	16-17	85-90	20-35
Trimontsium	2,1	80-100	100-120	0.6-0.7	2-3	13-14	85-90	20-35
Plovdivski 10	2	80-100	70-80	0.5-0.6	2-3	14-15	80-90	20-30
Pioner	1	100-105	60-80	0.8-0.9	1.5-2.5	11-13	85-90	25-35
Jubilee 50	1	95-105	90-120	0.9-1.1	1.4-2	11-13	90-95	30-45
Asenovgradska 5	1	110-120	120-250	0.7-0.9	1.5-2.2	9-10	70-80	40-50
Ispanski 482	1	115-120	150-300	0.9-1.2	1-2	10-11	80-85	40-55
Plovdivski red	1	100-105	70-115	0.8-1.0	1-2	10-11	80-90	25-35
Liyaskovski 90	2,1	75-95	80-100	0.7-0.8	1.6-2.5	16-19	88-95	20-30
Uspeh 6 F1	1	110-115	90-120	0.75-0.9	2	12-14	90-95	30-50

† 1 = growing by direct sowing; 2 = growing by sets.

Appendix I. Organization of ECP/GR and its activities during Phase V of the Programme (1994-1998)

Steering Committee

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Coordinating Secretariat

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Crop-specific Networks	**Cereals Network**	**Forages Network**	**Vegetables Network**	**Grain Legumes Network**	**Fruit Network**	**Minor crops Network**	**Industrial Crops & Potato Network**
Standing Working Groups (meetings Phase V)	**Barley** Germany 1993 Germany 1997 ***Avena*** Hungary 1993 Lithuania 1998	**Forage crops** Bulgaria 1995 Norway 1997	***Brassica*** Portugal 1994 Italy 1996 ***Allium*** Poland 1995 Bulgaria 1997	**Grain Legumes** Denmark 1995 UK 1998	***Prunus*** Turkey 1996 Italy 1996 ***Malus/Pyrus*** Ireland 1997		
A*d hoc* meetings Phase V	**Wheat** France 1996 ***Secale*** Poland 1996 **Maize** Italy 1996		***Daucus*** Poland 1997		***Malus*** UK 1995		
Collaboration with programme EC1467/94	**Maize** (GEN RES 88)		***Allium*** (GEN RES 20)		***Prunus*** (GEN RES 61) ***Vitis*** (GEN RES 81)		***Beta*** (GEN RES 42) **Potato** (GEN RES 34-45)
Thematic Networks	**Documentation and information** • Collaboration with FAO: Publication of the Directory of European PGR Collections, 1995. • Collaboration with CGN (Wageningen, The Netherlands): EGDS Project (East European Germplasm Documentation Systems); Workshop on Central Crop Databases, Hungary, October 1996 • Collaboration with ZADI (Bonn, Germany): Training workshop on on-line databases, Germany, June 1997 • Collaboration with NGB (Alnarp, Sweden): Training workshop on on-line databases, Sweden, February 1998						
	***In situ* and on-farm conservation** Workshop on *in situ* conservation of wild *Brassica* in Sicily, April 1997						
	Technical cooperation						

Appendix II. *Allium* Passport Descriptors

Based on the FAO/IPGRI Multicrop Passport Descriptors

***Allium* PASSPORT DESCRIPTORS**
1. Institute code (INSTCODE) Code of the institute where the accession is maintained. The codes consist of the 3-letter ISO 3166 country code of the country where the institute is located plus number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a 3-letter ISO 3166 country code and an acronym.
2. Accession number (ACCENUMB) This number serves as a unique identifier for accessions and is assigned when an accession is entered into the collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number should never be reused. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system).
3. Collecting number (COLLNUMB) Original number assigned by the collector(s) of the sample, normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identify-ing duplicates held in different collections. It should be unique and always accompany subsamples wherever they are sent.
4. Genus (GENUS) Genus name for taxon. Initial uppercase letter required.
5. Species (SPECIES) Specific epithet portion of the scientific name in lowercase letters plus authority.[**] Following abbreviation is allowed: "sp."
6. Subtaxa (SUBTAXA) Subtaxa can be used to store any additional taxonomic identifier plus authority*. Following abbreviations are allowed: "ssp." (for subspecies); "var." (for variety); "convar." (for convariety); "f." (for form).
7. Accession name (ACCNAME) Either a registered or other formal designation given to the accession. First letter uppercase. Multiple names separated with semicolon.
8. Country of origin (ORIGCTY) Name of the country in which the sample was originally collected or derived. Use the ISO 3166 extended codes, (i.e. current and old 3 letter ISO 3166 country codes)
9. Location of collecting site (COLLSITE) Location information below the country level that describes where the accession was collected starting with the most detailed information. Might include the distance in kilometers and direction from the nearest town, village or map grid reference point, (e.g. CURITIBA 7S, PARANA means 7 km south of Curitiba in the state of Parana)

[**] Authority is only provided at the most detailed taxonomic level.

10. Latitude of collecting site (LATITUDE)

Degrees and minutes followed by N (North) or S (South) (e.g. 1030S). Missing data (minutes) should be indicated with hyphen (e.g. 10—S).

11. Longitude of collecting site (LONGITUDE)

Degrees and minutes followed by E (East) or W (West) (e.g. 07625W). Missing data (minutes) should be indicated with hyphen (e.g. 076—W).

12. Elevation of collecting site [m asl] (ELEVATION)

Elevation of collecting site expressed in meters above sea level. Negative values allowed.

13. Collecting date of original sample [YYYYMMDD] (COLLDATE)

Collecting date of the original sample where YYYY is the year, MM is the month and DD is the day.

14. Status of sample (SAMPSTAT)

1	Wild	0	Unknown
2	Weedy		
3	Traditional cultivar / Landrace	99	Other (Elaborate in REMARKS field)
4	Breeder's line		
5	Advanced cultivar		

15. Collecting source (COLLSRC)

The coding scheme proposed can be used at 2 different levels of detail: Either by using the global codes such as 1, 2, 3, 4 or by using the more detailed coding such as 1.1, 1.2, 1.3 etc.

1	Wild habitat	2	Farm	3	Market	4	Institute / Research organization
1.1	Forest / woodland	2.1	Field	3.1	Town		
1.2	Shrubland	2.2	Orchard	3.2	Village		
1.3	Grassland	2.3	Garden	3.3	Urban	0	Unknown
1.4	Desert / tundra	2.4	Fallow	3.4	Other exchange system	99	Other (Elaborate in REMARKS field)
		2.5	Pasture				
		2.6	Store				

16. Donor institute code (DONORCODE)

Code for the donor institute. The codes consist of the 3-letter ISO 3166 country code of the country where the institute is located plus number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a 3-letter ISO 3166 country code and an acronym.

17. Donor number (DONORNUMB)

Number assigned to an accession by the donor. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system)

18. Other number(s) associated with the accession (OTHERNUMB)

Any other identification number known to exist in other collections for this accession. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN

indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system). Multiple numbers can be added and should be separated with a semicolon.

19. Remarks (REMARKS)

The remarks field is used to add notes or to elaborate on descriptors with value "99" (=Other). Prefix remarks with the field name they refer to and a colon (e.g. COLLSRC: roadside). Separate remarks referring to different fields are separated by semicolons.

20. Common name (EACOMMNAM)

1	Dry bulb onion	0	Unknown
2	Shallot		
3	Bunching onion		
4	Garlic	99	Other (Elaborate in REMARKS field)
5	Leek		
6	Kurrat		
7	Great-headed garlic		
8	Chive		
9	Rakkyo		
10	Chinese chive		

21. Collecting institute (EACOLLINST)

Institute or person collecting or sponsoring the original collection of the sample. The codes consist of the 3-letter ISO 3166 country code of the country where the institute is located plus number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a 3-letter ISO 3166 country code and an acronym.

22. Mode of reproduction (EAMODREP)

1	Vegetative	0	Unknown
2	Seed		
3	Both		

23. Preliminary assessment of daylength requirements (EAPDAYLREQ)

This preliminary assessment has to be defined in accordance with the latitude from which the accession originated.

1 Short (0-32º latitude N or S)
2 Medium (33-39º latitude N or S)
3 Long (>40º latitude N or S)

FAO WIEWS DESCRIPTORS
1. Location of safety duplicates (DUPLSITE) Code of the institute where a safety duplicate of the accession is maintained. The codes consist of 3-letter ISO 3166 country code of the country where the institute is located plus number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a 3-letter ISO 3166 country code and an acronym. Multiple numbers can be added and should be separated with a semicolon.
2. Availability of passport data (PASSAVAIL) (i.e. in addition to what has been provided) 0 Not available 1 Available
3. Availability of characterization data (CHARAVAIL) 0 Not available 1 Available
4. Availability of evaluation data (EVALAVAIL) 0 Not available 1 Available
5. Acquisition type of the accession (ACQTYPE) 1 Collected / bred originally by the institute 2 Collected / bred originally by joint mission / institution 3 Received as a secondary repository
6. Type of storage (STORTYPE) Maintenance type of germplasm. If germplasm is maintained under different types of storage, multiple choices are allowed, separated by a semicolon (e.g. 2;3). (Refer to FAO / IPGRI Genebank Standards 1994 for details on storage type) 1 Short-term 2 Medium-term 3 Long-term 4 *In vitro* collection 5 Field genebank collection 6 Cryopreserved 99 Other (elaborate in REMARKS field)

Appendix III. Example of a safety-duplication bilateral agreement

This Memorandum of Understanding (MOU) is entered into and executed by the Nordic Gene Bank (hereinafter referred to as NGB) and the Institute of Biology (hereinafter referred to as IB).

I. Purpose

The purpose of this MOU is to establish, within the framework of the Nordic-Baltic cooperation and in connection to the NGB base collection, a Safety Duplicate Collection (hereinafter referred to as SDC) of seed material of agricultural and horticultural crops originating in Latvia, having obtained the status ACCEPTED in the base collection of the IB.

II. Statement of common interest

The NGB (Alnarp, Sweden) is a Nordic institute under the auspices of the Nordic Council of Ministers with the regional mandate to conserve *ex situ*, on a medium to long-term basis, genetic material of agricultural and horticultural crops particularly adapted to Nordic conditions.

The IB is a research institute which co-ordinates conservation of agricultural and horticultural crops in Latvia as well as managing active, or short- to medium-term, collections of seed material stored *ex situ*.

III. Statements of the agreement

i. Of relevance for NGB:

§1 NGB accepts the responsibility of conserving *ex situ* under long-term conditions, as a 'black box' arrangement within the storage facilities at Alnarp, a SDC to be delivered by the IB.

§2 The SDC will be stored in accordance with standard NGB procedures.

§3 NGB will not use or distribute any seed material to third party from this SDC without a written consent of the IB.

§4 The cost of conserving this SDC will be covered by sources adrninistered by NGB.

§5 In a situation of emergency all measures will be taken by NGB to maintain the safe storage of the deposited material.

§6 In case of accidents or any other event that may inflict upon the viability, germinability, or availability of the deposited seed, NGB will not be liable to pay any damages to the IB.

ii. Of relevance for the IB:

§7 The IB is responsible for all seed management activities (threshing, drying, packing, germination tests, etc.).

§8 The IB accepts to deliver a recornmended number of 5000 high quality seeds per accession to be included in the SDC. All shipments shall be accompanied with a Phytosanitary Certificate issued by the Plant Quarantine Service in the country of the IB.

§9 The IB further accepts the responsibility of supplying NGB with a safety duplicate of computerized passport and relevant management data pertaining to each stored accession.

§10 Decisions regarding the inclusion or removal of accessions from the SDC will be taken by the IB within the scope defined in Section I. Purpose.

iii. Of relevance for both:

§11 The material deposited in the SDC at Alnarp is the property of the sovereign State of Latvia.

§12 Upon notice, the IB has the right to inspect the SDC at any suitable time.

§13 This MOU may be modified or discontinued at the request of either party.

§14 Requests for termination or any change to the MOU shall be submitted to the other party for consideration not less than six (6) months prior to the desired effective date of termination.

§15 This MOU has indefinite duration, but shall be reviewed once every five (5) years for relevancy.

Signed:	Alnarp, 8 January 1997	Salaspils, January 1997
		
	The Director Nordic Gene Bank Currently: Eva Thorn	The Director Institute of Biology Currently: Gunars Andrusaitis

Appendix IV. Abbreviations and acronyms

AFLP	amplified fragment length polymorphism
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit, Germany
BPGV	Banco Português de Germoplasma Vegetal, DRAEDM, Braga, Portugal
CGN	Centre for Genetic Resources, Wageningen, The Netherlands
CIFA	Centro de Investigacion y Formacion Agrario, Córdoba, Spain
CMS	cytoplasmic male sterility
CPRO-DLO	Center for Plant Breeding and Reproduction Research, The Netherlands
DRAEDM	Direcção Regional de Agricultura de Entre Douro e Minho, Quinta de São José, São Pedro de Merelim, Braga, Portugal
EADB	European *Allium* Database
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
ELISA	enzyme linked immunosorbent assay
ENMP	Éstação Nacional de Melhoramento de Plantas", Elvas, Portugal
ESVC	Experimental Station for Vegetable Crops (ESVC), Gorna Oryahovitsa, Bulgaria
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GEVES	Groupe de Contrôle et d'Etude des Variétés et des Semences, France
GISH	genomic *in situ* hybridization
HRI	Horticulture Research International, Wellesbourne, UK
IBPGR	International Board for Plant Genetic Resources
IGB	Israeli Gene Bank, Israel
IHAR	Plant Breeding and Acclimatization Institute, Radzików, Poland
IPGR	Institute for Plant Genetic Resources, Sadovo, Bulgaria
IPK	Institut für Pflanzengenetik und Kulturpflanzenforschung, Gatersleben, Germany
IPM	integrated pest management
ISAB	Institut Supérieur d'Agriculture de Beauvais, France
ITS	internal transcribed spacer
IVC	Institute of Vegetable Crops "Maritsa" (IVC), Plovdiv, Bulgaria
NGB	Nordic Gene Bank, Alnarp, Sweden
NGO	non-governmental organization
PCR	polymerase chain reaction
RAPD	random amplified polymorphic DNA
RFLP	restriction fragment length polymorphism

RICP	Research Institute of Crop Production, Prague, Czech Republic
RIVC	Research Institute of Vegetable Crops, Skierniewice, Poland
RIVFG	Research Institute for Vegetable and Flower Growing, Vidra-Ilfov, Romania
SFRS	Swiss Federal Research Station, Wädenswil, Switzerland
UPOV	Union pour la Protection des Obtentions Végétales, Switzerland
VIR	N.I. Vavilov Research Institute of Plant Industry, Russia
VRI	Vegetable Research Institute, Czech Republic
WIEWS	World Information and Early Warning System
WWW	World Wide Web
ZADI	Zentralstelle für Agrardokumentation und -information / Informationszentrum für Genetische Ressourcen, Bonn, Germany

Appendix V. List of participants

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