European Cooperative Programme for Crop Genetic Resources Networks

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Report of a Working Group on Barley

IPGRI

Sixth Meeting – 3 December 2000, Salsomaggiore, Italy

H. Knüpffer, R. von Bothmer, M. Ambrose, R. Ellis, A. M. Stanca, D. Enneking, L. Maggioni and E. Lipman, *compilers*

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

The international status of IPGRI is conferred under an Establishment Agreement which, by January 2001, had been signed and ratified by the Governments of Algeria, Australia, Belgium, Benin, Bolivia, Brazil, Burkina Faso, Cameroon, Chile, China, Congo, Costa Rica, Côte d'Ivoire, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Greece, Guinea, Hungary, India, Indonesia, Iran, Israel, Italy, Jordan, Kenya, Malaysia, Mauritania, Morocco, Norway, Pakistan, Panama, Peru, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Sudan, Switzerland, Syria, Tunisia, Turkey, Uganda and Ukraine.

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The European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) is a collaborative programme among most European countries aimed at facilitating the long-term conservation and the increased utilization of plant genetic resources in Europe. The Programme, which is entirely financed by the member countries and is coordinated by IPGRI, is overseen by a Steering Committee composed of National Coordinators nominated by the participating countries and a number of relevant international bodies. The Programme operates through ten 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, inter-regional cooperation). Members of the working groups and other scientists from participating countries carry out an agreed workplan with their own resources as inputs in kind to the Programme.

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Contents

Part I. Discussion and Recommendations

Introduction

The Sixth (extraordinary) Meeting of the ECP/GR Working Group on Barley was held in the Hotel Grande Albergo Centrale Bagni in Salsomaggiore, Italy, on 3 December 2000, in conjunction with two other meetings, namely the second meeting of the EU GENRES project CT98–104 on 'Evaluation and Conservation of Barley Genetic Resources to improve their Accessibility to Breeders in Europe' (4–6 December), and a discussion meeting on pre-breeding in barley (6 December), based on a decision of the ECP/GR Cereals Network Coordinating Committee meeting in Radzików, Poland, 7–8 July 2000. A considerable number of members of the Working Group on Barley were also partners or associated partners of the EU project, therefore the overall costs could be kept low. Several invited observers and EU project partners also participated in the meeting. The list of participants is given as Appendix IV and the Agenda of the meeting as Appendix III.

Michele Stanca, director of the hosting institute, Istituto Sperimentale per la Cerealicoltura in Fiorenzuola d'Arda, welcomed the participants. He gave some information about cereal breeding in Italy which dates back to the activities of the cereal breeder Strampelli—the founder of his institute—at the beginning of the 20th century, as well as on the importance of the region around Parma for agricultural production and famous food products.

Roland von Bothmer, Chairperson of the Working Group on Barley, welcomed the participants, also on behalf of ECP/GR whose coordinator, Lorenzo Maggioni, was unable to attend the meeting, due to a sabbatical leave. The Chairperson informed the Group that, due to an increased workload, he had decided to resign from this position at the end of the meeting, and that new Chairperson and Vice-Chairperson would have to be elected. He thanked the ECP/GR Secretariat for its logistic support to the organizers of the meeting.

Roland von Bothmer agreed to chair the meeting. Helmut Knüpffer, Dirk Enneking and Mike Ambrose took notes and drafted the report. Since the present meeting was scheduled for one day only, individual country reports were not presented orally but papers provided by the participants are included in Part II of this report.

The participants briefly introduced themselves.

Information on Phase VI of ECP/GR

Based on the information provided by L. Maggioni, R. von Bothmer gave a brief overview of the current Phase VI of ECP/GR.[1] This programme was founded in 1980, and now comprises 34 member countries, the latest to join being Armenia. In order to allow the Programme to expand its scope to more crops and activities, without significant increase of funding, the new system of operation will be based on increased coordination at the Network level, while crop-specific working groups would meet less frequently. For example, in the case of cereals, a Cereals Network Coordinating Group, composed of Working Group Chairpersons and Vice-Chairpersons or database managers, was established. This Group will work closely with the Secretariat to which it will submit proposals for activities and will review progress, achievements and future workplans of the Working Groups on *Avena*, Barley and Wheat. Full Network meetings were also planned as replacements for individual Working Group meetings, while remaining funds could be invested in small technical meetings addressing relevant issues identified within the Networks.

[1] See Introduction, p. 1 *in* Report of a Network Coordinating Group on Cereals. Ad hoc meeting, 7-8 July 2000, Radzików, Poland (L. Maggioni and O. Spellman, compilers). 2001. International Plant Genetic Resources Institute, Rome, Italy.

In this way it is hoped that an enhanced internal coordination within the Networks will facilitate better planning and follow-up of the agreed workplans. These operational changes are expected to result in increased scope and flexibility of operation, also for crops for which no formal working groups exist.

Chairperson's report

R. von Bothmer emphasized that this joint meeting of the ECP/GR Working Group on Barley and the Barley EU project provides an excellent opportunity for networking, since it combines diverse expertise in fields such as plant genetic resources, genetics, phytopathology and breeding. An important objective was to define the future of the Working Group on Barley in the light of recent developments (see section on Continuation of the ECP/GR Barley Working Group, p.13). Participants were encouraged to contribute ideas on how to continue barley activities.

Almost 20 years of activities of the Working Group on Barley have culminated in the compilation of the European Barley Database (EBDB) and the creation of a European Plant Genetic Resources Network for barley, which is starting to extend beyond Europe. Research activities on barley have been increasing again recently, due to a revitalization of barley as a model organism, as reflected by the growing number of participants in the International Barley Genetics Symposia (IBGS). The recent 8th IBGS (Adelaide, Australia, October 2000) clearly showed the potential of barley research.

R. von Bothmer stressed that the ECP/GR Working Group on Barley should intensively communicate and interact with other groups and organizations. He recommended that the Working Group on Barley and the EU project partners also use other opportunities to meet, such as the Triticeae meeting (10–12 September 2001, Córdoba, Spain), the American Barley Researchers Workshop (2001), the EUCARPIA Genetic Resources Section Meeting (Poznan, Poland, May 2001), the EUCARPIA Cereals Section meeting (Italy, 2002), and the 9th IBGS (Brno, Czech Republic, June 2004).

R. von Bothmer summarized the achievements of the Working Group on Barley since its previous meeting in 1997,[2] based on a recent report to the Cereals Network Coordinating Group.[3] The most notable achievements of the Working Group on Barley are:

- the European Barley Database (EBDB);
- the International Barley Core Collection (BCC); and
- the EU project GENRES CT98–104 on 'Evaluation and Conservation of Barley Genetic Resources to Improve their Accessibility to Breeders in Europe'.

The EBDB has been the backbone of the Working Group since its beginning. One of the aims of the present meeting was to define the future needs and role of the EBDB. The Group was also requested to develop ideas on the next steps of development of the BCC.

Complementing the activities of the Working Group on Barley, the EU project aims at further developing the EBDB, sharing the responsibilities for conservation among the partner genebanks, and the joint and coordinated evaluation of barley genetic resources for biotic and abiotic stress factors, with emphasis on the BCC. This project would have been impossible without the long-lasting relations between members of the ECP/GR Working Group.

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[2] Maggioni, L., H. Knüpffer, R. von Bothmer, M. Ambrose, K. Hammer and E. Lipman, compilers. 1999. Report of a Working Group on Barley. Fifth meeting, 10-12 July 1997, Alterode/Gatersleben, Germany. International Plant Genetic Resources Institute, Rome, Italy.

[3] Knüpffer, H. and R. von Bothmer. 2001. ECP/GR Barley Working Group: Review of the Group Progress and Future Perspectives. Pp. 14-25 *in* Report of a Network Coordinating Group on Cereals. *Ad hoc* meeting, 7-8 July 2000, Radzików, Poland (L. Maggioni and O. Spellman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

The recommendations made by the Working Group on Barley to the ECP/GR Cereals Network Coordinating Group were presented and summarized as follows:

- synergy with other cereal crop working groups;
- joint activities in scientific management of plant genetic resources;
- new role of Central Crop Databases in the light of the EPGRIS (European Plant Genetic Resources Information Infra-Structure) project;
- joint approaches to handling and summarizing evaluation data;
- handling of pedigree data;
- participation of non-EU partners (both candidate and non-candidate countries) in the EU GENRES projects; and
- fundraising and methodological aspects.

Information on the ECP/GR Cereals Network Coordinating Group Meeting

W. Podyma summarized the outcome of the Cereals Network Coordinating Group meeting held 7–8 July 2000, Radzików, Poland.[4] The meeting analyzed the progress of the ECP/GR Working Groups on cereals, compared their approaches, and discussed their future perspectives. Participants were the chairpersons and database managers of the existing Working Groups on Cereals (Barley, *Avena*, Wheat), and the database managers of the European Central Databases on Maize, *Secale* and *Triticale*. Main progress was reported to be in documentation. The importance of including pedigree data in Central Crop Databases (CCDBs) and their standardization were discussed; it was recommended that the suitability of existing free software be tested, such as the International Crop Information System (ICIS, from CIMMYT, Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico) (<http://www.cgiar.org/icis/documentTDM.htm>). It was recommended that a small meeting of genebank documentation experts and biometricians be organized in the framework of the ECP/GR Documentation Network to discuss issues related to handling and analysis of characterization and evaluation data in CCDBs. It was noted that the contents of the CCDB and the completeness of passport data are the responsibility of the contributing genebanks, not of the CCDB managers whose role would be to pinpoint missing or obviously incorrect data. Regarding the possibility for the CCDB managers to correct evident mistakes in the data, it was suggested that the original accessions table be maintained unaltered, and an additional table with corrected data be made available to the users. It was also recommended that minimum standards for basic search options in WWW-searchable CCDBs be developed. Further collecting activities are needed to fill gaps in collections.

In view of the importance and uniqueness of the germplasm collections of the N.I. Vavilov Research Institute of Plant Industry (VIR, St. Petersburg, Russia) and of the economic situation encountered by this institute at present, the necessity of supporting VIR was stressed. The ECP/GR support to VIR to complement the activities of the GENRES project, and existing bilateral cooperations were seen as a step in the right direction.

As an emergency, regeneration needs were discussed, especially in wild species that are difficult to handle under *ex situ* conditions. The need for a safety-duplication strategy for unique cereal accessions, especially those of European origin and those resulting from collecting activities of European countries elsewhere, was emphasized. A short discussion on safety-duplication issues followed in which the role of the EBDB was reiterated. The Cereals Network will play an important role in coordinating the future development of the respective CCDBs.

[4] Maggioni, L. and O. Spellman, compilers. 2001. Report of a Network Coordinating Group on Cereals. *Ad hoc* meeting, 7-8 July 2000, Radzików, Poland. International Plant Genetic Resources Institute, Rome, Italy.

The development of genebank quality standards for handling genetic resources of cereals, that would follow the ISO 9000 specifications, was also discussed. C. Germeier (Braunschweig, Germany) who brought this topic to the attention of the participants,[5] clarified that the ISO 9000 system is based on transparency of methodologies, rather than enforcement of an agreed standard. To adopt the ISO system for quality standard improvement, genebanks would need to appoint a quality manager and publish a handbook of internally applied standards. It was recommended that the genebanks cooperating with the Cereals Network adopt the ISO 9000 principles and that they develop and publish quality guidelines for their cereal collections.

Funding, the future role of the Cereals Network and its relation to the various crop working groups, and pre-breeding were other subjects discussed. The Group agreed to hold a full meeting of the Cereals Network in 2003, to review the progress made, and to plan for its future.

Discussion

A discussion on 'quality standards in genebanks' followed, based on the proposal to describe genebank activities using the ISO 9000 standard. It was mentioned that some genebanks, such as CGN (Centre for Genetic Resources, The Netherlands) have published descriptions in the form of a protocol, whereas other genebanks, although following high quality standards, have not. J. Valkoun commented that international genebank standards have been published, e.g. by CGIAR and FAO. It was suggested that genebanks undertake efforts to describe their procedures publicly, e.g. on their Internet pages.

The European Barley Database

D. Enneking, manager of the EU project on barley, presented recent activities to extend the contents and functionality of the EBDB (see Appendix I). The EBDB has been adapted to the IPGRI *Multi-Crop Passport Descriptor List*, with barley-specific additional data elements, as suggested at the previous meeting.[6] Barley pedigrees from published sources[7] are being included in the database.

He stressed the benefits of cross-referencing with other ongoing documentation projects related to barley, e.g. USDA-GRIN (United States Department of Agriculture—Germplasm Resources Information Network), SINGER (System-wide Information Network for Genetic Resources of the CGIAR) and ICIS (International Crop Information System—International Barley Information System, CIMMYT/ICARDA). Based on an overview of large barley collections worldwide, he advocated including them into the EBDB to identify unique germplasm, to establish links to existing evaluation data and for cross-referencing between duplicate accessions/safety duplicates. This would also lead to improved quality and

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[5] Germeier, C. and L. Frese. 2001. Regeneration standards, rationalization of collections and safety-duplication. Pp. 43-52 *in* Report of a Network Coordinating Group on Cereals. *Ad hoc* meeting, 7-8 July 2000, Radzików, Poland. (L. Maggioni and O. Spellman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

[6] Anonymous. 1999. Barley passport descriptors, including barley-specific attributes. Pp. 104-109 *in* Report of a Working Group on Barley. Fifth meeting, 10-12 July 1997, Alterode/Gatersleben, Germany (L. Maggioni, H. Knüpffer, R. von Bothmer, M. Ambrose, K. Hammer and E. Lipman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

[7] Arias, G., L. Reiner, A. Penger and A. Mangstl. 1983. Directory of Barley Cultivars and Lines. Ulmer, Stuttgart.

Baum, B.R., L.G. Bailey and B.K. Thompson. 1985. Barley register. Publ. Agriculture Canada No. 1783/B. Biosystematics Research Institute, Ottawa, Ontario, Canada.

Baumer, M. and R. Cais. 2000. Abstammung der Gerstensorten [Pedigrees of barley varieties]. Bayerische Landesanstalt für Bodenkultur und Pflanzenbau, Freising, 109 pp. [downloadable as a .pdf file from: <http://www.lbp.bayern.de/>]

completeness of passport data in European barley collections. With the recent inclusion of large data sets, e.g. from ICARDA (International Center for Agricultural Research in the Dry Areas, Syria), the Australian Cereals Collection and JIC (John Innes Centre, UK), the total number of registered accessions has increased to 135 320, thus covering 36.5% of the estimated world holdings of barley, amounting to 373 000 accessions.[8]

The high-quality geo-referenced collection site data of the data sets from ICARDA and USDA (for accessions with PI and CIho numbers originating from these collections), as well as the Alexandria Library on-line gazetteer (<http://fat-albert.alexandria.ucsb.edu:8827/gazetteer/>) were used to complement coordinates of collection sites in the EBDB. A distribution map of collection sites in the present EBDB derived from these coordinates was presented.

Finally, D. Enneking highlighted the need for common information resources to document plant genetic resources (PGR). Numerous breeders' codes, abbreviations and shorthand notations are encountered in passport data, and their meaning is often difficult to decipher. He reported that a list of abbreviations occurring in accession numbers and breeder's line designations is needed, to facilitate links to synonymous accessions, better interpretation of the available information, and to counteract erosion of knowledge occurring with each change of generations. He suggested that joint efforts should be started or continued to compile lists (databases) of various kinds of codes used in genetic resources documentation, focussing on barley.

For donor institutions, he recommended to use the FAO institution codes instead of the ECP/GR acronyms and demanded that the institution codes developed by FAO (Jerzy Serwinski) be completed for all institutions occurring as donors, breeders or other collaborators in European PGR databases (including breeders of currently grown cultivars, since these will enter PGR collection in the future), and that FAO be requested to commit itself to continuing the maintenance of these codes.

He also suggested compilation of a worldwide list (or database) of expeditions that collected barley, based on an earlier compilation,[9] with special emphasis on Europe. Based on such a list, a unique coding scheme for expeditions, collection numbers and collection site codes could be derived, following ICARDA's (J. Konopka) approach. H. Knüpffer informed the Group that such a compilation for IPK's (Institute of Plant Genetics and Crop Plant Research, Germany) expeditions has been published in 1993,[10] and that a list of VIR's expeditions is available on the Web site of this institution (<http://www.genres.de/vir/>). A common coding scheme for germplasm collected during expeditions would facilitate the tracking of accessions across genebank collections. It would also allow studies to determine the effectiveness of methods for the conservation of genetic diversity and safety-duplication.

D. Enneking reported that it is necessary to replace the present prototype of the EBDB at the ZADI (Central Agency for Agricultural Documentation and Information, Germany) server (<http://www.dainet.de/eccdb/barley>), with a more comprehensive database including more and better search functionalities.

Discussion

The need to facilitate links, and to move towards the integration of European data with other national and international databases was already expressed by the ECP/GR Cereals

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[8] Hintum, Th.J.L. van and F. Menting. 2000. Barley genetic resources conservation - now and forever. Barley Genetics VIII(1):13-20.

[9] IBPGR. 1983. Barley Working Group. Report of a Working Group held at the Zentralinstitut für Genetik und Kulturpflanzenforschung der Akademie der Wissenschaften der DDR, Gatersleben 18-19 May 1983. UNDP/International Board for Plant Genetic Resources, Rome.
Witcombe, J.R. 1983. A provisional world list of barley expeditions. Plant Genetic Resources Newsletter 53:25-40.

[10] Hammer, K., H. Gäde and H. Knüpffer. 1994. 50 Jahre Genbank Gatersleben - eine Übersicht [Fifty years of Gatersleben genebank - an overview]. Vortr. Pflanzenzüchtg. 27:333-383.

Network. The cereal databases managers were encouraged to start initiatives in this direction, identify any problems and discuss possible solutions within the Network Coordinating Group (NCG). Non-European collections and databases are valuable sources of novel germplasm for breeding and of relevant characterization and evaluation data, respectively.

The future development of the EBDB was discussed. The question whether non-European barley collections should be included in the EBDB was raised. The obvious benefits consist in the direct links between accessions and locally documented information related to these (evaluation results, genetics, research reports, etc.) and the resulting possibility to compare, and thus complete, the respective passport data. Access to germplasm and to current evaluation data is an important argument in favour of linking/including non-European collections.

J. Valkoun informed the Group that the International Barley Information System (IBIS) will be developed by ICARDA as an international initiative, desirably complemented by regional developments such as the EBDB. The cross-linking between the European and non-European holdings could then be implemented on the higher level of IBIS. In the mid- to longer term, effective *ex situ* conservation of genetic resources requires an inventory of existing collections at the global level. Duplication of accessions, particularly of landraces, in different collections may turn out to be a blessing rather than a curse, since it provides a safety back-up for germplasm that in many instances cannot be re-collected from *in situ* sources.[11]

With respect to the FAO institution codes, it was considered doubtful whether FAO would accept such responsibility, and whether all genebank collections would follow this standard. The difficulties of 'real-time' maintenance of such a database, and the workload for its coordinator, were also mentioned.[12]

H. Knüpffer stressed that an important aspect of future development is the inclusion of, and/or linking with, characterization and evaluation data. A survey needs to be made on what information (evaluation descriptors) is available where (genebanks, breeders, research institutions), and in which form (computerized/manual). Although standardization of characterization and evaluation descriptors is desirable from the point of view of database managers and users, valuable data sets exist that do not comply with such standards, e.g. from experiments or observations carried out before the implementation of descriptor lists. In addition, different user communities use different descriptor lists with respect to definition of descriptors and scoring, e.g. national vs. IPGRI lists, UPOV, etc. PGR databases need to be flexible enough to deal with valuable data sets resulting from non-standard experiments.[13] A bootstrapping approach would therefore be recommendable, in the sense of knitting together the available information with virtual shoelaces to build bridges between data islands.

R. von Bothmer commented that with the increasing implementation of Material Transfer Agreements (MTAs), the feedback of characterization and evaluation data to the genebanks will become mandatory, and that follow-up mechanisms need to be implemented in genebank systems. This will result in a higher amount of data transfer.

At present only a few genebanks worldwide are offering characterization and evaluation data through the Web, due to obvious difficulties with the standardization, homogenization

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[11] This point was raised by Dr Ken W. Richards, PGRC, Canada. His input is gratefully acknowledged.

[12] Institute codes are available from the FAO Web site. If new Institute Codes are required, they can be generated on-line by national WIEWS correspondents (<http://apps3.fao.org/wiews>).

[13] Knüpffer, H. 2001. Handling of characterization and evaluation data in crop databases. Pp. 58-65 *in* Report of a Network Coordinating Group on Cereals. *Ad hoc* meeting, 7-8 July 2000, Radzików, Poland (L. Maggioni and O. Spellman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

and compilation of such data. L. van Soest reported that CGN was aiming at providing such data for downloading on the Web,[14] but this operation was proving to be difficult to implement. For example, a descriptor such as mildew resistance is recorded in CGN's database, using more than 20 different definitions or methodologies.

D. Enneking suggested including in the database only 'primary attribute' information that summarizes the most interesting characteristics of each accession. H. Knüpffer commented that, in order to avoid unnecessary re-testing, the fact that an accession was found to be susceptible to a particular disease should also be documented. As an alternative, A. Jahoor recommended to include known genes and alleles into the database. M. Ambrose added that genotype information is of higher value than just evaluation data.

A lengthy discussion followed on malting quality data. B. Schinkel remarked that barley varieties considered good for malting 15 years ago would not be accepted by malting companies today. J.L. Molina-Cano mentioned that the European Brewery Convention Secretariat (c/o Heineken NV, Netherlands) keeps non-computerized records on 50-years multi-site trials on malting quality. It was recommended not to include characters related to malting quality into the EBDB.

The identification of unique material in each genebank was considered an important task (see section on Sharing of responsibilities, p. 9).

D.T. Endresen suggested that a link between the EBDB and GrainGenes[15] be established.

Recommendations

Priorities: given the limited remaining duration of the present EU project on barley, ending March 2002, the members of the Group strongly recommended concentrating the efforts on European collections and focusing on questions that can be answered in this period. M. Ambrose added that, although the extension of the EBDB into an international database is desirable, there are still tasks on the European level that need to be resolved with higher priority, and it was recommended that efforts should be concentrated on the identification of duplicates among European cultivars released since 1950.

It was stressed that other research communities should be made aware of the EBDB and the services it can offer, through publications in relevant journals.

Inclusion of pedigree information

M. Ambrose gave background information on pedigrees, their importance in plant breeding and plant genetic resources work, and widely adopted notation systems. A pedigree is a parentage or nomenclature assigned to breeders' material in the process of cultivar registration, as provided by the breeder (partial disclosure is also possible). This original source information should not be altered, neither by transforming the notation system, nor by correcting obvious misspellings, replacing abbreviations or breeder's line designations by later names of cultivars, since the published pedigree information for a cultivar is a historical

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[14] This feature has meanwhile been implemented at CGN's homepage (<http://www.plant.wageningen-ur.nl/cgn>).

[15] GrainGenes is a genetic database for Triticeae, oats, and sugarcane, being assembled as part of the United States Department of Agriculture, National Agricultural Library's Plant Genome Program, initiated by Jerome P. Miksche and currently directed by Henry L. Shands. Additional support is provided by ITMI, the International Triticeae Mapping Initiative, through a grant from the USDA/DOE/NSF Joint Program on Collaborative Research in Plant Biology. The GrainGenes project is coordinated by Olin Anderson (USDA, Albany, CA). The master database is at Cornell University, administered by Dave Matthews. Kinds of information include: genetic and cytogenetic maps; genomic probes, nucleotide sequences; genes, alleles and gene products; associated phenotypes, quantitative traits and QTLs; genotypes and pedigrees of cultivars, genetic stocks, and other germplasms; pathologies and the corresponding pathogens, insects, and abiotic stresses; a taxonomy of the Triticeae and *Avena*; addresses and research interests of colleagues; relevant bibliographic citations. (Source: <http://grain.jouy.inra.fr/ggpages/aboutgg.html>).

document. Some cultivars are known to be heterogeneous, and a name does not uniquely designate a variety.

Discussion

In view of the further development of the EBDB, it was asked whether known pedigrees for cultivars should become part of the EBDB, or whether a 'cultivar register' compiled from the available information source should be considered as a separate exercise. J. Valkoun reported that the International Barley Information System (IBIS) to be developed at ICARDA will include as much pedigree information as possible, thus allowing the tracing of sources of resistance genes in a cross-breeding programme. Knowledge of pedigrees would also provide better arguments in CBD- (Convention on Biological Diversity) related discussions on the origins of cultivars resulting from cross-breeding. Pedigree information was considered most useful for breeders when it consists of more than only the two parental lines. Although the disclosure of pedigree information is mandatory for cultivar registration in some countries (e.g. the Netherlands), in others it is not. In some cases they are still considered the breeder's secret. In such cases it would be difficult to trace pedigree information, especially for older cultivars, when the breeder cannot be asked.

Recommendations

- *It was recommended to preserve the original pedigree notation, while a transformed/standardized one in Purdy notation[16] can be created in a separate field for computerized analysis purposes.*
- *Pedigree information should in future be provided in Purdy notation.*
- *It was agreed that since pedigree-related questions are common to all cereal crops covered by the ECP/GR Cereals Network, these issues should be followed up by both this Network and the ECP/GR Documentation Network.*

Database on barley genetic stocks

This topic came up in the discussion on the EBDB and its possible extension. R. von Bothmer reminded the Group that barley has been an important model crop for genetics research since the 1930s, and thus large collections of genetic stocks have accumulated. Mutants, which often differ from the parental line by only a single allele, cannot be the primary concern of genebanks aiming at preserving diversity. In addition, some mutants need special care or knowledge to be properly propagated or preserved, which is beyond the possibilities of genebanks.

Discussion

The question was discussed whether genetic stocks collections should be included in the EBDB, or whether a separate database should be created. H. Knüpffer argued that for the adequate documentation of genetic stocks collections, additional specific descriptors not included in usual IPGRI descriptor lists would be needed. He recommended developing a separate database, in close consultation with holders of such collections. At a meeting at the beginning of the 1990s, NGB (the Nordic Gene Bank) had accepted responsibility for developing appropriate database structures for genetic stocks collections. Since genetics stock collections are already being documented by GrainGenes, it was suggested that the barley genetics community should include all important collections in this system. D.T. Endresen reported that NGB has started to develop a database for NGB's (Udda Lundqvist's) vast barley genetic stocks collections using AceDB software (on which GrainGenes is also based). D. Enneking reported that USDA has developed a database for

[16] Purdy, L.H., W.Q. Loegering, C.F. Konzak, C.J. Peterson and R.E. Allan. 1968. A proposed standard method for illustrating pedigrees of small grain varieties. Crop Science 8:405-406.

barley genetic stocks. The pcGRIN version is available in downloadable form at <http://www.ars-grin.gov/npgs/pcgrin/barleygs.zip>.

Recommendations

- *The creation of a network of barley genetic stock collections was proposed, possibly to exist within the framework of the International Barley Genetics Symposia, to take care of their continued maintenance and availability, as well as of their documentation.*
- *The compilation of a European (or international) database on genetic stocks collections could possibly be addressed by a joint project proposal. Several participants, including M. Ambrose, D.T. Endresen, D. Enneking, H. Knüpffer, J.L. Molina Cano and M. Stanca expressed interest in forming such a group. Since NGB has already started to develop such a database, D.T. Endresen was requested to take the lead.*[17]

The EPGRIS project

H. Knüpffer briefly informed the participants about the recently started project EPGRIS (European Plant Genetic Resources Information Infra-Structure) funded by the EU. The objective of this project is to promote the creation of national plant genetic resources inventories and to create a European Search Catalogue (EURISCO) at IPGRI headquarters in Rome, with passport information of all plant genetic resources maintained *ex situ* in Europe. The catalogue will be frequently and automatically updated from the national PGR inventories and easily accessible via the Internet. While initially the European Central Crop Databases will be the main source of data for the European catalogue, at the end of the 3-year project, the catalogue should ideally become the most updated and immediate source of all the passport data. It will therefore be possible to retrieve from the catalogue all data to develop new CCDBs directly. It is expected that, once established, EPGRIS will change the present role of European CCDBs whose managers would have the opportunity to focus on the compilation of crop-specific characterization and evaluation data, and on data analysis.

Sharing of responsibilities for conservation

W. Podyma summarized the status of the debate on sharing responsibilities within the ECP/GR Networks and gave an account of the different proposals made by the Working Groups.[18] The idea is to build virtually a decentralized European Genebank. Genebanks

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[17] Shortly before publication of this report, D.T. Endresen confirmed acceptance of this task, although the decision that the NGB become the coordinator for a joint project proposal will have to be made by NGB's Director or Board. He also added that NGB would be grateful for help with developing the barley genetic stock descriptor list and welcomed the opportunity to help develop the system further in this forum. Finally, he suggested that the information on the barley genetic stock could become, with time, part of the EBDB, just as NGB aims to integrate information on Udda Lundqvist's mutant collection with its ordinary collection.

For information on earlier NGB works on the development of a database on barley genetic stocks, see: Bjarnason, S. 1992. Database for barley genes. II. A proposal for an international database for barley genes and genetic stocks. Pp. 44-47 *in* Barley Genetic Resources. Papers of an International Barley Genetic Resources Workshop held at Helsingborg Kongresscenter, Helsingborg, Sweden, 20-21 July 1991. International Crop Network Series No. 9. International Board for Plant Genetic Resources, Rome.

[18] Podyma, W. 2001. Sharing of responsibilities for plant genetic resources in Europe. Pp. 53-57 *in* Report of a Network Coordinating Group on Cereals. *Ad hoc* meeting, 7-8 July 2000, Radzików, Poland (L. Maggioni and O. Spellman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

See also: Sharing of responsibilities, p. 6, ibid.

should take responsibilities for particular accessions on behalf of ECP/GR. Three approaches to sharing responsibilities[19] are possible, namely:

- on accession basis in decentralized collections
- crop-by-crop (e.g. Dutch–German cooperation on potatoes and beets)
- sub-regional (e.g. NGB's approach).

The concept of forming decentralized 'European collections' was adopted by several ECP/GR crop working groups, e.g. those on *Secale, Avena*, Barley, *Beta* and *Prunus.* The proposed steps are very similar, with a slightly different approach being chosen by the Working Group on *Prunus*, which aims at reducing the workload of the CCDB manager. In this case, curators offer to take responsibility for a list of accessions and it is not the Central Database manager's task to select a list of primary accessions and to contact each curator suggesting that they accept responsibility for these accessions.

The essential role of the CCDB managers in any mechanism of shared responsibility was stressed, since they are in the best condition to analyze the data and pinpoint gaps or duplications remaining after the curators have assumed responsibility for their own list of accessions.

The importance that eventually the same agreements be reached for all crops was stressed, in order to avoid genebanks dealing with many crops having to follow different mechanisms depending on the crop.

The importance that National Coordinators be involved in the process of accepting responsibility was also stressed, and the Group was made aware that in some cases countries will be waiting for the outcome of the international negotiations before taking any decision.

Finally, it was mentioned that descriptors for the identification of primary accessions and the corresponding maintainers would have to be included in the EURISCO catalogue.

Discussion

L. van Soest expressed some concern that when curators are requested to take responsibilities for certain lists of accessions only, it could result in the maintenance of collections with limited genetic variation and this would not be of interest to the potential users. He would be much more in favour of sharing responsibilities for whole or large collections representing a broad variation rather than only for a limited number of accessions of several collections. His preference would therefore be very close to the crop-by-crop option mentioned by W. Podyma.

In the case of sharing responsibilities on an accession basis in decentralized collections, the question was raised as to whether the curators of collections should make the first step in proposing accessions for which they accept responsibility, or whether the CCDB manager should first make recommendations on probable 'most original samples' and communicate these proposals to curators who might accept or reject responsibility. Existing compilations of barley cultivars (see section on EBDB above), which include country of origin and year of release, provide good starting points.

M. Ambrose commented that the National Coordinators should be involved in this process, to give more weight to this issue. Agreements on sharing responsibilities should,

[19] Gass, T. and F. Begemann. 1999. International efforts to sustain *ex situ* collections: options for a closer cooperation in Europe. Pp. 109-115 *in* Implementation of the Global Plan of Action in Europe – Conservation and sustainable utilization of Plant Genetic Resources for Food and Agriculture. Proceedings of the European Symposium, 30 June-3 July 1998, Braunschweig, Germany (T. Gass, L. Frese, F. Begemann and E. Lipman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

among others, include quality standards for maintenance of material, safety-duplication matters, and ensure continued free access by all partners.[20]

The Group agreed to the recommendations listed below, corresponding to the outcome of the Cereals Network Coordinating Group meeting:

Recommendations

- *Step 1. The Chairperson of the Working Group on Barley informs the Working Group members and genebank curators of the initiative and encourages its implementation.*
- *Step 2. The genebank curators offer to take responsibility, for maintenance and distribution to* bona fide *users, of a list of accessions and inform the CCDB manager of their detailed offer. This exercise should start from: (i) recent European cultivars released since 1950; (ii) material of local origin; (iii) unique material of each genebank; and (iv) all other material.*
- *Step 3. The CCDB manager combines the lists received from curators and identifies gaps in the responsibility net.*
- *Step 4. The Cereals Network Coordinating Group reviews the progress made and makes further recommendations.*

Base-broadening in barley

R. Ellis reported about an International Expert Workshop on Broadening the Genetic Base of Crops, organized by the Edinburgh School of Agriculture in cooperation with FAO and held in Edinburgh, 25–27 November 1999, gathering 26 experts and covering different crops, including all cereals. The yet unpublished report (copies of which can be requested from R. Ellis) gives recommendations for actions for each crop concerned. He gave a summary of his proposal that involves experimental populations of *H. vulgare* × *spontaneum*. A comparison of allelic frequencies in cultivars and wild barleys with the location of QTLs for domestication-related traits would identify potential genetic bottlenecks. An example is the brittle rachis trait, located on 3H. The development of suitable genetic markers would then permit the designed introgression of new alleles from *H. spontaneum*.

Abraham Korol briefly presented a project idea on 'Base-broadening in barley' which was also the topic of the brainstorming meeting on 6 December.

Discussion

Following the brief discussion, it was decided that suggestions to the above project ideas should come from the barley community, and that the Working Group on Barley would offer its network for further discussion of these issues. The discussions would be continued at the small meeting on 6 December.

The Barley Core Collection and its further development

H. Knüpffer reported about the progress with the International Barley Core Collection (BCC) since the fifth meeting of the Working Group on Barley in 1997. A status report was presented at the BCC Workshop held in conjunction with the 8th International Barley Genetics Symposium in Adelaide, Australia, 22–27 October 2000, and the International BCC committee took several decisions. Some BCC subsets have already been created and are

[20] On this topic, see: Sharing responsibilities for conservation, pp. 9-11 and Genebank quality standards, p. 12 *in* Maggioni, L., L. Frese, C. Germeier and E. Lipman, compilers. 2000. Report of a Working Group on *Beta*. First meeting, 9-10 September 1999, Broom's Barn, Higham, Bury St. Edmunds, United Kingdom. International Plant Genetic Resources Institute, Rome, Italy.
And see also: Sharing of responsibility, pp. 20-21 *in* Maggioni, L., P. Marum, N.R. Sackville Hamilton, M. Hulden and E. Lipman, compilers. 2000. Report of a Working Group on Forages. Seventh meeting, 18-20 November 1999, Elvas, Portugal. International Plant Genetic Resources Institute, Rome, Italy.

being used, e.g. by partners of the EU project on barley genetic resources. The cooperation in this international network is voluntary and not externally funded. The main decisions were:

- to include Tamworth, Australia, as fifth 'active BCC centre';
- to seek collaboration with Eritrea and Ethiopia for the creation of the Ethiopian and Eritrean BCC subset from pre-CBD material existing in germplasm collections outside of their countries of origin;
- to designate U. Lundqvist and J. Franckowiak as coordinators for the 'genetic stocks' subset and include them in the BCC committee;
- to request J. Valkoun (ICARDA) to accept responsibility for the *spontaneum* subset; and
- to increase efforts in developing an appropriate documentation system for the BCC, including evaluation data, and a BCC homepage at IPK, in collaboration with GrainGenes.

The problem of segregating accessions found by partners of the EU project during evaluations (which is in conflict with the concept of homogeneous, single-seed-descended lines) needs to be resolved by detailed feedback to the respective subset coordinators. A status report of the BCC is under preparation.

Discussion

A lengthy discussion followed. Possible ways to involve Ethiopian and Eritrean scientists in the creation of this BCC subset were considered. J. Valkoun reported that he had screened such material from ICARDA's collection with AFLPs, and that he could advise on the selection of BCC accessions. D. Enneking and A. Jahoor reported that with respect to some diseases, the present BCC turned out to be of little value. It was suggested that such information be used when revising the BCC in future.

Recommendations

It was proposed that information about utilization of the BCC for various purposes be compiled by the BCC committee and published on the BCC Web site. Close links with GrainGenes to publicize information about the BCC were advocated. The Group recommended continuing the activities of developing the International BCC and the efforts to make it available to the user community. A revision of the BCC composition should be undertaken in about three years, when more results from various diversity studies become available.

Proposal for an *in situ* project on wild relatives of cereals

R. von Bothmer reported on the proposal from members of the Cereals Network to establish a project on *in situ* conservation of wild relatives of cereals in Europe. Good information about the distribution of these species can be found in *Flora Europaea* as well as in country floras, and reference was also made to a compilation on wild relatives of crops by Heywood and Zohary.[21] He reported that a meeting of the ECP/GR *In Situ* Network in Rome in the second week of December 2000 would be devoted to the preparation of a project proposal for the establishment of a catalogue of European crop wild relatives occurring within existing protected areas. The project, to be submitted to the EU for funding, would provide individual taxon conservation management information and would undertake *in situ* conservation gap analysis of the distribution of PGR species in relation to existing European protected areas. It was also mentioned that a project was being funded in the Fertile Crescent by the Global Environmental Facility (GEF) of the UNDP (United Nations Development Programme), involving, as executing agencies, ICARDA, the governments of

[21] Heywood, V.H. and D. Zohary, editors. 1995. A catalogue of the wild relatives of cultivated plants native to Europe. Flora Mediterranea 5:375-415.

Lebanon, Jordan, Syria and the Palestinian Authority. The proposal to submit for funding a project on *in situ* conservation of wild cereals in Europe had been discussed by Jozef Turok, Director of the IPGRI Regional Office for Europe, with EU officers, but this did not raise interest.

Recommendation

R. von Bothmer suggested that IPGRI be proposed to organize a workshop on in situ *conservation of wild cereals in conjunction with the Triticeae meeting (September 2001, Córdoba, Spain).*[22] *M. Stanca pointed at the EUCARPIA Cereals Section meeting, which he will organize in Italy in 2002, as another possibility for such workshops.*

It was recommended that on-farm conservation be included in in situ *project proposals.*

Continuation of the ECP/GR Barley Working Group

R. von Bothmer opened the discussion about the future role of the ECP/GR Working Group on Barley. Among the major achievements of the first 20 years he mentioned its importance for bringing together people working on barley from all over Europe—breeders, researchers, genetic resources managers. Despite the fact that there was no ECP/GR funding except for meetings, several important goals have been achieved. The most substantial outcomes were the EBDB, the BCC, and the EU project on barley genetic resources. Other groups working on barley also exist. Decreasing funding for such activities can be expected in the future and indeed there were no specific funds for further barley meetings within the funding under Phase VI. Although consolidation of existing initiatives was still required, new agenda items for the Group were required in order to obtain a future mandate. It was important that the Group look outwards and outline in detail the links that could be made between the barley genetic resources community and other barley initiatives such as those involving genetic characterization, genomics and bioinformatics. These new areas of research would require high quality and complete data on plant genetic resources so the EBDB and the catalogue of genetic stocks collections would be increasingly important in these areas. The valuable work done under the EU Barley project in evaluation of barley germplasm for biotic and abiotic stress resistance would stop at the end of the project. A further future role for the Working Group was therefore to take the interactions between players and outcomes further in specific relation to barley.

Discussion

L. van Soest proposed evaluation of the EU COST programme (European Cooperation in the field of Scientific and Technical Research) (<http://www.belspo.be/cost>), which is providing funds for coordination of nationally funded research on a European level. COST has a geographical scope beyond the EU and most of Central and Eastern European countries are members. COST also welcomes the participation of European institutions from non-member states who have signed an agreement with the European Union. COST is based on Actions. These are networks of coordinated national research projects in fields that are of interest to at least five participants from different member states. The Actions are defined by a Memorandum of Understanding (MOU) signed by the Governments of the COST states wishing to participate in the Action. The duration of an Action is generally four years and can occasionally be extended with another period of four years. The funding is basically used to cover coordination expenditures such as contributions to workshops/conferences, travel costs for meetings and contributions to publications. The programme offers up to two

[22] Prior to publication of this report, R. von Bothmer confirmed that he had contacted the organizers of the Triticeae meeting who agree to hold a workshop on *in situ* aspects. Contact was also made with A. Bari (from IPGRI Regional Office for Central and West Africa and North Africa, Aleppo, Syria), who is currently working in Córdoba and will be responsible for the workshop.

annual meetings, but personnel or research costs are not eligible for funding. Such meetings could be used as a frame on which to develop further projects.

Recommendations

During the discussion, new topics to be dealt with by the Working Group on Barley were proposed, such as linking-up with other barley-related research groups and activities such as genomics and bioinformatics. The continuous improvement and extension of the EBDB was also recommended.

It was proposed that the activities of the ECP/GR Working Group on Barley be continued. As a possible place and date for its next meeting, the 9th IBGS in Brno, Czech Republic, in June 2004, was proposed.

Election of the Chairperson and Vice-Chairperson

According to the rules set up for ECP/GR crop Working Groups, a new Chairperson and a Vice-Chairperson had to be elected. R. von Bothmer resigned as Chairperson, and R. Ellis was elected as his successor. Merja Veteläinen, from the Nordic Gene Bank, who was represented at the meeting by Marja Jalli, was elected as Vice-Chairperson of the Working Group on Barley.

Closing remarks

H. Knüpffer informed the Group that ECP/GR offered to publish the report of the present meeting, and that the initial compilation would be done by IPK. Contributors to topics of the Agenda, as well as participants wishing to include brief country report updates, should send these in electronic form to IPK, following the guidelines provided by the ECP/GR Secretariat.

H. Knüpffer also informed the Group about a project aimed at the preparation of a book entitled 'Diversity in Barley (*Hordeum vulgare*)' to be published by Elsevier. International authors are contributing review-type chapters on various aspects of diversity.

R. von Bothmer thanked the Group for the good work done during the one-day meeting. He stated that he was confident for the future of the Group. He, on behalf of all participants, thanked M. Stanca and his colleagues from the Istituto Sperimentale per la Cerealicoltura in Fiorenzuola for the excellent preparation of the meeting, the good facilities provided, and the good choice of the hotel where the meeting was held. Then R. Ellis thanked R. von Bothmer for the work accomplished since the previous meeting of the Working Group on Barley and committed himself to the Group.

Part II. National collections

The national barley collection in Bulgaria

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Barley is an important cereal in Bulgaria, ranking after wheat and maize; it is cultivated and studied throughout the country, except at high altitudes. The area sown with barley in Bulgaria currently amounts to ca. 250 000 ha, with an average yield of ca. 3.0 t/ha. Approximately 150 000 ha are sown with forage barley and about 100 000 ha with malting barley. Two-row varieties are more frequent than multi-row varieties. Bulgarian selections occupy 90% of the area, and foreign varieties only 10% (Table 1).

Table 1. Barley varieties grown in Bulgaria

Varieties	Growth habit†	%
Bulgarian varieties		
a) two-row		
Obzor – St.	WS	70.00
Korten	W	5.00
Emon	W	0.50
Total		**75.50**
b) multi-row		
Hemus	W	10.00
Vesletz	WS	10.00
Izgrev	W	2.00
Panagon	W	2.00
Aheloj	W	0.50
Total		**24.50**
Total Bulgarian varieties		**90.00**
Total foreign varieties		**10.00**

†W = winter, S = spring

The barley collection is maintained essentially under *ex situ* conservation. The National Programme for Plant Genetic Resources in IPGR–Sadovo aims to develop a detailed inventory of all accessions of barley held at the Institute of Barley in Karnobat and at the Agricultural Institute in Plovdiv. The base collection of barley is currently maintained at IPGR-Sadovo. Since 1997, the barley collection has increased by 42 accessions; 3737 accessions are held in long-term storage. Accessions are registered upon receipt from donor countries or from collecting expeditions. Some of the seeds are preserved as original samples in the genebank, while the rest are sown in a quarantine plot where they are tested for quarantine diseases and pests. The accessions are then routinely characterized in the field. During the vegetation period, regular phenological observations are made for 12-15 characters. A biometrical analysis is performed on five to ten plants of each accession before harvest. Morphological characters of the crop and other characters are recorded. The accessions that have been evaluated for a number of descriptors and for which enough seeds have been regenerated are kept in long-term storage in the genebank of the Institute.

Besides being evaluated according to descriptor lists, barley accessions are characterized according to the major breeding trends in Bulgaria. In recent years, scientific and applied research on barley focused on the creation and introduction of barley varieties for different purposes. The existing local material for initial selections being limited, it was necessary to test and evaluate foreign collections under the Bulgarian climatic conditions with the aim of selecting genotypes adapted to local conditions. The particular climatic conditions of the past years (dry spring and high temperature during grain filling) resulted in a significant

decrease of the biological potential of barley. Breeders are being requested to create early varieties of barley. One of the tasks of the genebank is to search for early maturing accessions. In 1999, about 45 accessions were distributed, to be used mainly for breeding purposes at the Institute of Barley in Karnobat.

Safety-duplication

Except for samples collected in collaboration with other breeding institutes, such as the Institute of Barley in Karnobat and the Agricultural Institute in Plovdiv, the barley collection has not been duplicated in other genebanks in the country or abroad.

Literature

Koeva, R. and Z. Popova. 1995. The influence of climate on the malting quality of some barley cultivars. P. 89 *in* Proceedings of the Conference on sustainable agriculture under conditions of transition to market economy, 17–20 Oct. 1995, Plovdiv. Agricultural Institute, Plovdiv, Bulgaria.

Koeva, R. and Z. Popova. 1995. Analysis of the reaction of local and introduced barley accessions to climatic factors. P. 89 *in* Proceedings of the Conference on sustainable agriculture under conditions of transition to market economy, 17–20 Oct. 1995, Plovdiv. Agricultural Institute, Plovdiv, Bulgaria.

Malkov, K. 1906. Description of the local winter wheats. Works of the State Agricultural Experimental Station in Sadovo, Plovdiv, Bulgaria.

Popova, Z., R. Koeva and I. Lozanov. 1999. Status of the Bulgarian barley collection. Pp. 29–30 *in* Report of a Working Group on Barley. Fifth meeting, 10–12 July 1997 (L. Maggioni, H. Knüpffer, R. von Bothmer, M. Ambrose, K. Hammer and E. Lipman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

Barley production and status of the national barley collection in the Republic of Croatia

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In terms of cultivated area, barley is the third-ranking cereal in Croatia. During the period 1980–1989 it was grown on 55 496 ha / year (i.e. 3.7% of arable land area), while maize was grown on 506 575 ha (34%) and wheat on 311 378 ha (21%).

By 1999 the barley production area had decreased to 45 000 ha, but reached 46 363 ha in 2000. Owing to the construction of a new malt factory and the increasing demand for barley (up to 60 000–70 000 t), the grain production should be increased by 10 000–15 000 t. This means that barley should be cultivated on a total area of 55 000 ha, to reach a production level similar to that of 1990.

The average grain yield achieved during the period 1971–1999 was 2.77 t / ha. High yields were obtained in 1984 (3.40 t / ha), 1990 (3.81 t / ha) and 1993 (3.43 t / ha).

Analyses carried out by the State Department for Statistics for the period 1970–1999 show an increase of annual grain yield by 56 kg / ha (Lalić *et al.* 2000). Field trials conducted at the Osijek Agricultural Institute showed a significant increase in grain yield (90 kg / ha / year) and a significant influence of the genotype. The best results for winter barley grain production were obtained from 1985 to 1989, at a time when the most commonly cultivated cultivars were 'Sladoran', 'Rodnik', 'Robur' and 'NS293'.

The cultivars most frequently sown from 1970 to 1999 are listed below:

	Winter barley	**Spring barley**
1970–1974	'Satir', 'Agere' and 'M45'	'Union'
1975–1979	'Agere', 'Mursa', 'Malta' and 'Alkar'	'Union' and 'Velebit'
1980–1984	'Slavonac', 'Alpha' and 'Pan'	'Velebit' and 'Berenice'
1985–1989	'Sladoran', 'Rodnik', 'Robur' and 'NS293'	'Velebit', 'Jaran' and 'NS294'
1990–1994	'Sladoran', 'Rex' and 'Plaisant'	'Jaran', 'Gimpel' and 'Astor'
1995–1999	'Rex', 'Sladoran' and 'Plaisant'	'Jaran', 'Gimpel' and 'Astor'

During the war in Croatia (1991–1995) the conservation chambers and most of the barley and other seed collections of the Osijek Agricultural Institute were destroyed. After 1995 the barley collection was reconstructed, and we take this opportunity to thank all genebanks that provided us with barley material. However during the period 1994–2000 the barley collection could not be properly conserved, owing to the destruction of the buildings. The whole collection had to be sown every year. Therefore we cannot guarantee complete genetic purity of the collection but this system allowed us to maintain the collection of cultivars and lines from the Osijek Agricultural Institute.

In March 2000 the construction of new buildings was started, funded by the Ministry of Science of the Republic of Croatia (60%), Osijek and Baranja districts (15%), Osijek Town Council (15%) and Osijek Agricultural Institute (10%). These new facilities will allow the conservation in good storage conditions of the barley and other seed collections used in the breeding programmes of Osijek Agricultural Institute. The barley collection now contains 358 cultivars and lines of winter barley and 520 cultivars and lines of spring barley.

From 1952 to 2000, 11 582 combination crossings were carried out at Osijek Agricultural Institute. The new cultivars registered include 27 two-row winter barley, 10 six-row winter barley cultivars and 23 cultivars of spring barley. Tables 1–3 show the basic characteristics and pedigree of these registered cultivars. Important characters include earliness ('David',

'Zlatko', 'Sladoran'), high resistance to lodging ('Barun'; 'Sladoran', a two-row winter barley; and 'Karlo', a six-row winter barley), short stalk ('Sladoran', 'Karlo', 'Barun', 'Baja', 'Val'), high hectolitre weight and high first-class kernels portion ('Zlatko', 'Rex') (Martinčić and Kovačević 1984, 1985, 1989; Kovačević *et al.* 1989, 1995; Lalič and Kovačević 1997).

The location of Osijek Agricultural Institute and the prevalent climatic conditions influenced the selection of very early maturing winter and spring barley (particularly spring barley).

References

Kovačević, J. and A. Lalić. 1999. The national collection of winter and spring barley in Croatia. Pp. 31–33 *in* Report of a Working Group on Barley. Fifth meeting, 10–12 July 1997, Alterode/Gatersleben, Germany (L. Maggioni, H. Knüpffer, R. von Bothmer, M. Ambrose, K. Hammer and E. Lipman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

Kovačević, J., A. Lalić and G. Drezner. 1995. Our experiences in barley (*Hordeum vulgare* L.) breeding on plant height reduction and increasing grain yield. Fragmenta Agronomica 2(46):76–77.

Kovačević, J., A. Lalić and J. Martinčić. 1989. Interrelationship between grain yield and malting quality of two-rowed winter and spring barley. XII EUCARPIA Congress on Science for Plant Breeding, 27 Feb–4 March 1989, Göttingen, Germany. Book of Poster Abstracts, Part I, Poster Groups 1–15.

Lalić, A. and J. Kovačević. 1997. Oplemenjivanje ječma za potrebe sladarstva i stočarstva u Republici Hrvatskoj. [Barley breeding for malt industry and livestock feeding at the Osijek Agricultural Institute]. Poljoprivreda 3(2):31–45.

Lalić, A., J. Kovačević and D. Babić. 2000. Urod zrna i pivarska kakvoća ječma u Republici Hrvatskoj od 1970. do 1999. godine [Malting barley in the Republic of Croatia in the period 1970–1999]. Poljoprivreda 6(2):16–26.

Martinčić, J. and J. Kovačević. 1981. Utjecaj lokaliteta proizvodnje na prinos i kvalitetna svojstva ozimog pivarskog ječma. [Influence of growing locality on winter malting barley grain yields and quality traits]. Pivarstvo 14(2–3):5–12.

Martinčić, J. and J. Kovačević. 1984. Iskustva i perspektiva proizvodnje ječma za industriju slada i ishranu stoke [Experiences and perspectives of barley production for malting industry and livestock feeding]. Poljoprivredne aktualnosti 3:519–528.

Martinčić, J. and J. Kovačević. 1985. Prikaz rada na oplemenjivanju ječma [Barley breeding review]. Pivarstvo 18(4):201–204.

Martinčić, J., and J. Kovačević. 1989. Selekcija kao faktor unapreenja proizvodnje jema [Selection as a factor of barley production improvement]. Pp. 427–436 *in* Zbornik radova Instituta za strna žita Kragujevac [Paper summary of Institute for wheat Kragujevac].

Table 1. Pedigree and basic characteristics of registered winter barley of the Osijek Agricultural Institute[†]

Variety	Year of registration	Origin	Grain yield (t/ha)	Earliness	Stalk height	Lodging resistance	Special characteristic
Two-row winter barley							
Satir	1970	71 A 3 × Kruševa≠ki 1	4	6	4	5	
Alkar	1973	(Belje 607 × 73 B.3) × Herta) × Rika	4	6	5	6	
Mursa	1972	(Belje 607 × 73 B.3) × Herta) × Rika	4	6	4	5	
Osje≠ki goli	1974	Osk.101/19 × (COAC × Maksimirski) × Herta)					naked grain
Marsonija	1977	Satir × Osk. 6. 1/39/66	4	5	5	5	
Slavonac	1980	Osk.5.1/155-65 × Hauters	5	6	6	6	
Pan	1983	Mursa × Maris Otter	6	6	7	7	
Dorat	1983	Satir × Kearney	5	5	5	6	
Sladoran	1984	Alpha × Mursa	7	9	9	9	
Osje≠anin	1984	Mursa × Alpha	6	7	6	6	
Sokol	1984	Osje≠ki goli × (Osk.5.2/30-65 × Haganemugi)	5	6	5	5	
Baja	1985	Alpha × Mursa	6	7	9	8	
Rodnik	1986	Alpha × Mursa	7	7	6	7	
Panonac	1987	Alpha × Osk. 3.145-77	6	6	6	7	
Val	1989	(Dorat × (Alpha × Mursa)	6	7	8	8	
Rex	1990	(Dorat × (Alpha × Mursa) × Osk.5.59/6-78	7	6	7	7	low protein content
Danko	1991	(Dorat × (Alpha × Mursa) × Osk. 5.59/6-78	7	6	8	9	
David	1993	Pan × NS 293	8	9	7	8	
Mihael	1993	Osk. 5.59/6-78 × Osk.5.96/2-76	8	7	7	7	
Zvonimir	1995	Osk. 5.59/6-78 × (Pan × NS 293)	7	7	8	9	
Viktor	1996	Osk.5.88/2-80 × Osk.5.48/9-82	7	7	7	8	first-class grain portion 9
Olimp	1997	Osk.6.59/9-79 × Osk.4.58/2-81	8	7	7	7	
Gustav	1998	Osk.5.24/4-84 × Osk.4.197/17-84	7	7	7	8	
Zlatko	1999	(Sladoran × KB18-82) × Rex	8	9	7	7	hectolitre weight 9
Martin	2000	(Osk.5.12/1-84 × jLux) × Osk.4.197/6-84	8	7	8	8	
Barun	2001	Osk.4.208/2-84 × KB3-87	9	7	8	9	first-class grain portion 9
Pegas	2001	(Sladoran × KB18-82) × Rex	8	8	7	7	hectolitre weight 9
Six-row winter barley							
Val-Ma	1976	Haunter × Montendin	4				
Kornakum	1977	Hauters × Osk. 5.1/155-65	5				
Osje≠ki rani	1983	Osk. 5.1/155-65 × Hauters	5	8		6	
Osijek	1988	Morgenrote × Osje≠ki rani	6	7	6	6	
Posavac	1993	Osk.6.59/10-79 × Osk.3.52/2-81	7	7	7	7	
Baranjac	1993	Sladoran × Plaisant	8	7	7	8	
Podravac	1996	Ciklon × Pan	6	7	7	8	
Bartol	1998	Kompolti korai ×Osk.4.32/1-87	7	7	6	6	
Karlo	2000	Osk.5.241/6-86 × Plaisant	8	7	9	9	
Lord	2000	Osk.4.211/1-85 × Plaisant	8	6	6	6	first-class grain portion 8

[†]characters evaluated according to a 1-9 scale where:

1: low trait value (lower grain yield, later in earing, highest stalks, worst in lodging resistance);
9: high trait value (highest grain yield, earliest in earing, lowest stalks, best in lodging resistance)

Table 2. Pedigree and basic characteristics of registered two-row spring barley of the Osijek Agricultural Institute†

Variety	Year of registration	Origin	Grain yield (t/ha)	Earliness	Stalk height	Lodging resistance	Special characteristic
Velebit	1977	Wisa × Hunter	5	4	4	5	
Dilj	1980	(Browarny × Volla) ∗ Sultan	6	8	6	7	
Kalnik	1980	Osk.4.5/4-67 × Ofir	6	8	6	7	
Papuk	1980	Hassan × Amsel	6	8	6	7	
Nehaj	1981	Osk.4.5/4-67 × Ofir	6	8	7	7	
Jaran	1983	(Browarny × Volla) × Sultan	7	5	5	6	
Prenj	1985	Osk.4.1/1-70 × Hassan	6	8	6	8	
Osvit	1988	Kr. 72310 × (Osk.4.1/1-70 × Carina)	7	7	6	7	
Pivarac	1990	Osk.4.1/1-70 × (Carina × Triumph)	6	7	7	7	
Orion	1990	Menuet × Osk.4.27/6-76	6	7	7	7	
Astor	1991	Villa × Nehaj	6	9	7	9	hectolitre weight 9
Lux	1991	Osk.4.1/1-70 × (Carina × Triumph)	6	6	8	7	
Lunar	1991	Menuet × Osk.4.27/6-76	7	8	7	7	
Favory	1993	(Osk.5.3/4-77 × Cornell) × NS 301	7	6	6	6	
Vitez	1993	Osk.6.27-78 × Europa	6	9	7	8	hectolitre weight 9
Baltazar	1993	Osk.3.74/5-81 × NS 301	7	7	8	8	
Igor	1998	Osk.5.241/1-83 × Osk.6.50/3-85	8	6	9	9	
Darko	1998	Osk.4.31/6-84 × Osk.4.240/14-82	8	8	9	9	low protein content
Marko	1999	Osk.5.103/2-86 × Havila	8	7	6	7	1000-kernel weight 9
Dominik	1999	Jaran × Osk.4.210/3-83	8	7	6	7	first-class grain portion 9
Valentin	2000	Osk.6.168/4-85 × Osk.4.226/2-82	9	7	6	7	
Mislav	2001	Osk.5.104/1-86 × Osk.4.71/4-83	8	9	8	8	
Zdeslav	2001	Regent × Osk.4.72/1-82	8	9	8	8	

†Characters evaluated according to a 1-9 scale where:

1: low trait value (lower grain yield, later in earing, highest stalks, worst in lodging resistance)
9: high trait value (highest grain yield, earliest in earing, lowest stalks, best in lodging resistance)

Genebank management at the Jõgeva Plant Breeding Institute, Estonia

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Introduction

Significant activities on the collection and conservation of plant genetic resources (PGR) were initiated at Jõgeva Plant Breeding Institute (Jõgeva PBI) in 1994. A strategic plan for the development of plant genetic resources conservation in Estonia was prepared in accordance with the Nordic-Baltic Project (Rashal 1999).

Activities started with the inventory of breeders' crop collections. PGR collections in other genebanks were investigated for identification and repatriation of PGR of Estonian origin. Appropriate procedures were elaborated for the collection, identification, evaluation, characterization, documentation and conservation of accessions in accordance with the internationally recognized standards (FAO / IPGRI 1994).

The main priority of the genebank of Jõgeva PBI is to ensure the long-term conservation of advanced cultivars and breeding lines of Estonian origin. According to van Soest *et al.* (1993) and to Goldringer *et al.* (1994), the germplasm preserved in the genebank has an ultimate importance for plant breeders. Evaluation and characterization of accessions have been a very important commitment of the genebank, which should provide adequate information to plant breeders and other users of the accessions (Kukk 1998).

The Committee on Plant Genetic Resources for Agriculture was founded in Estonia in 1997. The Committee's mandate is to consolidate all institutions dealing with the conservation of plant genetic resources for food and agriculture into the Estonian National Network and to develop national strategies for PGR conservation (Kukk and Küüts 1997).

Management of the collection

A number of accessions of Estonian origin have been repatriated from other genebanks: NGB (Nordic Gene Bank, Sweden), CGN (Centre for Genetic Resources the Netherlands) and VIR (N.I. Vavilov Institute of Plant Industry, Russia). The inventory of the collection and the identification of accessions of the genebank are carried out according to the recommendations of van Hintum and Knüpffer (1995).

The genebank of Jõgeva PBI is well equipped for the management of the collection: seed-processing laboratory, drying room, equipment for the determination of seed moisture content, germination cabinet and deep-freezers. All procedures meet internationally recognized standards for long-term conservation (FAO / IPGRI 1994).

All samples are cleaned and graded before drying. In the drying room the temperature is 15–16°C, and the relative air humidity is 12–13%. The seed moisture content is determined once a week on a number of randomly selected samples. The samples are dried for 4-10 weeks until the required level of seed moisture content (3–7%) has been reached. Before the seeds enter the storage, a germination test is carried out on all samples in a germination cabinet in accordance with ISTA (International Seed Testing Association) rules (ISTA 1993).

Seeds are packed in laminated aluminium foil bags and stored in bulk bags (4000–10 000 seeds per accession) and distribution bags (100–250 seeds per accession) in deep-freezers at the temperature of –20°C. Distribution bags (5–10 bags per accession) are prepared to fulfil seed requests of the germplasm users, as well as for germination tests and regeneration. Annual germination tests are undertaken on selected accessions of different species to monitor changes in germination capacity.

The documentation of accessions has a very significant role in increasing the accessibility and usefulness of collections (van Hintum and van Soest 1997). The database management system of the genebank is under development. Passport descriptors have been developed for the database. They include accession number, accession name, Latin and Estonian name of the species, packing date, number of distribution bags, germination percentage, bulk weight, harvest year and donor accession number.

Accessions held at the genebank

The mandate of the genebank of Jõgeva PBI is not only to collect and preserve seeds of agricultural and horticultural plant varieties, breeding lines with specific characteristics and landraces of Estonian origin, but also material of foreign origin with useful biological and agronomic traits for breeding. Currently 566 advanced cultivars or breeds of 33 species are maintained in long-term storage. Cereals constitute 81% of all accessions, with a majority of oats and barley (Fig. 1).

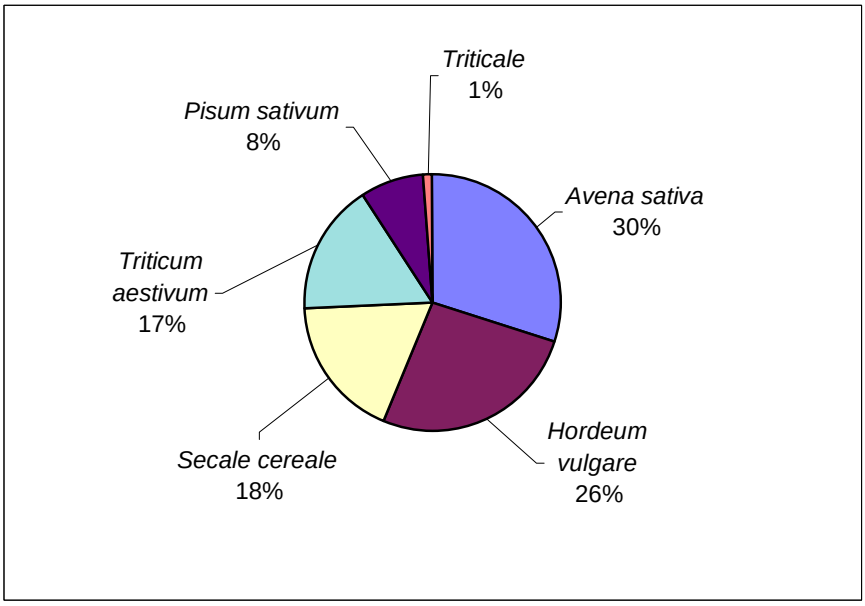

Fig. 1. Percentage of the accessions of cereals stored in the genebank.

Today the oldest varieties kept in long-term storage in the genebank are the garden bean 'Liplapi uba' (1920), the winter rye 'Sangaste' (1926), the meadow fescue 'Jõgeva 47' (1928) and the oat 'Kehra saagirikas' (1929).

To secure *ex situ* material of Estonian origin, the Nordic Gene Bank and Jõgeva Plant Breeding Institute have signed an agreement concerning 'black-box' arrangements whereby NGB agrees to maintain, for safety reasons only, safety-duplicates of the most valuable genotypes (Weibull 1999).

Future developments

The value and usefulness of accessions is determined by the available information on their genetic variability (Esquinas-Alcázar 1993). Cooperative efforts of the genebank and plant breeders should be concentrated on pre-breeding activities to facilitate germplasm improvement. According to Holden (1984) and Loosdrecht *et al*. (1988), plant breeders are looking for very definite traits, useful in breeding programmes. Therefore the real value of the genebank does not depend as much on the number of traits characterizing each accession as on the usefulness of the information for breeders.

The genebank of Jõgeva PBI has set up the following goals for the near future:

- to develop an optimal set of descriptors for characterization of the accessions;
- to improve the cooperation with the breeders for evaluation of the accessions;
- to continue the evaluation of breeders' active collections for the determination and utilization of the most valuable accessions; and
- to extend cooperation with other PGR holders.

References

Esquinas-Alcázar, J.T. 1993. Plant genetic resources. Pp. 33–51 *in* Plant Breeding Principles and Prospects (M.D. Hayward, N.O. Bosemark and I. Romagosa, eds.). Chapman and Hall, London.

FAO / IPGRI. 1994. Genebank standards. Food and Agriculture Organization of the United Nations, Rome / International Plant Genetic Resources Institute, Rome, Italy.

Goldringer, I., J.-L. Pham, J.L. David, P. Brabant and A. Gallais. 1994. Is dynamic management of genetic resources a way of pre-breeding? Pp. 163–170 i*n* Evaluation and exploitation of genetic resources. Pre-breeding (F. Balfourier and M.R. Perretant, eds.) Proceedings of the Genetic Resources Section Meeting of EUCARPIA, 15–18 March 1994, Clermont-Ferrand, France. INRA, Clermont-Ferrand, France.

Hintum, T.J.L. van and H. Knüpffer 1995. Duplication within and between germplasm collections. I. Identifying duplication on the basis of passport data. Genetic Resources and Crop Evolution 42(2):127–133.

Hintum, T.J.L. van and L.J.M van Soest. 1997. Conservation of plant genetic resources in the Netherlands. Plant Varieties and Seeds 10:145–152.

Holden, J.H.W. 1984. The second ten years. Pp. 277–285 *in* Crop genetic resources: conservation and evaluation. (J.H.W. Holden and J.T. Williams, eds.). George Allen & Unwin, London.

ISTA. 1993. International rules for seed testing. Rules 1993. Seed Science and Technology 21, Supplement.

Kukk, V. 1998. Preservation of plant genetic resources for agriculture in Estonia within the framework of the Nordic-Baltic co-operative programme. Pp. 35–38 *in* Report from a Nordic-Baltic conference. Nordic Council of Ministers, Copenhagen.

Kukk, V. and H. Küüts. 1997. Plant Genetic Resources for Agriculture in Estonia. Transactions of the Estonian Academic Agricultural Association 4: 37–384.

Loosdrecht, M.P.H. van, L.J.M. van Soest and M.T.A. Dik. 1988. Descriptor list for wheat developed for a regeneration programme in the Netherlands. Plant Genetic Resources Newsletter 73 / 74:35–38.

Rashal, I. 1999. PGR activities in the Baltic countries: achievements and prospects. Sveriges utsäsedsföringen 109:205–210.

Soest, L.J.M. van, H.D. Masterbroek and E.P.M. de Meijer 1993. Genetic resources and breeding: a necessity for the success of industrial crops. Industrial Crops and Products 1:283–288.

Weibull, J. 1999. Collaboration in the neighbourhood. Pp. 13–17 *in* Nordic Gene Bank 1979–1999. NGB, Malmö.

Status and development of the barley germplasm collections in France in 2000

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The national barley collection

Since the Fifth meeting of the ECP / GR Working Group on Barley in Alterode, July 1997, little has changed concerning the French national barley collection (Jestin 1999). This collection of about 500 accessions is managed by a coordination unit—the coordinator and database manager is A. Le Blanc—located at the GEVES Centre in Le Magneraud. Deep-frozen duplicates are kept there for safety reasons, while original seed samples are preserved by users / members of the national cereal genetic resources network themselves.

To date, and since the first publication in 1997 of the *Bread wheat and barley national collection catalogue* (BRG 1997), the guidelines followed are those which have been prescribed and derived from the Rio Conference on biological diversity. Hence we include in this 'national' germplasm series only material assumed to be of French origin in one way or another. However, inclusion of material actually bred in France, but originating from crosses involving foreign germplasm could be a matter of discussion.

Its enrichment is mainly generated now by outclassed cultivars, bred and previously registered in the country, which are entered in the collection after having been removed from the official list of cultivated material. Some breeding or pre-breeding lines are also considered, in particular those proposed by INRA for evaluation in nursery networks. Table 1 shows the frequencies of the various kinds of accessions found in the national barley collection, extracted from ERGE, the national database system.

Table 1. Distribution of the French national barley collection according to the type of accessions

	Accessions
French landraces or derived	80
Crossed-off ancient cultivars	210
Breeder's lines (genitors)	178
Lines with identified genes	10
Wild *Hordeum*	4
Total	**482**

Concerning national barley landraces, or lines closely derived from those, it is generally agreed that almost no such material cannot be collected anymore in France, even in mountain refuge areas, where the last traditional small farms which used to re-sow locally adapted seed ecotypes year after year, have disappeared. This contrasts with the situation still observed in 2000 for old vegetable landraces or ancient orchard tree clones, for which local accessions could until recently, or can still be collected, often by private associations of 'old variety' fans. Several regional eco-ethnological museums regularly organize field exhibitions of ancient cultivars, and rely mostly on the national collection or on that of INRA (Institut National de la Recherche Agronomique) to obtain seeds for these events. Part of this material has been recently studied for its overall molecular, biochemical and morphological diversity (Bahrman *et al.* 1999).

Finally, regarding wild *Hordeum* species naturally found in France (*H. murinum*, *H. bulbosum*, *H. marinum* and *H. secalinum)*, no recent and comprehensive collection has been carried out, although the development of tourism and the ensuing coastal urbanization may

significantly endanger the genetic diversity of some of these species, in particular *H. bulbosum* and *H. marinum*. Whether *in situ* conservation is still sufficient should be discussed, although the distribution area of these two species in Europe and/or the Mediterranean Basin is quite large (von Bothmer *et al.* 1995). Even if this diversity is not truly threatened, it might be worthwhile to consider collecting these materials, perhaps at the European level where this has not yet been done, and to define afterwards core collections, as has been done for *Lolium perenne* (Balfourier *et al.* 1998).

Development of the national barley collection

The following issues related to this national collection are presently receiving special consideration:

- Implementation of a more comprehensive description and evaluation system in the ERGE germplasm database. It is felt that for any user inquiring about a given accession, apart from basic passport data and information on pedigree, a fairly simple summary of agronomic evaluation, including the main traits of interest to the breeder, should be provided.

  This is relatively easy for Mendelian traits (e.g. covered vs. naked kernel) or those exhibiting a high level of heritability, such as heading date, plant height, etc. In contrast, for traits prone to environmental fluctuation, genotype interaction or pathogen race evolution, the question appears more difficult and there is no fully satisfactory solution yet. For such traits, a five-class scale (1–3–5–7–9) is presently proposed, and the frequency data, with reference to standard varieties, are presented for all genotypes in a small histogram giving a quick visual appraisal of the trait. For pathogen races, especially when the turnover of breakdown of resistances is rapid, this may be confusing. Even within the same year, a new race may be present or not in various regions of the country. Documentation of the resistance alleles that are present is relatively seldom available, except sometimes for powdery mildew, brown rust and Barley Yellow Mosaic Virus (BaYMV), for part of the European cultivars. In addition, for some diseases, including those caused by BaYMV and Barley Yellow Dwarf Virus (BYDV), there are tolerance and partial or horizontal resistance effects which generally cannot be assigned to identified genes.

  Therefore this attempt to make a 'summary' for each trait could be completed, when more detailed information is requested, with a direct linked access to original tables of observations, containing the location of the nursery, year of cultivation, appropriate controls, context and history of the trait considered. This also has the advantage of providing comparative information on contemporary accessions studied in the same design. This is the solution widely found in the 'Genetic Resources Information Network' (GRIN) database of the USDA (United States Department of Agriculture), for instance.

- The seed re-multiplication/renewal for series of accessions is also being discussed, as far as this rather tedious task should probably be better shared—i.e. more equally—between all members of the collection and network users (breeders, research and educational organizations). In contrast, the multiplied seed could be better preserved under the control of a single and central curator in the network. Now this cold storage is fairly decentralized, although quite a large percentage is concentrated at INRA. This central holding would allow in particular avoidance of the risk of losing some accessions when programmes are discontinued. This has occurred occasionally in the past, with the trend toward increased business concentration.

- A last point has also been evoked: the increasing number of registered cultivars, some of which have never really been used by farmers before being removed from the official list of marketed and cultivated cultivars. It may be questionable whether every crossed-off accession should necessarily enter the national collection, at least when both parents are already maintained, and if an expert panel declares that the accession considered is bringing no perceivable diversity or progress.

  Obviously the objection has also been raised that any potential interest of a given accession may become apparent only quite some time later, sometimes even decades later. And, of course, a fully disregarded accession can easily disappear; it would then be lost forever. Such an example already exists: old winter six-row types, released or registered between 1930 and 1955, had a very weak straw, a tall height and a relatively low grain yield. They have been superseded by cultivars such as 'Dea' and 'Ager' and even more modern accessions. In fact these old accessions revealed interesting resistances to BaYMV, including the latest pathotype Y2, as was the case for the cultivars 'Comte de Serre' and 'Superchampenois' (Le Gouis *et al.* 2000b). By the time they became out-classed, BaYMV had been recognized in Japan—as early as in 1940—but not yet in Europe, where this occurred by the end of the 1970s (Huth and Lesemann 1978). By chance, the old, lodging-susceptible cultivars had been kept in collections, and they have proved useful in applied and successful breeding programmes. BaYMV resistances of exotic origin—Japan, China, etc. —were also used in parallel, but otherwise these exotic accessions often showed a lower level of overall adaptation, making several back-crosses necessary.

Other public or private barley collections

Several organizations still hold significant barley collections. In the public sector, INRA maintains about 4200 accessions of cultivated barley and 60 wild *Hordeum* accessions in cold store conditions. At the last updating of January 1999, the INRA-ENSA Collection in Montpellier recorded 3285 accessions, of which 870 were also present in the INRA collection in Clermont-Ferrand (C. Chaballier, pers. comm.).

GEVES (Groupement d'étude et de contrôle des variétés et des semences) is in charge of studying plant material applying for official registration and of establishing the genetic basis for plant breeders' rights protection. State-funded institutions, private breeders and seed growers unions cooperate in this organization. GEVES holds reference collections stored in cold rooms at Le Magneraud and La Minière. This represents some 2400 accessions for barley, about 1000 of which are 'genetic resources', the remaining 1400 being cultivars which are still registered, in course of registration, or which were relatively recently under study for registration but have been discarded.

In addition to this germplasm in the public or semi-public sector, private breeding companies carrying out barley breeding programmes generally maintain an active collection. Among the largest and oldest ones, the collections of Secobra at Maule, Desprez at Cappelle, Serasem at Premesques, Verneuil-Recherche at Verneuil-L'Etang, GAE (Groupement agricole Essonnois) at Maisse, Rustica, Unisigma, etc., can be mentioned. Secobra-Recherches was the first organization to undertake barley germplasm collection on a large scale in France, essentially landraces, as early as in 1901. Some of its accessions have been lost, due to war or other incidents, but recently this collection contained more than 2500 accessions (genetic resources and modern varieties). Most of the old French barley cultivars presently kept in the national or INRA collections originate from the Secobra initial *in situ* collection, raised at a time when the public sector was little involved, or not at all, in barley research in France (before 1927).

Use of germplasm by breeders: access to barley genetic diversity

Most French barley breeders participate in the barley evaluation network that is run yearly for winter barley and biennially for spring barley. Enquiries on the use they make of these networks show that they continue to use part of this material in their crossing programmes. Their main interest is oriented toward disease resistance, in particular viral diseases.

This concerned essentially all barley mosaic viruses between 1985 and 1995. Now a large quantity of mosaic-resistant germplasm is available, in particular material with the *ym4* resistance allele to the Y1 pathotype of BaYMV, and the level of emergency is lower. Barley stocks or cultivars with *ym5* or *ym11* alleles, notably, have also been tested and distributed. These stocks frequently need further pre-breeding efforts, as they are often poorly adapted to French conditions. The efforts in this direction are relatively moderate, since the spread of the new pathotypes seems to be relatively slow. In addition, the genotypes already carrying the *ym4* resistance allele seem to be more tolerant, either because Y2 is less aggressive than Y1, or because the *ym4* resistance to Y1 pathotype also confers partial resistance to Y2, or for both reasons.

The other important virus disease is caused by BYDV. Here tolerance alleles at the *Yd2* locus are the main sources reported. However, tolerance in the Canadian winter six-row cultivar Elmira, supposed to be polygenic, has also been reported (D. Falk, pers. comm.). If the trait is polygenic there, this will obviously make the use more difficult to breeders. More recently, another potential tolerance locus has been documented (Niks *et al.* 2000). BYDV-tolerant accessions have been introduced during the recent years mainly from Belgium (CRA, Centre de recherches agronomiques, Gembloux), Italy (Istituto Sperimentale per la Cerealicoltura, Fiorenzuola d'Arda), Germany (BAZ, Federal Centre for Breeding Research on Cultivated Plants, Aschersleben) and ICARDA (International Center for Agricultural Research in the Dry Areas, Syria) (IBYDV series); others have been developed from INRA programmes (Le Gouis *et al.* 2000a). Some of these sources still require a considerable pre-breeding work to be usable in commercial crosses.

Another trait for which breeders would appreciate access to a larger genetic diversity concerns malting quality among winter barleys. For this complex trait—or series of traits—, the increase in diversity is mostly brought by new cultivars registered in Europe. This is a difficult challenge, since in this respect the use of exotic material is often detrimental to malting quality when compared to the acceptable level reached by the relatively narrow pool of existing malting winter barley cultivars. For various other traits, material originating from CIMMYT (Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico) or from the International Barley Core Collection (BCC), in particular through the EU GENRES Project, is also being considered and studied.

References

Balfourier, F., G. Charmet, J.M. Prosperi, M. Goulard and P. Monestiez. 1998. Comparison of different spatial sampling strategies of a core collection among natural populations of fodder crops. Genet. Sel. Evol. 30:215–235.

Bahrman, N., J. Le Gouis, D. Hariri, L. Guilbaud and L. Jestin. 1999. Genetic diversity of old French six-rowed winter barley varieties assessed with molecular, biochemical and morphological markers and its relation to BaMMV resistance. Heredity 83:568–574.

Bothmer, R. von, N. Jacobsen, C. Baden, R.B. Jørgensen and I. Linde-Laursen. 1995. An ecogeographical study of the genus *Hordeum*. 2nd edition. Systematic and Ecogeographic Studies on Crop Genepools 7. International Plant Genetic Resources Institute, Rome, Italy. 129 pp.

BRG. 1997. Collection nationale 'France': Catalogue des Ressources Génétiques Blé Tendre et Orge. Bureau des Ressources Génétiques, Paris. 92pp.

Huth, W. and D.E. Lesemann. 1978. Eine für die Bundesrepublik neue Virose an Wintergerste [A new virus disease on winter barley in the Federal Republic]. Nachrichtenbl. Deutscher Pflanzenschutzdienst 30:184–185.

Jestin, L. 1999. The French barley national collection: present status and organization. Pp. 37–41 *in* Report of a Working Group on Barley. Fifth meeting, 10–12 July 1997, Alterode/Gatersleben. (L. Maggioni, H. Knüpffer, R. von Bothmer, M. Ambrose, K. Hammer and E. Lipman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

Le Gouis, J., N. Bahrman, D. Béghin, E. Jacquot and L. Jestin. 2000a. Breeding for barley yellow dwarf virus tolerance using controlled field test and molecular markers. Pp. 134–136 *in* Proceedings of the 8th International Barley Genetics Symposium, 22–27 October 2000, Adelaide, South Australia. Vol. II. (S. Lange, ed.). Department of Plant Science, Waite Campus, Adelaide University, Glen Osmond, S. Australia.

Le Gouis, J., D. Hariri, N. Bahrman and L. Jestin. 2000b. Resistance of old French barley cultivars to barley mosaic viruses. Journal of Plant Disease and Protection 107(4):433–438.

Niks, R.E., R. van Berloo and A. Werkman. 2000. Near-isogenic lines for partial resistance against barley leaf rust (*Puccinia hordei*) in cultivated barley. Pp. 148–150 *in* Proceedings of the 8th International Barley Genetics Symposium, 22–27 October 2000, Adelaide, South Australia. Vol. II. (S. Lange, ed.). Department of Plant Science, Waite Campus, Adelaide University, Glen Osmond, S. Australia.

Status of the spring barley collections in Lithuania

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Activities related to spring barley genetic resources are conducted within the framework of the National Plant Genetic Resources Programme for cultivated plants initiated in Lithuania in 1994. The objectives of this Programme include exploration, collecting, conservation and evaluation of the existing plant genetic resources and plant diversity of Lithuania. Eight research and educational institutions, which had earlier been involved in the conservation of genetic resources, joined the programme (Būdvytytė 1998). It is subsidized by the Lithuanian Science Foundation and coordinated by the Lithuanian Institute of Agriculture.

Three institutions out of eight—the **Lithuanian Institute of Agriculture** (LIA, Dotnuva), **Vilnius University** (VU, Vilnius) and the **Lithuanian University of Agriculture** (LUA, Kaunas)—maintain cereal collections. All spring barley accessions are kept in the active collections of the above-mentioned institutions. In 1994–1997 the collections of spring barley were inventoried. Seed of many accessions was rejuvenated and multiplied for conservation. Since 1997 the collections have been increased by new material received from other institutions or obtained from breeding programmes. The type of material and the number of accessions are shown in Table 1.

Table 1. Lithuanian spring barley collections, 2000

Institution	Number of accessions			
	Total	Varieties	Breeding lines, mutants, genetic stocks, infraspecific taxa	Varieties of Lithuanian origin
Lithuanian Institute of Agriculture	746	518	215	13
Vilnius University	336	7	326	3
Lithuanian University of Agriculture	23	5	17	1
Total	**1105**	**530**	**558**	**17**

In 1997 the collection contained 12 spring barley varieties of Lithuanian origin. In 1998 one new Lithuanian variety was registered and included in our collection. Two old spring barley varieties of Lithuanian origin have been lost. The collection currently contains 13 spring barley varieties of Lithuanian origin. All varieties of Lithuanian origin are kept at the LIA spring barley collection, and only duplicates in the other two locations. The Nordic Gene Bank (NGB) has provided facilities for long-term seed storage at LIA. Ninety-three spring barley accessions of Lithuanian origin (old varieties, breeding lines, mutants) have already been placed under long-term conservation (10 000 seeds per accession). Twelve spring barley accessions of Lithuanian origin have been placed in the long-term safety-duplication collection in the base collection of the Nordic Gene Bank (Table 2).

Table 2. Number of accessions stored in long-term seed storage at the Lithuanian Institute of Agriculture, 2000

Institution[†]	1996	1997	1998	1999	Total	Safety-duplicated at NGB
Lithuanian Institute of Agriculture	13	5	2	3	23	12
Vilnius University	11	40	19	0	70	0
Lithuanian University of Agriculture	0	0	0	0	0	0
Total	**24**	**45**	**21**	**3**	**93**	**12**

[†]All accessions are stored in LIA long-term storage.

A large part of the Lithuanian spring barley accessions was described in the Catalogue of Lithuanian Plant Genetic Resources (LIA: 436 accessions; VU: 205 accessions; LUA: 23 spring barley accessions and 6 winter barley accessions) (Būdvytytė *et al.* 1997). In 1998 material was prepared for the Baltic plant genetic resources catalogue; it will include only varieties and lines of Baltic origin.

In 1998 a new phase of the National Programme for Genetic Resources was started, focusing on increasing the diversity of plant genetic resources of local origin and on the exploitation of different research and breeding programmes that could facilitate the development of valuable genetic material (Būdvytytė 1999). The possibilities for enriching national spring barley with local diversity are very limited; therefore the greatest attention is being paid to the evaluation and study of genetic resources that have already been gathered, because the real value, possibility of use and relevance for further preservation of such material can be determined only after detailed evaluation and investigation. The evaluation of collections is carried out according to national barley descriptors, prepared on the basis of IPGRI descriptors.

The Lithuanian Institute of Agriculture has an active spring barley collection, which is mainly used for breeding purposes. It is not stored in long-term seed storage. The number of accessions is not constant. Since 1989 all spring barley varieties received at the Lithuanian Institute of Agriculture have been collected and maintained. The number of accessions collected at LIA currently amounts to 746. Most of the accessions (405) were received from VIR (N.I. Vavilov Research Institute of Plant Industry). Every year, about 300 accessions are planted and evaluated in experimental fields. In order to maintain a high seed viability, the varieties must be regenerated every three years.

The spring barley collection of the Lithuanian University of Agriculture is used exclusively for educational purposes. It consists mostly of morphologically different lines representing different infraspecific taxa. The spring barley collection of Vilnius University is used for genetic research.

In the framework of a close interinstitutional cooperation between LUA, VU and LIA, valuable agronomic traits of mutant lines and different lines representing infraspecific taxa from LUA and VU were evaluated in trials carried out at LIA.

Our future plans include continuation of the collection, preservation, identification, characterization, evaluation and documentation of the accessions, and extension of cooperation and exchange of genetic material with other holders of plant genetic resources.

References

Būdvytytė, A. 1998. Genetic resources of cultivated plants in Lithuania. Biologija 1:13–15.

Būdvytytė, A. 1999. A new phase of cultivated Plant Genetic Resources (PGR) programme in Lithuania. Biologija 3:30–32.

Būdvytytė, A., J. Labokas, L. Balčiūnienė, O. Bartkaitė, D. Budriūnienė, B. Gelvonauskis, N. Lemežienė, A. Pliura, J. Radušienė, A. Sliesoravičius and D. Smaliukas, compilers. 1997. Cereals. Pp. 11–31 *in* Catalogue of Lithuanian Plant Genetic Resources. Lithuanian Institute of Agriculture, Dotnuva-Akademija, Lithuania.

Status of the CGN barley collection, The Netherlands

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Collection

The CGN barley collection consists of 3436 accessions, i.e. 3342 cultivated forms of *H. vulgare*, 15 accessions of *H. spontaneum* and 79 accessions of 16 different wild species (Table 1). The material was mainly obtained from the former SVP (Stichting voor Plantenveredeling, Foundation for Plant Breeding), whereas a few other institutes from Wageningen and some private breeding firms contributed to the establishment of the collection (van Soest *et al.* 1995).

Table 1. Overview of the *Hordeum* collection of CGN

Species	Cultivated or wild	Number of accessions
H. vulgare (spring)	cultivated	2689
H. vulgare (intermediate)	cultivated	48
H. vulgare (winter)	cultivated	605
Total cultivated		**3342**
H. spontaneum (spring)	wild	15
H. bulbosum (winter)	wild	15
H. murinum (winter)	wild	27
Hordeum spp. (13)	wild	37
Total wild		**94**
Grand total		**3436**

The *Hordeum vulgare* group is divided in 1721 landraces, 626 cultivars, 740 accessions of research material (breeding lines, etc.) and 255 accessions of which the population types are not known. It includes more than 1500 landraces collected in the centres of diversity in Asia and Africa. This material was collected during ten different expeditions organized in the period 1953 to 1981 (van Soest and Boukema 1995). Countries sampled during these expeditions were, among others: Nepal (402 accessions), Pakistan (398), Ethiopia (292), India (161), Turkey (55) and Syria (41). The collection includes only a few old Dutch landraces from before 1900 (e.g. 'Maartse gerst', '6-rijige[23] uit Wijhe', 'Terschellings 2-rijige' and '4-rijige Blauwkaf'). In addition, the collection comprises several old varieties (1880 to 1935) from the Netherlands and some other European countries. Examples are: 'Toolse 6-rijige' and 'Minister Ruijs' from the Netherlands, 'Chevallier' and 'Pasteur' from France, 'Danubia' and 'Bavaria' from Germany and 'Prentice' and 'Goldthorpe' from the United Kingdom.

The most recent cultivars originate mainly from Europe and North America, but varieties from Japan, South America and North Africa are also found in the collection. Important wild species in the collection are *H. bulbosum* and *H. murinum*. Other wild species included are: *H. pusillum, H. chilense, H. cordobense, H. stenostachys, H. comosum, H. jubatum, H. lechleri, H. procerum, H. depressum, H. marinum, H. bogdani, H. brevisubulatum* and one unknown *Hordeum* species.

The majority of the cultivated *H. vulgare* material belongs to the spring type, 48 accessions are intermediate types and 605 accessions are winter barleys. The intermediate barley types are mainly landraces from the centres of diversity in Asia. A large part of the intermediate types were collected in Pakistan at altitudes of around 2000 m asl, during the joint Pakistan-Netherlands expedition (Hashmi *et al.* 1981).

[23] 'rijige' means 'row'

Regeneration and characterization

Most of the material included in the small grain cereal collections has been regenerated and is stored under long-term storage conditions (–20°C) in the genebank facilities of CGN. Regeneration of the majority of the accessions included in the collection was conducted in 1986–1992, partly in cooperation with private breeding firms from the Netherlands. Recently, several wild species were regenerated in the greenhouse.

Winter types are sown in October and spring types in March at a density of 350–400 seeds per m² in plots of 1 m² and 20–25 cm row distance. The seeds are harvested with a special combine.

During regeneration the accessions are characterized for a set of agromorphological traits using our own developed minimal descriptor list (Koch 1985). The procedure of developing the minimal descriptor list for barley was similar to the method used in wheat as described by van Loosdrecht *et al.* (1988). Table 2 presents information on the available characterization and evaluation data of the barley collection. The study of the agromorphological descriptors was conducted over many years in several experiments. In the case of testing for resistance to diseases, different methods were used. Evaluation data of screenings for resistance to some important barley diseases such as *Erysiphe graminis*, *Puccinia hordei*, *Rhynchosporium secalis* and *Helminthosporium teres* are available. In the framework of the Barley GENRES project, new evaluation data will become available.

Table 2. Overview of the observed characterization and evaluation traits of barley accessions in the information system GENIS

Trait	Number of methods	Number of experiments	Number of scores
Thousand grain weight	1	1	172
Spike density	1	11	1682
Lodging susceptibility	1	18	2959
Spike brittleness	1	2	259
Row number	1	20	3295
Growth height	2	19	3586
Awnedness–hoodedness	1	19	3261
Lemma colour at maturity	1	15	2725
Seed colour	2	16	1453
Seed hull	1	16	3071
Seed shape	1	9	2033
Flagleaf auricle colour	2	16	2956
Annuality	1	16	2911
Winter susceptibility	1	3	296
Spike shape	1	4	395
Rachilla hair length	1	1	75
Second growth tendency	1	1	75
Early growth tendency	2	13	2331
Erysiphe graminis	20	15	5080
Puccinia hordei	2	6	1576
Rhynchosporium secalis	1	3	630
Helminthosporium teres	1	1	153
Homogeneity	1	1	172
Blister size	1	1	46
Yellow dwarf virus resistance	2	2	246
Lodging resistance	1	1	173
Leaf covering	1	1	173

Documentation

All accessions of the barley collection are documented for passport data in GENIS, the data information system of CGN (van Hintum 1989). The passport data of some accessions are not complete. The country of origin of 214 accessions and the population type of 257 accessions are missing. Furthermore information on the ancestor, the year of origin and the breeder of a number of cultivars is not registered in GENIS. In addition, characterization and evaluation data stored in GENIS (Table 2) can be made available to potential users.

Since April 1998 passport data of the barley collection can be searched on-line or downloaded from CGN's Web site at <http://www.plant.wageningen-ur.nl/cgn/>.

Utilization

Since 1987 some 1603 accessions have been distributed to users all over the world. Users receive 100 seeds in the case of cultivated material, however for the wild barley species smaller amounts (25–50 seeds) are distributed.

As a result of the activities of the barley GENRES project, 731 CGN accessions were distributed to two partners for resistance evaluation to several diseases (e.g. BaYMV-1 and BaMMV complex, *Drechslera teres, Erysiphe graminis* and *Rhopalosiphum padi).*

References

Hashmi, N.I., L.J.M. van Soest, A.R. Rao, M. Mesken and Zahoor Amad. 1981. Collecting in Baluchistan, Pakistan. Plant Genetic Resources Newsletter 47:31–35.

Hintum, Th.J.L. van. 1989. GENIS: A fourth generation information system for the database management of genebanks. Plant Genetic Resources Newsletter 75/76:13–15.

Koch, M. 1985. Descriptorlijst Gerst [List of descriptors for barley]. CGN/SVP, Wageningen. 7pp.

Loosdrecht, M.P.H. van, L.J.M. van Soest and M.T.A. Dik. 1988. Descriptor list for wheat developed for a regeneration programme in the Netherlands. Plant Genetic Resources Newsletter 73/74:35–38.

Soest, L.J.M. van, I.W. Boukema and Th.J.L. van Hintum. 1995. CGN does more than collecting and freezing seeds. Prophyta Yearbook 1995. Vol. 49:94–97.

Soest, L.J.M. van and I.W. Boukema, editors. 1995. Diversiteit in de Nederlandse Genenbank. Een overzicht van de CGN collecties. [Diversity in the Dutch genebank. An overview of the CGN collections]. Centrum voor Genetische Bronnen Nederland (CGN). Centrum voor Plantenveredelings- en Reproduktieonderzoek (CPRO-DLO), Wageningen. 126pp.

Barley conservation at the Nordic Gene Bank

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Introduction

The Nordic Gene Bank (NGB) is a regional genebank for the five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. The mandate of the genebank is to preserve material from this geographical area. Furthermore, the aim is to document, characterize and carry out research and pre-breeding projects on preserved material.

The barley collection

The barley material preserved at the Nordic Gene Bank is presented in the tables below. The true Nordic collection is composed of 543 accessions (479 spring barleys, 55 winter, 9 unknown) with long-term preservation responsibility (Table 1). We also report here our non-Nordic accessions (Table 2) to encourage other European genebanks to repatriate or request this material. They will not be regenerated at the NGB. Only in special cases may non-Nordic material be accepted for long-term preservation and regenerated.

NGB also holds three so-called special collections including *Hordeum*: the barley mutant collection with over 9000 accessions, the collection of barley translocation lines with ca. 800 accessions, and the collection of wild *Triticeae* with ca. 1200 accessions, most of which are *Hordeum*.

Table 1. Current Nordic accessions of *Hordeum vulgare* subsp. *vulgare* accepted for long-term preservation at the Nordic Gene Bank

Country of origin	Breeding material	Cultivars	Landraces	Total
DNK	69	75	5	149
FIN	38	26	37	101
FRO			1	1
NOR	7	31	8	46
SWE	125	117	4	246
Total	**239**	**249**	**55**	**543**

Documentation

A review of NGB's barley collection has been started with the aim of screening passport data. In addition, possibilities to integrate 'old' evaluation and description data into NGB's information system are underway. Information on barley collection is now available at <http://www.ngb.se/>.

Characterization and evaluation

During 1998–1999 a characterization project on malting quality has been carried out on 347 accessions of Nordic spring barley material. This work has been accomplished by Svalöf Weibull AB in Sweden.

Research activities

NGB also finances external studies on Nordic barley material. During 1997–1999, two projects on spring barley have been implemented. The project dealing with problems concerning repatriation of germplasm from other collections will give valuable information on how to formulate a repatriation strategy for a genebank. This study has been conducted in cooperation with the Royal Veterinary and Agricultural University, Denmark.

The second current project studies near-isogenic spring barley lines and their resistance to *Rhynchosporium*. This study is being carried out in cooperation with the Agricultural University of Norway.

GENRES project CT98-104 'Evaluation and Conservation of Barley Genetic Resources'

NGB is a partner of the EU-funded project with the aim to improve the accessibility of barley genetic resources to breeders in Europe. NGB takes part in the project as coordinator for a group of Nordic partners. The achievements of the first project year include donation of test material for evaluation against barley stripe, update of NGB's barley database and screening for duplicates in NGB's barley collection.

Table 2. Non-Nordic material of *Hordeum vulgare* subsp. *vulgare* (536 spring barley, 92 winter, 19 unknown type) at the Nordic Gene Bank

Country of origin	Breeding lines	Cultivars	Landraces	Wild	Unknown†	Total
AFG			42			42
ALG					1	1
ARG					1	1
ARM					1	1
AZE					1	1
BEL			4		1	5
BGR	3					3
CAN			1		4	5
CHN			3		1	4
CZE			28			28
DEU	1	6	30		28	65
EGY			1			1
ESP			1			1
EST			2		1	3
ETH					3	3
FRA			35		7	42
GBR		5			15	20
GBS					4	4
GNR					1	1
GRC			1			1
HRV			7			7
HUN			2		1	3
IND					1	1
IRL			2		2	4
IRN					1	1
IRQ			1	1		2
ITA			10			10
KOR					1	1
LTU			10			10
NLD	1	4	27		10	42
NPL			1			1
PER			1			1
POL			1			1
PRT			1			1
ROM			21			21
RUS	2		5		4	11
USA	27		1		14	42
Unknown	12	1	70		173	256
Total	**46**	**16**	**308**	**1**	**276**	**647**

†Most of the accessions marked as 'unknown' are probably cultivars, but no priority is given at NGB to sort this out since the accessions are of non-Nordic origin.

Status of the Romanian barley collection

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Suceava Genebank, Romania

Introduction

In Romania only *Hordeum vulgare* subsp. *hexastichon* and subsp. *distichon* are cultivated. The first is cultivated to feed animals and in the highest mountainous isolated villages, and the second for beer making.

Composition of the national barley collection

The national barley collection is composed of a total of 3786 accessions (Table 1), of which 3032 are unique.

Table 1. Romanian institutes holders of the national barley collection

Institute	Number of accessions
ICCPT Fundulea	2096
Research Station Suceava	845
Research Station Turda	165
Suceava Genebank	647
Research Station Simnic	25
Agricultural University Timi oara	8
Total	**3786**

The Agricultural Institute ICCPT Fundulea holds the main barley working collection and distributes it to the regional Agricultural Research Stations, which also hold germplasm adapted to local climatic conditions. Duplicates were identified between research stations (508 accessions). They are maintained as working collections in some stations.

Fig. 1 shows the distribution of accessions according to their growth habit. Winter varieties are cultivated mostly in the south of the country and spring varieties in the north. During the past 12 years the winter barley form 'Fundulea' was adapted to early sowing in spring in Suceava.

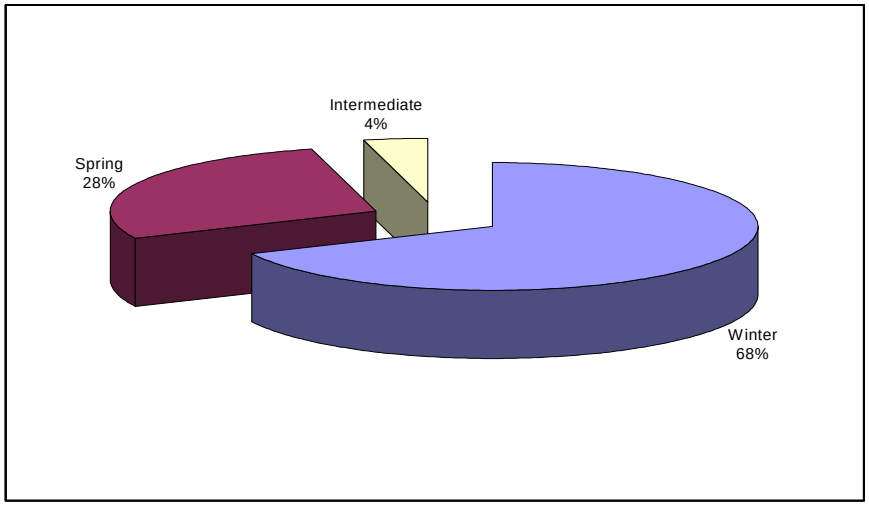

Fig.1. Distribution of barley accessions according to growth habit.

Varieties that have been registered and recommended for cultivation include 21 winter barley varieties and 9 spring barley varieties (Table 2).

Table 2. Barley varieties used in Romania (updated in 2000)

Cultivar name	Habit	Number of rows	Country of origin	Cultivar holder†	Year of registration
Adi	W	6	ROM	1001	1993
Amilis	W	2	FRA	2058	1999
Andra	W	2	ROM	1001	1994
Andrei	W	6	ROM	1001	1998
Aura	S	2	ROM	1005	1992
Balkan	W	6	FRA	2004	1997
Cecilia	S	2	FRA	2004	2000
Compact	W	6	ROM	1001	1998
Daciana	S	2	ROM	1005	1999
Dana	W	6	ROM	1001	1993
Ditta	S	2	DEU	2003	1995
Farmec	S	2	ROM	1003	1995
Glenan	W	6	FRA	2004	1995
Kelibia	W	2	FRA	2004	1995
Kristal	W	2	YUG	2042	1998
Laura	W	2	ROM	1001	1992
Maria	S	2	ROM	1003	1998
Madalin	W	6	ROM	1001	1994
Miraj	W	6	ROM		1974
Novosadski 293	W	2	YUG	2012	1997
Orizont	W	6	ROM	1001	1996
Precoce	W	6	ROM	1001	1986
Prima	W	2	ROM	1003	1988
Productiv	W	6	ROM		1981
Regal	W	6	ROM	1001	2000
Sonora	W	6	FRA	2004	1996
Thuringia	S	2	DEU	2003	2000
Tremois	S	2	FRA	2004	1995
Turdeana	S	2	ROM	1005	1988
Victoria	W	2	ROM		1977

†Holders:
1001 = ICCPT Fundulea
1002 = SCA Lovrin
1003 = SCA Suceava
1005 = SCA Turda
2004 = Roman Verneuil Com.
2003 = Saaten Union Romania SRL
2012 = Institute for Field and Vegetable Crops Novi Sad, Yugoslavia
2042 = Center for Agricultural and Technological Research Zajecar, Yugoslavia
2058 = Verneuil Recherches, France

The most frequently cultivated Romanian varieties are as follows:

- winter varieties
  - subsp. *hexastichon:* 'Miraj', 'Productiv', 'Precoce', 'Adi', 'Dana' and 'Madalin'
  - subsp. *distichon:* 'Victoria' and 'Laura'
- spring varieties: 'Precoce' (Precocious), 'Farmec', 'Maria', 'Turdeana' and 'Aura'. The latter two are typical of the chilly and damp climate of Transylvania.

Wild species of the genus Hordeum *and their distribution in Romania*

Species	Distribution
Hordeum secalinum Screb.	Rare. Ilfov county, Neajlov valley
Hordeum bulbosum L.	Rare. Mehedinti, Gorj, Tulcea, Danube Delta
Hordeum jubatum L.	Very rare. Only in the Danube Delta
Hordeum hystrix Roth subsp. *gussoneanum* Parl.	Cluj, Brasov, Alba, Ilfov, Gala i, Vaslui, Ia i
Hordeum marinum Huds. subsp. *marinum*	Arad, Timis, Cara -Severin, Bucure ti, Braila, Constan a, Galati
f. *hirtellum* Deg.	Very rare, growing only in Timi oara.

Hordeum bulbosum is the only species used for breeding purposes at ICCPT Fundulea.

The Suceava Genebank barley collection

At present, the genebank collection is represented by 647 accessions belonging to *Hordeum vulgare* including subsp. *distichon* and *hexastichon*.

Regeneration and storage

Barley accessions are multiplied in the field every year. In 2000, 162 accessions of spring barley were regenerated and multiplied.

Seeds are stored in medium-term storage at +4°C and 8% seed moisture content. All accessions will be placed in long-term storage as of January 2001, at –20°C and up to 5% humidity.

The composition of the barley collection in the Suceava genebank is shown in Fig. 2.

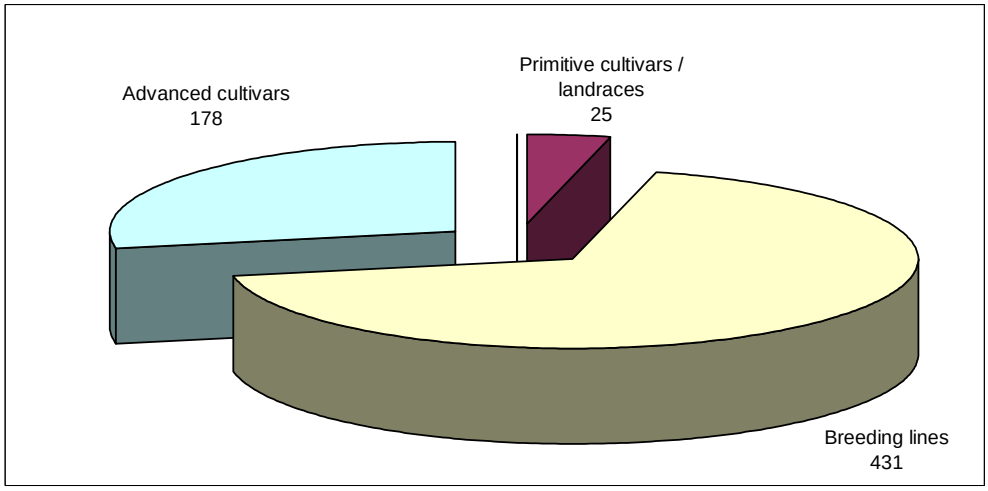

Fig. 2. The barley collection in the Romanian genebank.

There are two main sources for material acquisition: collecting missions and exchange with Romanian or foreign research institutes. The distribution of genebank accessions according to their origin is represented in Fig. 3.

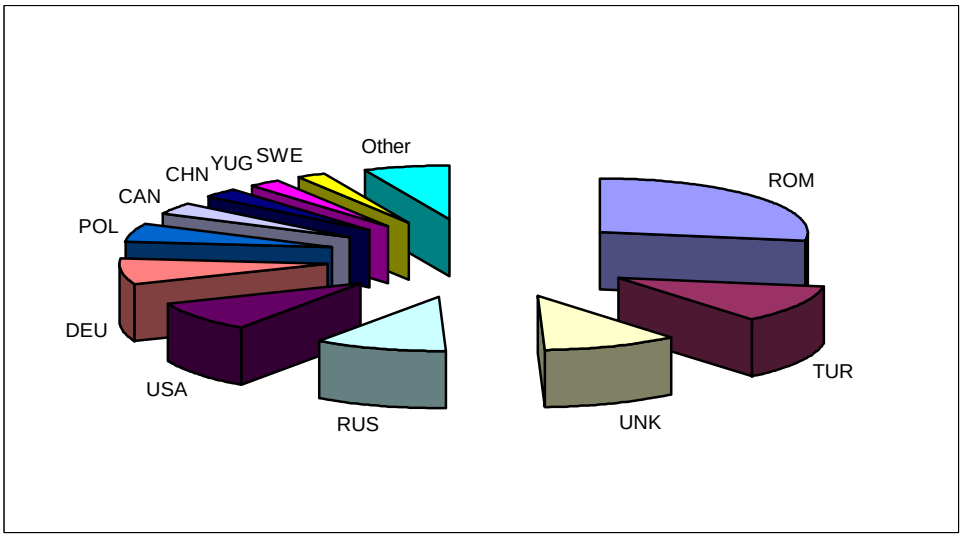

Fig. 3. Top ten donor countries.

Greater attention has been given to barley evaluation since 1997, which has allowed definition of the distribution of subspecies with the Romanian collection. More than half of the collection has been attributed to a subtaxon (Fig. 4).

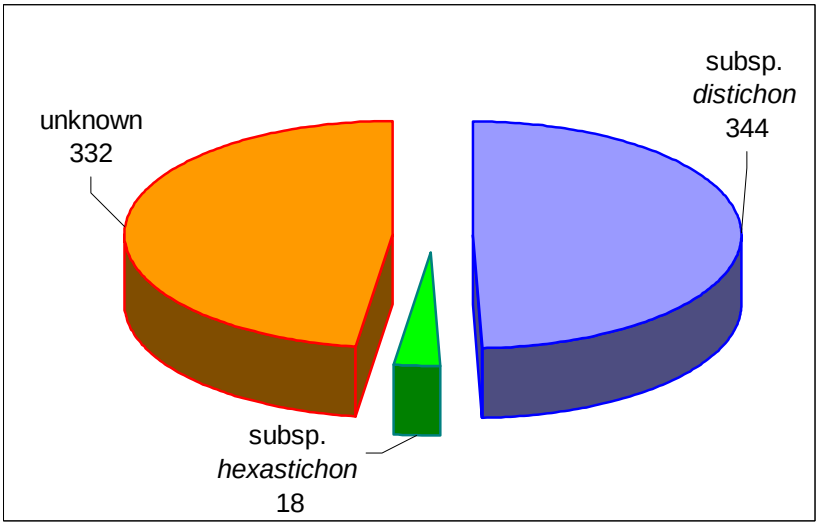

Fig. 4. Distribution of barley subtaxa in the genebank collection.

Characterization and evaluation

Accessions are characterized in the field during the vegetation period for multiplication and regeneration. Morphological characterization includes descriptors such as phenological data, 1000-grain weight, lodging, etc. Disease resistance was also evaluated this year in the field and in the laboratory, and resistant genotypes to seven fungi diseases (*Erysiphe graminis, Helminthosporium sativum, H. teres, H. graminis, Rhynchosporium secalis, Ustilago hordei* and *Septoria tritici)* were identified within local populations. The methodology adopted for the scoring of the diseases followed the agreement outlined in the EU Barley Project

GENRES 98-104 (Evaluation and Conservation of Barley Genetic Resources to Improve Their Accessibility to Breeders in Europe) in which Romania is a partner.

Evaluation descriptors for the laboratory are still under development.

Passport and characterization/evaluation data are registered in a database system, using the database software Microsoft® Visual FoxPro.

Emphasis is currently set on data recording for the publication of the national catalogue of genetic resources which includes all germplasm data of the Romanian Agricultural Institutes and Universities. This work is carried out with financial and counselling support from IPGRI.

References

Anonymous. 2000. Catalogul oficial al soiurilor si hibrizilor de plante de cultura din Romania [Official catalogue of hybrids and varieties in Romania]. Ministerul Agriculturii si Alimentatiei, Institutul de stat pentru testarea si inregistrarea soiurilor [Ministry of Food and Agriculture, National Institute for Breed Testing and Registration], Bucharest, Romania.

Balteanu, Gh. 1998. Cereale si Leguminoase pentru boabe [Phytotechny of cereals and grain legumes]. Pp. 150–163 *in* Fitotehnie, vol. I [Phytotechny, vol. I]. Ceres, Bucharest, Romania.

Maggioni, L., H. Knüpffer, R. von Bothmer, M. Ambrose, K. Hammer and E. Lipman, compilers. 1999. Report of a Working Group on Barley. Fifth meeting, 10–12 July 1997, Alterode/Gatersleben, Germany. International Plant Genetic Resources Institute, Rome, Italy.

Status of the VIR barley collection, Russia

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Introduction

The development and maintenance of an active barley collection and its evaluation are important activities of the N.I. Vavilov Institute of Plant Industry (VIR). VIR has long-standing experience in the collecting, multiplication, characterization and evaluation of barley genetic resources. The VIR barley collection was started in 1901. Many expeditions were organized by N.I. Vavilov in the former USSR as well as in other countries, and unique barley material was collected. VIR possesses a very rich material obtained during many expeditions undertaken after World War II and through exchanges between genebanks.

Composition of the VIR barley collection

The VIR barley collection comprises 20 197 accessions of cultivated barley, *Hordeum vulgare* L., including more than 200 botanical varieties. It includes 39% landraces, 46% cultivars, 8% breeder's lines, 6% mutants and genetic stocks, 19% winter, 73% spring and 8% facultative barleys. Thirty percent of the accessions originate from Russia and the former Soviet Union, followed by USA (12%), central Europe (9%), East Asia (8%), Ethiopia (6%) and northern Europe (5%).

Reproduction and storage

The barley collection is maintained at six VIR stations: Pushkin Experiment Station, Volgograd Experiment Station, Kuban Experiment Station, Daghestan Experiment Station, Yekaterinino Experiment Station, and Moscow Branch of VIR.

The main part of the collection is stored at the national seed storage, in Krasnodar region. Two years ago, VIR started to implement the National Programme for Conservation of Plant Genetic Resources, involving storage in the centre of St. Petersburg. Seeds are kept in long-term storage at –18°C.

Evaluation

The following characters are evaluated: vegetation period, quality, and resistance to lodging, drought, diseases and frost.

Documentation

Passport data (accession number, accession name, country of origin, expedition, date of collection, farmer name, pedigree, botanical variety, growth habit, year of entry in the collection, year of reproduction) are now included in the database. The cultivars released in different zones of the Russian Federation have been included in the database with more details since 1997. The following information is recorded in the database for these cultivars: pedigree, year of release, breeding institute, morphological characteristics, characterization results.

Publications

Evaluation results are published in VIR proceedings and bulletins and in the catalogues of VIR's world collection (multi-site 3-year evaluation of new accessions and specific studies); they are included in the database. This work will be continued in the future.

Status report on the barley collection in Slovakia

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Characteristics of the Slovak barley collection

The Research Institute of Plant Production (RIPP) in Piešťany has been working with plant genetic resources (PGR) and organizing them since 1951. Barley breeders were the first collectors and maintainers of PGR collections. In 1999, the Slovak National List of Released Varieties recorded 27 spring barley varieties, 14 domestic and 13 foreign varieties, and 8 winter barley varieties. The current composition of the barley collection is presented in Table 1. It comprises 1692 accessions, of which 371 are winter genotypes. *Hordeum vulgare* L. is the prevalent species, and 3%, 33% and 64% of the accessions have been described as landraces, breeder's lines and cultivars respectively. Nearly 25% of the material originates from the Slovak and Czech Republics.

Table 1. Barley accessions in the Slovak genebank

	Working collection	Base collection	Active collection
Spring barley	1321	21	482
Winter barley	371	0	284

Regeneration/multiplication and storage conditions

Barley accessions are evaluated in field conditions. In the base collection, barley genetic resources are stored at –17°C and the germination will be monitored over a 10-year cycle. In the active collection, accessions are stored at 2–5°C.

Documentation and database structure

The genebank information system is based on the database management system Microsoft®Visual FoxPro. The structure of the passport data follows the principles of the FAO/IPGRI *Multi-Crop Passport Descriptor List*. This list was adopted after the documentation workshop held in Budapest in 1997.[24]

Morphological, biological and economic characters of barley are evaluated according to the morphological descriptor list developed on the basis of UPOV, IPGRI and EVIGEZ Descriptor Lists. At present, about 30 morphological characters are being studied. During the vegetation period the usual phenological observations are made: diseases and productivity parameters are evaluated in the field, and chemical and technological analyses are carried out after harvest. Most of these data are not computerized yet, and therefore, data entry and revision is a priority for the future. The structure of the barley database also includes primary data. A colour scale for the characterization of morphological characters, to be added to the barley descriptor list, is in preparation.

[24] Lipman, E., 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.

Activities of RIPP

Molecular identification and characterization

Activities of the genebank include genotype identification by biomolecular techniques (study of electrophoretic differences in storage proteins and isoenzymes and DNA polymorphism analyses). Molecular analyses, using protein and DNA markers, enable the study of polymorphism among genotypes and assessment of genetic variability level. These have a great value for the identification of duplicates, cultivar identification, exclusion of foreign material and study of the pedigree of the genotypes.

The genotypes released for cultivation in the Slovak Republic, presented in the current List of Registered Varieties, have been identified, as well as the most frequently grown varieties not mentioned in this list. In total, more than 55 genotypes have been identified.

The biomolecular database includes data on the following loci: HVM3, HVM4, HVM40, HVM43, HVM44, HVM68, HVWAXY, BLYRCAB, BMS02, BMS32, BMS40 and NRT2.

Characterization of plant type using multivariate statistical methods

Multivariate statistical analysis is often used for the analysis and study of morphological and biochemical data. Cluster analysis of the morphological and biochemical data is carried out with SPSS software.

Multivariate analyses of agromorphological and biochemical traits show that the relationships between these traits are generally low. Last year the morphological and agronomic characteristics were studied on 14 descriptors in spring barley (collection of 181 genotypes). First priority was given to finding duplicates on the basis of morphological characteristics.

Phenograms were constructed from these data using the cluster method by Ward and the squared Euclidean distance matrix of similarity. Accessions originating from Syria, Mexico, China, etc., formed one cluster. In the set of spring barley, domestic varieties were found more stable than foreign ones. On the basis of the morphological data no duplicates were found in this set.

Results are provided every year to researchers working in breeding stations and research institutes. In the period 1996–1999, 234 barley accessions were distributed.

Molecular breeding

The programme is based on the utilization of identified markers and their controlled transfer to our genotypes, and on the identification of new markers for selected genes. Molecular markers are also used for the detection of some important genes in barley (*Rrn2*, *rpg4*, *RHY*). In our molecular breeding programme we use marker genes *ym4* and *ym11* for the development of new genotypes by means of controlled transfer of resistance genes to leaf rust and to viruses BaYMV and BaMMV.

Study of spring barley resistance to facultative leaf phytopathogens (*Pyrenophora teres and Rhynchosporium secalis*)

Eighty-nine spring barley genotypes were analyzed for *in vitro* and *in situ* interactions with isolates of both pathogens last year. The field isolation experiment was carried out in parallel in six different localities in Slovakia. After the field tests for resistance, the selected genotypes were tested under standard laboratory conditions in repeated tests on leaf segments. In our experiments, genotypes of Ethiopian origin had the lowest percentage of virulent clones and also confirmed their high resistance not only to local populations but also to *Pyrenophora teres* populations from Slovakia as a whole. Therefore their use was recommended in breeding programmes. According to the results obtained in the greenhouse, four genotypes could be recommended as sources of resistance to *P. teres* and *Rhynchosporium secalis.*

Future prospects

The Slovak barley collection appears acceptable from the viewpoint of primary conservation and passport data stored in database. However, some gaps remain, for example a standard agronomic evaluation of all barley resources would be necessary. It is also planned to link the biomolecular database to the other databases.

Status of the Yugoslav barley collection

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Barley breeding in Yugoslavia started at the beginning of this century, after the founding of the Agricultural and Chemical Experimental Station in Belgrade, the first Yugoslav research institution in the field of agriculture. The Station, founded by the Ministry of National Economy in 1898, had been preceded by the first state-run farm established in Belgrade back in 1851, which carried out initial experiments with fertilizers, organized first meteorological monitoring and made the first crosses. Activities on barley work began with the collecting of the initial material for breeding from local landraces and introducing varieties from European countries (Austria, Czech Republic, France, Germany, Hungary, the Netherlands, Slovakia, etc.). Unfortunately, all accessions from that period (before World War II) have been lost. Even a part of the accessions collected after World War II and old Yugoslav varieties are no longer held in our collections, partly due to the lack of a national genebank where they could have been deposited.

The Yugoslav genebank is not operative yet and barley collections are maintained at the three institutes that are dealing with barley breeding: the Institute of Field and Vegetable Crops in Novi Sad, the Small Grains Research Centre in Kragujevac, and the Agricultural and Technological Centre in Zajecar. The numbers of accessions and their types are given in Table 1. All accessions belong to the *vulgare* subspecies. The Novi Sad Institute holds about 100 naked barley genotypes.

Table 1. Structure of the Yugoslav barley working collections

Institute	Winter barley		Spring barley	
	6-row	2-row	6-row	2-row
Institute of Field and Vegetable Crops, Novi Sad	258	163	137	287
Small Grains Research Centre, Kragujevac	175	147	56	207
Agricultural and Technological Centre, Zajecar	322	438	5	21

The three institutes maintain working barley collections where only some accessions have passport and minimum characterization data (Przulj *et al.* 1997). The Yugoslav barley cultivars (Table 2) represent an exception where each entry has passport, characterization and evaluation data. Only a part of the Yugoslav Barley Gene Bank is included in the European Barley Database (Dencic *et al.* 1997).

Although small, the Yugoslav collections do not have appropriate documentation (no software, financial support for evaluation, maintenance, etc.). There are probably a number of duplicates because the institutes frequently exchange germplasm. We suppose that about 25% of the total number of accessions represent Yugoslav landraces, cultivars and advanced lines while the remaining 75% are accessions from different countries (Przulj *et al.* 1996). Each institute maintains its collection by planting the stored material from time to time. At the Novi Sad Institute, barley collections are planted at 5-year intervals using the pedigree method.

Table 2. Yugoslav barley cultivars

Cultivar	Year of registration	Habit†	Spike type	Pedigree
Institute of Field and Vegetable Crops, Novi Sad				
Novosadski 4082	1953	W	6R	Individual selection from local population
Novosadski 4276	1955	W	6R	Individual selection from local population
Novosadski dvoredac	1961	W	2R	Individual selection from local population
Novosadski 27	1973	W	6R	Ceres/Jumbo
Novosadski 150	1976	W	6R	Ceres/Engelen Dea/Leon
Novosadski 183	1977	W	2R	Ager/Emir
Novosadski 293	1982	W	2R	Fr.33/NS.185-2
Novosadski 295	1982	W	2R	Fr.33/NS.190
Novosadski 298	1983	W	2R	Fr.33/NS.185-2
Novosadski 299	1983	W	2R	Fr.33/NS.190
Novosadski 307	1984	W	2R	Fr.33/NS.185-2
Novosadski 309	1985	W	2R	Fr.33/NS.185-2
Novosadski 311	1985	W	2R	Fr.33/NS.90
Novosadski 313	1986	W	6R	Dura/2*NS.150
Novosadski 315	1987	W	2R	NS.185-2/2*Fr 33
Novosadski 317	1988	W	6R	Dura/2*NS.150
Novosadski 319	1988	W	2R	NS.185-2/2*Fr 33)
Novosadski 321	1988	W	6R	NS.272/Novosadski 27
Novosadski 323	1988	W	2R	NS.185-2/Fr 33//Osj.goli/3/NS.185-2/4/Sonja
Novosadski 331	1989	W	2R	NS.185-2/2*Fr 33
Novosadski 329	1990	W	6R	Novo.4082/3*Novo. 27
Novosadski 701	1991	W	6R	Aksamit/NS.185-2//Novo.27
Novosadski 703	1992	W	6R	Novo.150/Riso Mutant 1508//Novo.27
Galeb	1993	W	6R	L.2-79/NS.305
Novosadski 519	1998	W	2R	Rodnik/Corona
Novosadski 525	1999	W	2R	Ranij-1/Novo.293//NS.327/3/ Sladoran
Novosadski 529	1999	W	2R	OJK 8-82/Novo.293// Sladoran
Novosadski 535	2000	W	2R	L.107-87/Sladoran
Novosadski brzak	1960	S	2R	Individual selection from local population
Novosadski 135	1976	S	6R	Ceres/Gazelle
Novosadski 292	1980	S	2R	NS.38/Emir//Union
Novosadski 294	1980	S	2R	NS.39/Emir//Union
Novosadski 296	1982	S	2R	NS.39/Emir
Novosadski 300	1983	S	2R	NS.38/Emir//Union
Novosadski 301	1983	S	2R	NS.127/Union
Novosadski 306	1984	S	2R	NS.38/Emir//Union
Novosadski 310	1985	S	2R	NS.96/Emir//Fr 33
Novosadski 316	1989	S	2R	Magnific 102/NS.96//NS.96 /3/Union
Novosadski 324	1989	S	2R	Magnific 102/NS.96//NS.96 /3/Union
Vihor	1990	S	2R	NS.291/Sundance
Pek	1992	S	2R g	TU 50-77/Sundance//Novo.294
Jelen	1993	S	2R	Novo.183/Sundance//Novo.294
Novosadski 406	1993	S	2R	Engl.India/L.127-76//Spartan/3/ NS.250/4/Novo.294
Lazar	1994	S	2R	NS.320/Novo.135//NS.185-2/3/ Spartan
Viktor	1994	S	2R	Akka/2*NS.96//2*NS.185/3/ Spartan/4/NS.297
Milan	1995	S	2R	Novo.301/Aramir//Menuet/3/ Novo.294
Novosadski 418	1996	S	2R	Novosadski 183/C.10
Novosadski 420	1996	S	2R	L.156-78/C.10//Novosadski 294
Novosadski 428	1998	S	2R	Novosadski 301/C.10
Novosadski 430	1998	S	2R	Novo.300/Aramir//Koral/3/ Novo.294
Uroš	1999	S	2R	NS.297/Aramir//Novo.294
Slavko	1999	S	2R	L.21-80/2*Novosadski 301
Novosadski 438	1999	S	2R	NS.243/I 265//Koral/3/Novo.301
Lav	2000	S	2R	Novosadski 294/Alva// Novosadski 316
Branko	2000	S	2R	Ksakade/Novosadski 310
Novosadski 448	2001	S	2R	L.153-87/Menuet
Novosadski 450	2001	S	2R	Safir/2*Fj6850-85//Bonus

†W: winter, S: spring

Table 2. Yugoslav barley cultivars (cont.)

Cultivar	Year of registration	Habit†	Spike type	Pedigree
Small Grains Research Center, Kragujevac				
Kraguj	1977	S	2R	Gerda/Ceres
Biser	1979	S	2R	Gerda/Ceres
Zenit	1979	S	2R	Union/Gerda
Oplenac	1987	S	2R	CGS44-74/Kraguj
Orijent	1988	S	2R	CGS44-74/Kraguj
Astor	1989	S	2R	CGS44-74/Kraguj
Galeb	1990	S	2R	CGS44-74/Kraguj
Jastrebac	1993	S	2R	Georgie/Pirouette
Dinarac	1994	S	2R	Georgie/Kraguj
Dunavac	1995	S	2R	Georgie/Pirouette
Dukat	1999	S	2R	Union/Kraguj
Djerdan	2000	S	2R	Cornel/Georgie
Ukras	2000	S	2R	Dilj/KM-184
Horizont	2000	S	2R	NS-292/Nehaj
Jadran	2000	S	2R	KM-184/NS.301
Dragulj	2000	S	2R	KM-184/NS.301
Kragujevacki 73	1973	W	6R	Ager/Jumbo
Gruzanin	1975	W	6R	Jumbo/Ager
Rudnicanin	1976	W	6R	Jumbo/Ager
Partizan	1977	W	6R	Ager/Jumbo
Jagodinac	1992	W	2R	Novosadski 313/KG 422
Rekord	1999	W	2R	SSK 1986-13/Novosadski 183
Sampion	2000	W	2R	SSk 86-87-8/Novosadski 293
Gigant	2000	W	2R	Sladoran/Novosadski 293
Agricultural and Technological Centre, Zajecar				
Djerdap	1980	W	2R	Union/Ager
Timok	1985	W	2R	Union/Ager//Union/3/ Union/Ager
Kristal	1987	W	2R	Union/Ager//NS.185
Krajinac	1991	W	2R	Union/Ager//NS.185
Midzor	1994	S	2R	NS.183/Sonja//Djerdap/NS.310
Zlatan	1999	S	2R	Alkar/Union//Ager/3/NS.310
ZA-31	2000	S	2R	Djerdap/NS.185//OSK.471.4-83
Timocanin	1996	S	6R	Iris/NS.183//NS.313/Sonja

†W: winter, S: spring

References

Przulj, N., V. Momcilovic and D. Knezevic. 1996. Utilization of introduced germplasm in malting barley breeding. Pp 209-211 *in* Proceedings of 5th International Oat Conference & 7th International Barley Genetics Symposium, 29 July-6 August, Saskatoon, Canada (A. Slinkard, G. Scoles and B. Rossnagel, eds.). Univ. Extension Press, Univ. of Saskatchewan, Saskatoon.

Dencic, S., N. Przulj, M. Milovanovic, R. Protic, M. Simovic, Z. Stojanovic and D. Perovic. 1997. Genetic resources in cereals. Contemporary Agriculture (Novi Sad, Yug.) 46:1-2: 87-98.

Przulj, N., V. Momcilovic, N. Mladenov, S. Dencic. 1997. Divergence of the active barley (*Hordeum vulgare* L.) collections of the Institute of Field and Vegetable Crops in Novi Sad. I. Spike Traits. Contemporary Agriculture (Novi Sad, Yug.) 3-4: 289-294.

Appendices

Appendix I. The European Barley Database

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Introduction

The European Barley Database (EBDB) is the virtual backbone of the ECP/GR Working Group on Barley. In this report, information on the development of the EBDB is presented, with emphasis on the progress made since the fifth meeting of the Barley Working Group in 1997 (Maggioni *et al.* 1999).

In 1983 the original aims stated for the EBDB were:

- complete documentation (inventory) of European barley collections with respect to passport and characterization data using the standard IBPGR descriptor list;
- registration of these data in computer databases;
- free and effective data exchange between genebanks, and between genebanks and their clients;
- detection of replicated accessions;
- rationalization of collections by agreement between participating genebanks with consequent elimination of potential waste of resources in storage, multiplication, characterization and evaluation of redundant accessions;
- detection of gaps in the representation of barley germplasm under threat of erosion;
- rational planning of further collecting (IBPGR 1983).

The first version of the EBDB was developed between 1984 and 1987 (Knüpffer 1988), and resulted in the publication of the European Barley List (Knüpffer 1987). It contained passport data of 55 000 barley accessions from ca. 35 genebanks in Europe. Methods for the identification of potential duplicates based on passport descriptors were developed, and 'duplicate groups' were identified. From that exercise it became obvious that, without additional personnel, it would not be possible to keep the EBDB up-to-date and to continue the time-consuming analyses of the database, e.g. for identification of duplicates and synthesis of the data.

Therefore, both the International Barley Genetic Resources Network (IBPGR 1992, 1993), and the ECP/GR Working Group on Barley (e.g. Frison *et al.* 1993), recommended seeking external funding for the EBDB, and when the EU GENRES programme (Council Regulation 1467/94 of June 1994) was launched, a first project proposal was submitted in 1995 which however was not selected for funding by the EU.

The second version of the EBDB was built up in 1997, when support for staff was provided by IPK for six months. During the fifth meeting of the Working Group on Barley in 1997, Knüpffer and López (1999) gave a detailed technical description of the database. At that time, the EBDB accounted for nearly 90 000 accessions conserved in 29 European genebanks, e.g. almost a quarter of the estimated *ex situ* world holdings of barley amounting to 373 000 accessions (van Hintum and Menting 2000).

The Meeting of the Working Group on Barley in 1997 strongly supported re-submission of a new project application on barley to the EU GENRES programme (Maggioni *et al.* 1999), one of the major aims being the update of the EBDB at IPK and its utilization with respect to identification of duplicates and definition of responsibility-sharing. The second submission in 1998 was successful and provided for funding of the current EU project on barley genetic resources (EU GENRES CT98-104, April 1999 to March 2002). Besides setting up a European barley evaluation network for biotic and abiotic stresses, further work on updating and extending the EBDB is being carried out within the project, and the database functionality is

being improved. Some major collections from outside of Europe have recently been included. The main aims are: to improve the documentation of individual collections through links to passport, characterization and evaluation data of donor institutions; to identify redundancy at the accession level; to analyze / synthesize the compiled information; and to work towards a global inventory for barley germplasm. In the international context it is intended to create a strong European component which can be linked with major non-European activities, both national (e.g. U.S., Canada) and regional or international (e.g. ICIS, SINGER) to form an international information network on barley genetic resources.

Progress of the EBDB in 1997–2000

The following progress has been made since the fifth meeting of the Working Group on Barley in July 1997:

Updates received since 1997, together with the Australian and the ICARDA barley collections have been included in the database, bringing the total number of accessions up to 135 320 accessions from 33 genebanks (Fig. 1).

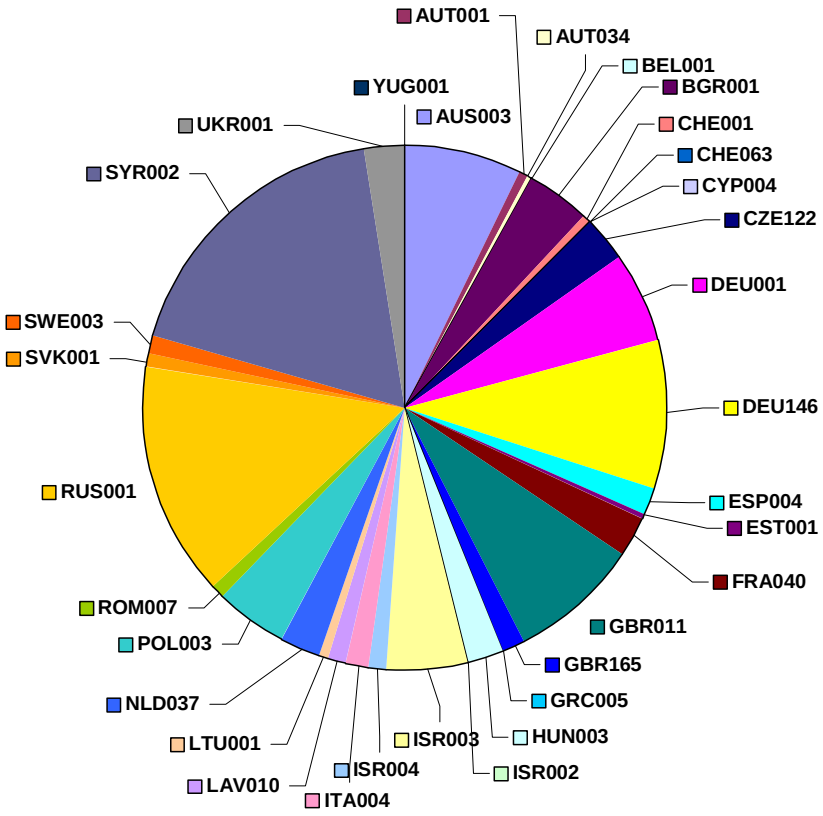

Fig. 1. Breakdown of accessions per contributing genebank in the European Barley Database. (Abbreviations and detailed numbers are listed in Table 2).

The EBDB was adapted to fit with the IPGRI *Multi-Crop Passport Descriptors*, including barley-specific data elements. Contributors to the EBDB are encouraged to use this agreed exchange format for their passport data contributions.

The updated EBDB (version 2) was handed over to ZADI (Central Agency for Agricultural Documentation and Information, Bonn, Germany) in 2000, for replacement of

the former prototype established in 1997. On-line access is provided at <http://www.dainet.de/eccdb/barley/>.

Identification of possible duplicates and unique accessions among cultivars of European origin was started, using parallel accession numbers in different collections and accession names. The basis for this is assigning unique identifiers to accessions in the EBDB, compared with major non-European collections such as ICARDA (International Center for Agricultural Research in the Dry Areas, Syria) and USDA (United States Department of Agriculture) (Enneking 2000). Possible duplicates identified in the first version of EBDB (1987–1989) will be taken into account in version 3.

The identification of duplicates between genebanks allows links to be established between accessions and their evaluation data accessible in the respective databases. Cooperation with the International Crop Information System (ICIS) is envisaged.

Pedigree information is included in some contributors' data sets, but needs to be standardized, e.g. following the proposal of Purdy *et al.* (1968). These data need to be stored in a well-designed database format. ICIS offers this possibility together with appropriate and freely accessible software (MS®-Windows™). Three published sources of barley pedigree data and other cultivar-related information are available (Arias *et al.* 1983; Baum *et al.* 1985; Baumer and Cais 2000). These are increasingly being integrated into the database.

The botanical nomenclature for wild species and cultivated forms of barley was standardized, based on relevant literature (Mansfeld 1950; Lukyanova *et al.* 1990 for infraspecific names in cultivated barley; von Bothmer *et al.* 1995 for wild species). The descriptions and synonymy of 216 botanical varieties of *Hordeum vulgare* from Mansfeld (1950) and Lukyanova *et al.* (1990) were translated into English from German and Russian, respectively, and organized in a database. This database will be verified and prepared for publication in cooperation with the Barley Department of the Vavilov Institute (VIR, St. Petersburg, Russia). The composition of the EBDB by species and by botanical varieties within *H. vulgare* was presented in detailed tables by Knüpffer and von Bothmer (2001).

Other work in progress includes standardization of collecting site information and completion with geographical coordinates, harmonization of donor, breeder and other institution or person acronyms with FAO/IPGRI codes (table INSTCODE.DBF maintained by FAO), and compilation of a list of barley-relevant expedition/collector acronyms.

The inclusion of additional fields to maximize the capture of informative content is under development (see below).

In light of the EU-funded project EPGRIS (European Plant Genetic Resources Information Infra-Structure project) which started recently, and in which a centralized passport database for all genetic resources accessions preserved in European genebanks will be created at IPGRI in Rome, the ECP/GR Central Crop Databases will take on a new role.

The role of the EBDB in sharing of responsibilities is outlined in the main report.

Evaluation data

Individual groups are developing their systems to store and present evaluation data. The United States Department of Agriculture (USA029) provides its information on the World Wide Web through its Genetic Resources Information Network (GRIN) (<http://www.ars-grin.gov/npgs/searchgrin.html>). Data from ICARDA's (SYR002) characterization of barley germplasm is available at <http://www.singer.cgiar.org>, site of the System-wide Information Network for Genetic Resources (SINGER) of the CGIAR (Consultative Group on International Agricultural Research). German evaluation data for the Gatersleben (DEU146) and Braunschweig (DEU001) collections are accessible at <http://www.dainet.de/genres/eva/gerste.htm>. The catalogue of the Barley Germplasm Centre in Kurashiki of the Okayama University (JPN108) can be searched at <http://shigen.lab.nig.ac.jp/barley/barley_search3.html>. The Centre for Genetic Resources, The Netherlands (NLD037) provides individual evaluation data files for downloading at <http://www.plant.wageningen-ur.nl/about/Biodiversity/Cgn/>.

Much information about barley genetic resources is also available in print; however, unless genotypes can be identified unambiguously (Accession IDs are preferable to cultivar names), direct referencing to inventories such as the EBDB remains a formidable challenge and may in some instances be futile.

Barley descriptors

The revised IPGRI barley descriptors and their codes have been made available at <http://barley.ipk-gatersleben.de/descriptors/>.

Surprisingly, to our knowledge, no database is currently using these descriptors, nor could examples be found where IPGRI descriptors have been implemented in a data model.

In the downloadable PC version of the USDA GRIN system (pcGRIN), the evaluation data are stored as individual observations (Accession ID, Attribute, Observation value, Site ID, etc.). A similar data model has been adopted by ICIS (<http://www.cgiar.org/icis/homepage.htm>).

Following the general agreement on the use of a minimum set of descriptors (IPGRI *Multi-Crop Descriptor List*), a discussion is now warranted about the implementation of IPGRI descriptors in databases in order to accommodate characterization and evaluation data. In order to provide flexibility, the matching and bi-directional translation of these descriptors (Fieldnames) and their encoding with those developed for existing documentation systems (EVIGEZ - e.g. Lekeš *et al*. 1986, VIR, UPOV, COMECON, USDA, SINGER) might be a useful approach.

Redundant duplicates vs. safety-duplication

Identification of duplicate and possibly redundant accessions has attracted considerable attention. Duplicate groups were identified in the first version of the EBDB, as already outlined above. With regard to landraces and populations collected from sites where these cannot be found any more because of genetic erosion, replication of such germplasm between collections is a safeguard against accidental losses and might also be considered a countermeasure against genetic drift. Widely distributed accessions of genetically homogeneous lines might also prove to be useful as unintentionally replicated controls to compare, validate and interpret characterization and evaluation observations.

Description of some new features in the database

The database is currently made up of two major files, EBDB_multicrop and EBDB_ID. Smaller files containing the botanical names and explanations for coded fields are linked to EBDB_multicrop.

The main passport table EBDB_multicrop

EBDB is essentially a long list of barley passport records from individual collections.

Each record is labelled with the institute code [INSTCODE] and an automatically generated sequential number [ORDER]. These two fields currently serve as the primary key for the database. Accession ID numbers from individual collections were separated into a maximum of three separate fields, Prefix [DEST], number [ACC_NO], suffix [ACC_NO_SUF]. Accession IDs in passport data contributed to the EBDB are in some cases simple numbers. Through addition of a collection-specific prefix, these can be distinguished from identical numbers in other collections. Prefix + number + suffix have been merged into a single INDEX field. For the majority of accessions listed in the EBDB, the accession ID in the INDEX field is unique. Thus it could serve as a natural primary key for the database in the near future.

Selection of genotypes with specific adaptive traits based on passport data is presently limited. New fields were therefore added to capture additional information, e.g. collecting site details. Using ICARDA's collection site descriptors, e.g. fields for collector [COLLECTOR], decimal geographic coordinates [LAT_DD; LON_DD] have been added.

Since accessions can be grouped into those developed by breeding or research, and those collected from the field, their associated descriptors may be split into separate database tables. Prior to this move, however, it would be desirable to identify material of common origin, e.g. collected from identical sites by identical missions. Qualitative differences of geo-references are being recorded in a separate field [GEO_NOTES] to specify the precision and source of geographic coordinates (GPS = Geographical Positioning System; D = Degrees only; DM = Degrees and minutes; DMS = Degrees, Minutes and Seconds; Derived data based on Accession name, location name (nearest populated place, province, country, etc.)).

Further fields for ecogeographic information will be included once a separate collecting site file is finalized. Precisely geo-referenced accessions are valuable as anchoring points for associated data (Fig. 2). In combination with Geographical Information Systems they can be used to access environmental information about habitat (soil type, climate, biogeography).

Table 1 is a snapshot list of fields in EBDB_multicrop with some short explanations.

The ID number table EBDB_ID

A second table containing synonymous ID numbers is linked via the primary key to the main table. It consists of columns listing ID numbers for separate collections in various formats to facilitate linking to individual documentation systems. While it is very useful to record all synonymous or parallel numbers in a single field (OTHERNUMB), each separated by a semicolon, for practical linking to other data sets these need to be available in separate columns or temporary arrays (SELECT DISTINCT). Care is required to avoid ambiguous links and some accession IDs may need to be excluded when compiling evaluation data from different sources. To locate passport data from donors, however, this approach to link 'sticky ends' appears to be quite useful (Fig. 3).

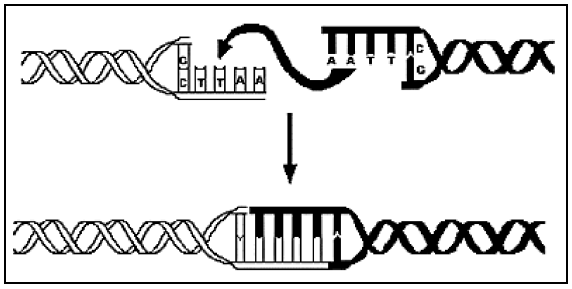

Fig. 3. 'Sticky ends': synonymous accession ID numbers are being used to link corresponding accessions from different collections.

Regarding USDA accession IDs, PI and CIho number series are each separated into corresponding prefix, numerical and suffix fields. PI and CIho can be synonymous, however, USDA currently uses both formats, so by trial and error the primary and currently used designation for a direct link to USDA documentation has been identified. This link is recorded in the column USA004. This column can serve as a check for the existence of USDA synonyms. An additional column contains the primary key used in pcGRIN, the downloadable PC version of the GRIN documentation system. This field can be used to link to the dbf files that come with pcGRIN. The pcGRIN internal primary key may change with the next update, so its usefulness in the EBDB may only be temporary. Similarly, fields for the ID numbers for DEU146 = IPK Gatersleben and RUS001 = VIR (Vavilov Institute, St. Petersburg) and their corresponding division into prefix, numerical and suffix have been created in the ID table to enable the linking of all duplicated / related accessions from the entire database. Pursuing this approach, the overlap between each donor and all recipient collections can be documented.

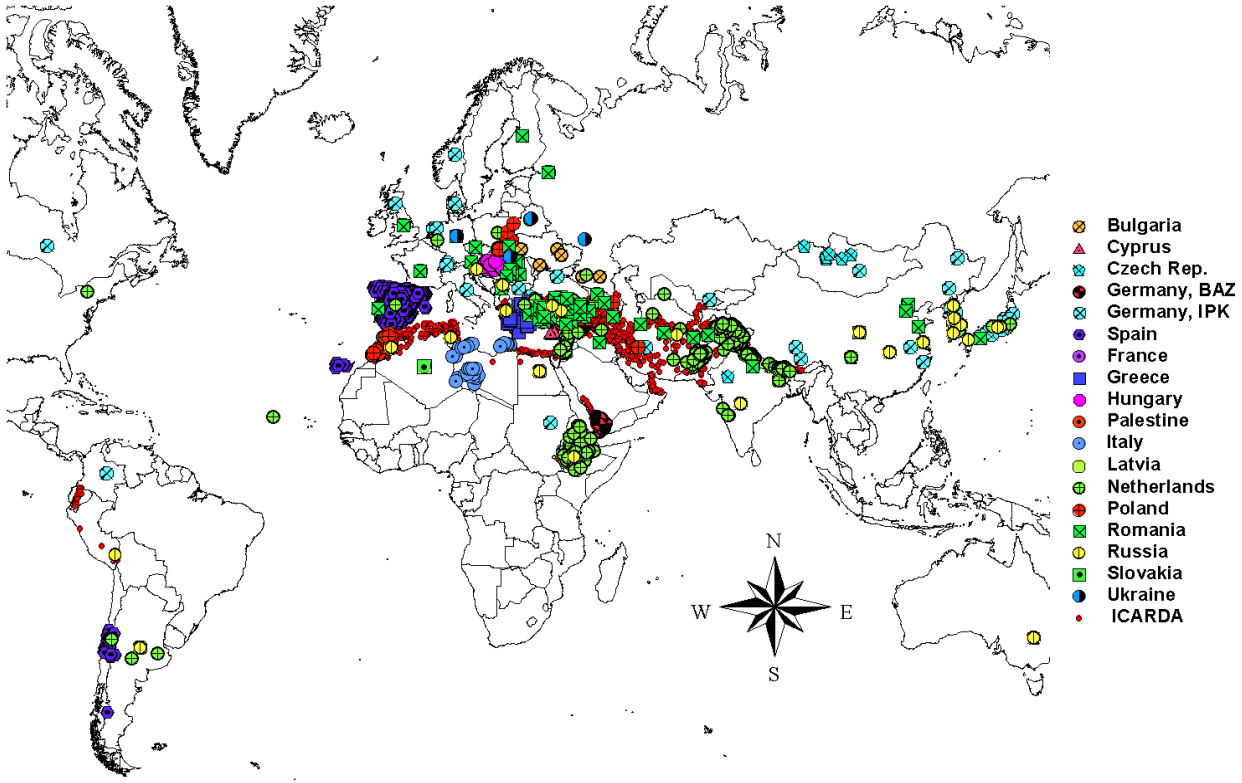

Fig 2. Geo-referenced barley accessions registered from individual collections in the European Barley Database.

Table 1. Snapshot list of fields in EBDB_multicrop

Field name	Comment/ Explanation
INSTCODE	Institute acronym, collection identifier (FAO codes)
ORDER	Sequential order, artificial component of primary key
INDEX	Accession ID composed of DEST & ACC_NO & ACC_NO_SUF
ACCENUMB	Accession number as provided by collection holder
DEST	Accession ID prefix
ACC_NO	Accession ID numerical part
ACC_NO_SUF	Accession ID suffix
INTRONUMB	Introduction number
REC_DATE	Date of receipt
POP_TYPE	Population type
COLLNUMB	Collecting number
COLLDATE	Collecting date
COL_DAT_TXT	Collecting date text field; some collecting dates only specify year or month and year
COLLNAME	Acronym for collecting expedition
SITE_CODE	Code for collecting site
SITE_NO	Collecting site number
TAXON	Botanical name
ID_BOT	Botanical ID, link to Botanical name table EBDBOTNAM
ACCNAME	Accession name. Cultivar name, breeding line ID, local name, most original accession ID; genotype name
SYN	Synonym, either synonymous cultivar names or breeder accession IDs
PEDIGREE_MEM	Pedigrees as memo field to provide unlimited space; avoids loss of information through field size limitation
PEDIGREE	Pedigree as text field to facilitate alpha-numerical sorting
SELHIS	Selection history; this field has been added with inclusion of the Australian passport data
ORIGCTY	Country of origin, ISO3 country codes
COLLINST	Collecting institutions
COLLECTORS	Collector names
PROVINCE	Political, administrative or geographical province of the collecting site
COLLSITE	Collecting site
COLLSITEtxt	Collecting site as text field to facilitate sorting; this field is temporary
LATITUDE	Latitude of collecting site
LONGITUDE	Longitude of collecting site
LAT_DD	Latitude in decimal degrees
LON_DD	Longitude in decimal degrees
GEO_NOTES	Notes related to geo-references, documenting source and precision of the recorded information. AlexGaz =Alexandria Library Gazetteer
ELEVATION	Altitude in m
BREEDMTHD	Breeding method (cf. ICIS, not implemented yet)
BREEDINST	Breeding institute or Breeder
YEAR_RELE	Year of cultivar release
SAMPSTAT	Sample status (1=wild, 2=weedy, 3=landrace, 4=breeder's line, 5=advanced cultivar)
STATUS	Degree of heterogeneity; this field has been imported together with the ICARDA passport data (SP=Single Plant, SG=Segregating population, PO=Population)
COLLSRC	Collecting source
DONORCTY	Donor country
DONORCODE	Donor code (FAO codes where these are available)
DONORNAME	Name of donor
DONORNUMB	Donor Accession ID
OTHERNUMB	Other Accession IDs
REMARKS	Comments
SEASONAL	Seasonal habit (A=Spring, H=Winter, I=Facultative/Intermediate, P=Perennial)
ROWNUMB	Number of spike rows
KERNELCOV	Kernel cover
PRATTRIB	Primary attribute(s)
UPDATE	Date of last entire record change
UPDATE_SRC	Source of updated record
REFERENCE	Literature reference(s)
REM_TODO	Temporary field to note work to do
ACCRSP	Responsibility taken (ACC=Accepted for long-term conservation, TMP=temporary conservation (adopted from Nordic Gene Bank SWE002)).

Thesaurus to decode recorded information

Data for the ID number table is derived from the Donor number, Accession name, Other number, sometimes even the collecting number fields. VIR (K- or VIR- numbers), IPK (GRA- or HOR- numbers) and USDA (PI or CI numbers) are relatively easy to recognize. Not so widely known are the facts that CI equates with CIho and that IPK numbers in other databases are often recorded together with the year of cultivation (/68 = seed harvested in 1968).

A large amount of information remains hidden in abbreviations and codes. Some of the designations used for accessions are shorthand designations for breeder's lines, others are clearly numbers assigned during collecting expeditions, while some have undergone evolution through mutation during transcription. There are thus many unintentional artefacts in the documentation. These may be regarded as historical records or simply as a hindrance towards harmonization. To unravel the hidden mysteries and to tighten up the documentation of collections, a thesaurus is needed to explain the intricacies of the different codes, so that curators may interpret their records and distinguish between historical record and transcription errors.

Standardization of plant genetic resources documentation

There is a need for standardized information and reference data related to collecting missions, geo-referenced collecting sites, Breeders, Breeder's line codes, Donor institutions, Cultivars, their synonyms and pedigrees. The use of common data files for e.g. collecting sites would facilitate cross-referencing between different germplasm collections and allow the tracking of accessions for other species collected at the same site.

Jan Konopka (ICARDA) has developed a useful system to standardize collecting information. Each collecting mission in a given country is coded with the country ISO3 code and the year when the expedition was carried out. Individual sites are then numbered sequentially. Similarly, collected samples are numbered sequentially for each mission. The collecting number then becomes a composite of country, year, site and sample number. This scheme can also be adapted to code collecting missions of other organizations.

Collecting codes represent historical information. Therefore it is important to keep the original records in a separate field when standardizing the collecting codes. This may be achieved by keeping the codes assigned by collectors, while providing additional information in a standardized format, e.g. country and year.

Accession names

The original/historical record is then kept for reference and backup. To harmonize the compiled information, it would be useful to correct spelling variants and errors. In some cases information recorded in this field would be more appropriate in other fields (Collecting number, Province, Collecting site), e.g. 'Abyssinian' points towards origin in Ethiopia. Names of Austrian landraces contain references to specific regions, sometimes valleys. This information should be transferred to the appropriate fields, in combination with a consultation of relevant publications. Recognized cultivars or breeder's lines may be cross-referenced via the ACCNAM field to pedigree and genotype registers.

Inventory of collecting missions

An updated inventory of collecting missions (Witcombe 1983) referenced with published and archived documents detailing the results of collection missions would be very useful in this context.

Updating the inventory / feedback to individual curators

The challenge ahead is to communicate improvements in documentation back to individual curators and documentation specialists. In consideration of the fact that individual genebank documentation systems have developed their own coding systems, standardization of codes requires flexibility. To automate the communication between individual information systems and the international compiled database, interfaces of native[25] codes with standardized codes need to be created. These may then be used to program conversion routines for future updates and/or dynamic linking.

The coding of Donors will be used to illustrate the general principle of this proposal. In the EBDB the donor codes have recently been standardized according to the FAO Institute coding list, originally devised by J. Serwinski. Compliance with the recommendation to use ECP/GR acronyms is hampered by the lack of many codes in the FAO list. Not all institutes listed have a corresponding ECP/GR acronym. In some documentation systems synonymous local codes are being used. A standardization of institute codes has therefore been attempted through the use of the FAO codes (ISO3 country code + numerical sequence combination), since this set of codes covers a maximum of donors. IPK uses a donor coding scheme similar to the ECP/GR acronyms which also allows, besides institutions, registration of individual persons. This list, together with that of the first ECP/GR Rye Database at the beginning of the 1980s, formed the basis for the present 'ECP/GR acronyms'. This code can be separated into a list of cooperators and their institutes. Currently, the IPK institution acronyms used in the EBDB have been converted to FAO institute codes, thus reducing their information content, but at the same time facilitating vertical integration of the data through standardization.

Records of persons or cooperators are relevant to the documentation of collecting information. Here the EBDB lacks much detail. Some genebanks, including IPK, are using expedition acronyms, with the possibility of linking them to a list of collectors participating in the expedition. A field for collectors has been added, following the model provided by the ICARDA passport data. Ideally, the names of persons should be indexed to allow retrieval of all associated records. This feature has been implemented in USDA's GRIN system and is useful for tracking down accessions collected, developed or donated by individuals.

Updating mechanism

The EBDB will be split into data sets corresponding to individual collections. Accession ID should be in a format that allows linking to the native documentation system. For this the ACCENUMB field preserves accession IDs as they were supplied with the original passport data. In the longer term, the primary code for the database can be based on Accession ID Prefix + Numerical + Suffix /or on a single Accession ID field (INDEX). This would then be the backbone for linking with local documentation systems and their additional data.

Interfaces of native codes with standardized codes (code translation files) can be created through selection in the international database of unique and distinct records pairs of corresponding codes, e.g. Code EBDB matched with Code NATIVE. This can be done for each coded field to provide a translation from EBDB to NATIVE and vice versa (Fig. 4). Thus each documentation system can continue to use its own coding and new updates in either direction are facilitated by code translation files. It may be necessary to provide separate files for each direction, since one-to-many relations can occur. Once the translation codes are established, the updating can proceed automatically by collecting updated files. Individual collections may provide their updated data, either by mail, e-mail or in the ideal case, directly via FTP sites on the Internet. By using a script that checks the date of files at agreed

[25] Native is used in the sense of local, national or individual (NAT), whereas standardized may be equated with international (INT).

sites on the Internet, the international database can be kept current without the time-consuming manual updating and re-coding process (Morten Huldén, NGB, pers. comm.). This model delegates the responsibility of data integrity back to individual curators. In practise it may, however, be preferable to only update changed fields/records, rather than complete data subsets.

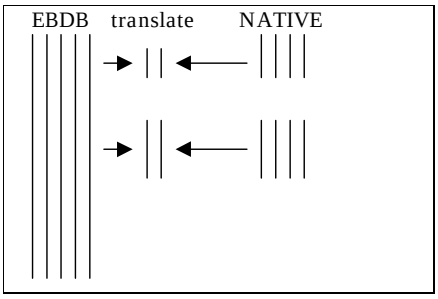

Fig. 4. Interfacing individual documentation systems (NATIVE) with the EBDB (INT) to facilitate bi-directional updating through translation of codes for corresponding database fields.

Conclusion

Improvements to the European Barley Database concentrate on standardization, harmonization, completion and analysis of the compiled information. Concepts to link with donor information systems and to develop an automated update mechanism are being explored. Integration of the available information about barley genetic resources remains a formidable challenge.

While focusing on the improvement of European data sets, the virtual door has been opened to invite curators of barley collections outside of Europe to join us in the creation of a global barley inventory.

References

Arias, G., L. Reiner, A. Penger and A. Mangstl. 1983. Directory of Barley Cultivars and Lines. Ulmer, Stuttgart.

Baum, B.R., L.G. Bailey and B.K. Thompson. 1985. Barley register. Publ. Agriculture Canada No. 1783/B. Biosystematics Research Institute, Ottawa, Ontario, Canada.

Baumer, M. and R. Cais. 2000. Abstammung der Gerstensorten [Pedigrees of barley varieties]. Bayerische Landesanstalt für Bodenkultur und Pflanzenbau, Freising, 109pp. (downloadable as a pdf file from <http://www.lbp.bayern.de/>).

Bothmer, R. von, N. Jacobsen, C. Baden, R.B. Jørgensen and I. Linde-Laursen. 1995. An ecogeographical study of the genus *Hordeum*. 2nd ed. International Plant Genetic Resources Institute, Rome. 129pp.

Enneking, D. 2000. Not drowning but waving—surfing the European barley gene pool. Barley Genetics VIII(2):11–12.

Frison, E.A., M. Ambrose, F. Begemann and H. Knüpffer. 1993. Report of the Fourth Meeting of the ECP/GR Barley Working Group. European Cooperative Programme for Crop Genetic Resources Networks. International Board for Plant Genetic Resources, Rome.

Hintum, Th.J.L. van and F. Menting. 2000. Barley genetic resources conservation—now and forever. Barley Genetics VIII(1)1:13–20.

IBPGR. 1983. Barley Working Group. Report of a Working Group held at the Zentralinstitut für Genetik und Kulturpflanzenforschung der Akademie der Wissenschaften der DDR, Gatersleben 18–19 May 1983. UNDP/International Board for Plant Genetic Resources, Rome.

IBPGR. 1992. Barley Genetic Resources. Papers of an International Barley Genetic Resources Workshop held at Helsingborg Kongresscenter, Helsingborg, Sweden, 20–21 July 1991.

International Crop Network Series No. 9. International Board for Plant Genetic Resources, Rome.

IBPGR. 1993. Report of the International Barley Crop Network Barley Database Task Force 13–14 May 1993, held at Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Germany. International Board for Plant Genetic Resources, Rome.

Knüpffer, H., compiler. 1987. European Barley List. Vol. 1: Introduction. Vol. 2, Part 1: Cultivars, lines and special resources. Part 2: Collected material, unnamed accessions. Part 3: Wild species, species hybrids. Zentralinstitut für Genetik und Kulturpflanzenforschung, Gatersleben / International Board for Plant Genetic Resources, Rome. 829pp.

Knüpffer, H. 1988. The European Barley Database of the ECP / GR: An introduction. Kulturpflanze 36:135–162.

Knüpffer, H. and R. von Bothmer. 2001. ECP / GR Barley Working Group: Review of the Group Progress and Future Perspectives. Pp. 14–25 *in* Report of a Network Coordinating Group on Cereals. *Ad hoc* meeting, 7–8 July 2000, Radzików, Poland (L. Maggioni and O. Spellman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

Knüpffer, H and L. López. 1999. Status report of the European Barley Database (EBDB). Pp. 18–24 *in* Report of a Working Group on Barley. Fifth meeting, 10–12 July 1997, Alterode / Gatersleben, Germany (L. Maggioni, H. Knüpffer, R. von Bothmer, M. Ambrose, K. Hammer and E. Lipman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

Lekeš, J., P. Zezulová, I. Bareš, J. Sehnalová and M. Vlasák. 1986. Descriptor list genus *Hordeum* L. Vyzkumny a Slechtitelsky Ustav Obilnarsky Kromeriz / Vyzkumny Ustav Rostlinne Vyroby, Praha-Ruzyně.

Lukyanova, M.V., A.Ya. Trofimovskaya, G.N. Gudkova, I.A. Terentyeva and N.P. Yarosh. 1990. Flora of Cultivated Plants. Vol. 2, part 2, Barley [in Russian]. Leningrad, Agropromizdat. 421pp.

Maggioni, L., H. Knüpffer, R. von Bothmer, M. Ambrose, K. Hammer and E. Lipman, compilers. 1999. Report of a Working Group on Barley. Fifth meeting, 10–12 July 1997, Alterode / Gatersleben, Germany. International Plant Genetic Resources Institute, Rome, Italy.

Mansfeld, R.1950. Das morphologische System der Saatgerste, *Hordeum vulgare* L. s.l. [The morphological system of cultivated barley, *Hordeum vulgare* L. s.l.]. Züchter 20:8–24.

Purdy, L.H., W.Q. Loegering, C.F. Konzak, C.J. Peterson and R.E. Allan. 1968. A proposed standard method for illustrating pedigrees of small grain varieties. Crop Science 8:405–406.

Witcombe, J.R. 1983. A provisional world list of barley expeditions. Plant Genetic Resources Newsletter 53:25–40.

Table 2. FAO codes for institutions mentioned in the text

INST	EBDB	WIEWS[26]	Acronym	ECP/GR Acronym	Organization	City, State
AUS003	9947	6000	TAMAWC	AUSAWCC	Australian Winter Cereals Collection, Agricultural Research Centre	Tamworth NSW 2340
AUT001	716	598	BVAL	AUTBVAL	Federal Office of Agrobiology Seed Collection	Linz
AUT011	243		BAPBFU	AUTBAPBFU	Federal Office & Research Centre for Agriculture - Cereals Coll.	Vienna
BEL001	145	300	CRAGXAP	BELCRAGXAP	Centre de Rech. Agron. de l'Etat, Station d'Amélioration des Plantes	Gembloux
BGR001	5119	14	IPGR	BGRIIPR	Institute of Plant Introduction and Genetic Resources 'K. Malkov'	Sadovo, District Plovdiv
BRA003		18210	CENARGEN	BRACENAGE	National Res. Center of Genetic Resources and Biotechnology	Brasilia DF
CAN004		41360	PGRC	CANPGRCSAS	Eastern Cereal & Oilseed Res. Centre, Saskatoon Research Centre	Saskatoon, Saskatchewan
CHE001	794	791	RAC	CHERAC	Station Fédérale de Recherches Agronomiques de Changins	Nyon
CHE063	8		PSR		PRO SPECIE RARA	St. Gallen
CHN001		17045	ICGR-CAAS	CHNCAAS	Institute of Crop Germplasm Resources, CAAS	Beijing
CYP004	26	3426	ARI		Agricultural Research Institute Plant Genetic Res. and Herbarium	Nicosia
CZE047		2390	KROME	CSKKROME	Agricultural Research Institute	Kromeriz
CZE122	3748	1562	RICP		Genebank Dept.-Div. Genet. & Plant Breed.- Res. Inst. Crop Production	Prague 6 - Ruzyne
DEU001	7467	9139	BGRC	DEUBGRC	Federal Centre for Breeding Research on Cultivated Plants(BAZ)	Braunschweig
DEU146	12360	10648	IPK	DEUGAT	Genebank, Inst. for Plant Genetics and Crop Plant Research (IPK)	Gatersleben
EGY002		3355	FCRI		Field Crops Research Institute Agricultural Research Centre (ARC)	Giza
ESP004	2333	1934	CRF	ESPINIAMAD	Centro de Recursos Fitogeneticos	Alcala de Henares, Madrid
EST001	488	620	JOGEVA		Jogeva Plant Breeding Insitute	Jogeva
ETH001		12648	PGRC/E	ETHPGRC/E	Plant Genetic Resources Centre	Addis Ababa
FRA040	3384	3715	INRA-CLERMON	FRAINRACLF	Station d'Amélioration des Plantes INRA	Clermont-Ferrand Cedex
GBR011	10828	23766	IPSR	GBRJII	John Innes Centre Norwich Research Park	Norwich, Norfolk NR4 7UH
GBR165	1647	1631	SOAFD		Scottish Agricultural Science Agency	Edinburgh EH12 8NJ
GRC005	243	240	GGB	GRCGGB	Greek Genebank, Agric. Res. Center of Makedonia and Thraki, NAGREF	Thermi - Thessaloniki
HUN003	2738	4094	RCA	HUNRCA	Institute for Agrobotany	Tapioszele
IND004		3000	IARI	INDIARI	Indian Agricultural Research Institute	New Delhi
INTBCC	1126				International Barley Core Collection	
ISR002	232	566	IGB	ISRIGB	Israel Gene Bank for Agricultural Crops, Agricultural Research Org.	Bet Dagan
ISR003	6646	8500	TELAVUN	ISRTELAVUN	Lieberman Germplasm Bank, Inst. Cereal Crop Devt., Tel-Aviv Univ.	Tel-Aviv
ISR004	1434	2000	HAIFA	ISRHAIFA	Institute of Evolution Haifa University	Haifa
ITA004	2102	1000	IDG	ITAIDG	Istituto del Germoplasma, Consiglio Nazionale d. Richerche	Bari
JPN003		6242	NIAR	JPNNIAR	Department of Genetic Resources I, Natl. Inst. of Agrobiol. Resources	Tsukuba-gun, Ibaraki-ken
JPN108		5435			Okayama University	Kurashiki
LBY001		2500	ARC		Agricultural Research Centre	Tripoli
LTU001	652	600	LIA		Lithuanian Institute of Agriculture	Dotnuva-Akademija
LVA010	1548	350			Plant Genetics Laboratory Institute of Biology	Salaspils
NLD037	3466	3466	CGN	NLDCGN	Centre for Genetic Resources, the Netherlands (CGN)	Wageningen
PER002		2500	UNA-L.MOLINA	PERUNA	Universidad Nacional Agraria-La Molina.	La Molina, Lima
POL003	5942	5341	IHAR	POLIHAR	Plant Breeding and Acclimatization Institute	Blonie, Radzikow

[26] WIEWS = World Information and Early Warning System (FAO), source of data IPGRI, 2000.

INST	EBDB	WIEWS[26]	Acronym	ECP/GR Acronym	Organization	City, State
ROM002		2546	ICPCPT	ROMICCPT	Genetic Resources Dep. - Research Inst. for Cereals and Ind. Crops	Fundulea, Judetul Calarasi
ROM007	1014	485	GS	ROMGS	Genebank of Suceava	Suceava
RUS001	19437	17495	VIR	SUNWIR	N.I. Vavilov Research Institute of Plant Industry	St. Petersburg
SVK001	1473	872	SVKPIEST	SVKPIEST	Research Institute of Plant Production	Piestany
SWE001		2633	SVALOF	SWESVALOF	Dept. of Plant Breeding Research, Swedish Univ. of Agric. Sciences	Svalöv, now Alnarp
SWE002	1205	1560	NGB	SWENGB	Nordic Gene Bank	Alnarp
SYR002	24372	24082	ICARDA	SYRICARDA	Internat. Centre for Agricultural Research in Dry Areas	Aleppo
UKR001	3414		IR		Yurjev Institute of Plant Breeding	Kharkov
UKR044		8000	IAB		Institute of Agroecology and Biotechnology	Kiev
USA029		26802	NSGC/GSHO	USANSGC	National Small Grains Research Facility, USDA-ARS	Aberdeen, Idaho
YUG001	149	117	MRIZP	YUGMRIZP	Maize Research Institute 'Zemun Polje'	Belgrade-Zemun

Appendix II. Acronyms and abbreviations

AFLP	amplified fragment length polymorphism
BaMMV	barley mild mosaic virus
BaYMV	barley yellow mosaic virus
BAZ	Federal Centre for Breeding Research on Cultivated Plants, Aschersleben, Germany
BCC	International Barley Core Collection
BYDV	barley yellow dwarf virus
CBD	Convention on Biological Diversity
CCDB	Central Crop Database
CGIAR	Consultative Group on International Agricultural Research
CGN	Centre for Genetic Resources, The Netherlands
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico
COMECON	Council for Mutual Economic Aid
COST	European Cooperation in the field of Scientific and Technical Research (EU)
CRA	Centre de recherches agronomiques, Gembloux, Belgium
DOE	Department of Energy (USA)
EBDB	European Barley Database
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
ENSA	Ecole nationale supérieure agronomique (France)
EPGRIS	European Plant Genetic Resources Information Infra-Structure project
EU	European Union
EURISCO	European Search Catalogue
EVIGEZ	Evidence genetických zdrojù rostlin v ÈR (Czech Information System on Plant Genetic Resources)
FAO	Food and Agriculture Organization of the United Nations, Rome
GEF	Global Environmental Facility (UNDP)
GENIS	Genetic Resources Information System (CGN)
GEVES	Groupement d'étude et de contrôle des variétés et des semences, France
GRIN	Germplasm Resources Information Network (USDA)
IBGS	International Barley Genetics Symposia
IBIS	International Barley Information System (ICARDA)
IBPGR	International Board for Plant Genetic Resources, Italy (now IPGRI)
ICARDA	International Center for Agricultural Research in the Dry Areas, Syria
ICCPT	Research Institute for Cereals and Industrial Crops, Fundulea, Romania
ICIS	International Crop Information System (CIMMYT)
ICIS–IBIS	International Crop Information System—International Barley Information System (CIMMYT/ICARDA)
INRA	Institut national de la recherche agronomique, France
IPGR	Institute for Plant Genetic Resources, Sadovo, Bulgaria
IPK	Institute of Plant Genetics and Crop Plant Research, Germany
ISTA	International Seed Testing Association
JIC	John Innes Centre, United Kingdom
LIA	Lithuanian Institute of Agriculture, Dotnuva, Lithuania
LUA	Lithuanian University of Agriculture, Kaunas, Lithuania
MOU	Memorandum of Understanding
MTA	Material Transfer Agreement
NCG	Network Coordinating Group
NGB	Nordic Gene Bank
NSF	National Science Foundation (USA)
PBI	Plant Breeding Institute, Jõgeva, Estonia

PGR	plant genetic resources
QTL	quantitative trait loci
RIPP	Research Institute of Plant Production, Piešťany, Slovakia
SINGER	System-wide Information Network for Genetic Resources (CGIAR)
SVP	Stichting voor Plantenveredeling (Foundation for Plant Breeding), The Netherlands
UNDP	United Nations Development Programme
UPOV	Union pour la protection des obtentions végétales, Switzerland
USDA	United States Department of Agriculture
VIR	N.I. Vavilov Research Institute of Plant Industry, St. Petersburg, Russia
VU	Vilnius University, Vilnius, Lithuania
WIEWS	World Information and Early Warning System on Plant Genetic Resources
ZADI	Central Agency for Agricultural Documentation and Information, Germany

Appendix III. Agenda

Sixth meeting of the ECP/GR Working Group on Barley, Salsomaggiore, Italy, 3 December 2000, held in conjunction with the Second meeting of the EU Barley Project GENRES CT98-104, 4-6 December 2000

8.30 Introduction

- Opening and welcome address: M. Stanca (host institute); R. von Bothmer (Barley Working Group and ECP/GR)
- Brief self-introduction of the participants
- Chairperson's report (R. von Bothmer and H. Knüpffer)
- ECP/GR Cereals Network Coordinating Group (R. von Bothmer and W. Podyma, with contributions from L. Maggioni)

Discussion

10.00 Coffee break

10.30 Documentation

- The European Barley Database (H. Knüpffer and D. Enneking)
- Inclusion of pedigree information (M. Ambrose)
- The EPGRIS project

Discussion and recommendations

12.30 Lunch

14.00 Sharing of responsibilities for conservation

- Introduction (W. Podyma)

Discussion and recommendations

14.45 Use of barley genetic resources

- Base-broadening of barley (R. Ellis, A. Korol)
- The Barley Core Collection and its further development (H. Knüpffer)

Discussion and recommendations

15.30 Coffee break

16.00 *In situ* conservation

- A proposal for an *in situ* project on wild cereals (R. von Bothmer)

Discussion and recommendations
Brainstorming on possible new developments in the ECP/GR Working Group on Barley

16.45 Other matters
17.15 Election of the Chair and Vice-Chair
17.30 Closing remarks

19.30 Dinner

Appendix IV. List of Participants

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(until 3 December 2000)
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ECP//GR

Report of a Working Group on Barley

Sixth Meeting – 3 December 2000, Salsomaggiore, Italy

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