EUROPEAN COOPERATIVE PROGRAMME FOR CROP GENETIC RESOURCES NETWORKS (ECP/GR)

Report of a Working Group on *Avena*

ECP/GR

Fifth meeting
7-9 May 1998
Vilnius, Lithuania

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E. Lipman, *compilers*

International Plant Genetic Resources Institute
IPGRI

IPGRI is an institute of the Consultative Group on International Agricultural Research (CGIAR)

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 plant genetic resources for the benefit of present and future generations. IPGRI's headquarters is based in Rome, Italy, with offices in another 14 countries worldwide. It 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 1998, 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, Pakistan, Panama, Peru, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Sudan, Switzerland, Syria, Tunisia, Turkey, Uganda and Ukraine.

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

The geographical designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of IPGRI or the CGIAR concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries. Similarly, the views expressed are those of the authors and do not necessarily reflect the views of these participating organizations.

Cover: Divergence in the group of black-coloured oat collection of genetic resources. Accessions of oat cultivars prepared for conservation at the Agricultural Research Institute Kroměříž, Ltd.

Citation: Maggioni, L., M. Leggett, S. Bücken and E. Lipman, compilers. 1998. Report of a Working Group on *Avena*. Fifth meeting, Vilnius, Lithuania, 7-9 May 1998. International Plant Genetic Resources Institute, Rome, Italy.

ISBN 92-9043-386-8

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Part I. Discussion and Recommendations

Introduction

Alma Budvytyte, National PGR Coordinator for Lithuania, welcomed all the participants and guests and wished them a fruitful meeting and an enjoyable time in Lithuania. She also thanked the Nordic Gene Bank and IPGRI for support given in recent years to the establishment of a National Programme for plant genetic resources in Lithuania. A first result of this international cooperation was the publication in 1997 of the Catalogue of Lithuanian Plant Genetic Resources, a copy of which was distributed to all the participants.

Lorenzo Maggioni, ECP/GR Coordinator, welcomed the participants on behalf of IPGRI and thanked the Lithuanian Institute of Agriculture for providing excellent local organization. He also thanked the Lithuanian Government for covering the local expenses of the meeting as an input in kind to ECP/GR. He emphasized with pleasure that for the first time an ECP/GR meeting was being held in Lithuania, since its joining ECP/GR during Phase V. A special welcome was given to representatives from Estonia, Lithuania and Romania, who attended the *Avena* Working Group for the first time. The presence of observers from Latvia and Russia was also appreciated. Donal Coleman, Ireland, Loek van Soest, Netherlands, Wieslaw Podyma, Poland, Mihaela Cerne, Slovenia, Roland von Bothmer, Sweden and Patrick Heffer, ASSINSEL, sent their apologies for not being able to attend. L. Maggioni introduced Mike Leggett, who has acted as Chair of the Group since 1994, after the retirement of Professor Hugh Thomas. With the approval of the Group, M. Leggett kindly accepted to chair the meeting.

M. Leggett asked all the participants to briefly introduce themselves and to approve the agenda.

Information on ECP/GR

L. Maggioni gave an overview of the activities of ECP/GR during Phase V, informing the Working Group on *Avena*, which had not met since 1993, of the changes in the structure and mode of operation, decided at the meeting of the Technical Consultative Committee (TCC) in Nitra, Slovakia, in September 1995. He summarized the different types of action taking place within the crop networks and specifically within the Cereals Network, such as meetings of standing Working Groups, *ad hoc* actions and support for participation of non-EU countries in EU-funded projects (EC 1467/94). He also reported on the activities of the Documentation and Information Network, and gave a brief overview of the results of the meeting of the European Central Crop Database Managers in Budapest (October 1996), such as the agreement on the IPGRI/FAO *Multicrop Passport Descriptors* and its subsequent formal adoption by several Working Groups. The establishment of an Internet European Information Platform on Crop Genetic Resources, accessible at http://www.cgiar.org/ecpgr/platform, was also mentioned, as a result of the activity of the ECP/GR Internet Advisory Group.[1] L. Maggioni explained that several European Central Crop Databases, including the European *Avena* Database (EADB) are now on-line and accessible from the Platform together with a range of services, such as lists of addresses of relevant institutions, FAO institution codes, minutes of workshops, IPGRI publications, etc. He reminded the participants of the approaching end of the present phase of ECP/GR in December 1998 and briefly presented to the Group the draft proposal for the continuation of ECP/GR into a Phase VI, which was recently

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[1] Members of the Internet Advisory Group are Theo van Hintum (CGN), Kevin Painting (IPGRI), Pierre Campo (GEVES), Morten Hulden (NGB), Daniel Jiménez Krause (ZADI) and Lorenzo Maggioni (ECP/GR Coordinator). They can be contacted for advice on documentation-related issues.

prepared by the IPGRI Secretariat for the ECP / GR Steering Committee meeting, to be held in Braunschweig, Germany, 29 June–5 July 1998. The proposal consists of three budget options, addressing the request that ECP / GR fulfils its mandate as the Platform for the implementation of the Global Plan of Action in Europe. A broader range of crop activities, open attendance for all ECP / GR member countries to the network meetings, maintenance of an emergency action budget and of continuing support to non-EU countries to join the EU-funded programmes, would be the targets of the more comprehensive option.

Chairperson's report

Introduction

Firstly, welcome to you all. For those of you whom I didn't meet yesterday or who don't already know me, my name is Mike Leggett, I work at the Institute of Grassland and Environmental Research (formerly the Welsh Plant Breeding Station), Aberystwyth, Wales, in the UK.

I am a cytogeneticist working on *Avena* with a minor interest in *Triticale*. I have some 25 years experience of working with the wild species of *Avena* and have been associated with IBPGR/IPGRI since 1985. Enough about me!

I am here as acting Chairperson, and unless anyone has any objections, my intention is to run this meeting until we formally elect a Chairperson.

There have been many events relating to genetic resources globally since the last *Avena* Working Group meeting in Gödölö, Hungary, in 1993, and as an introduction to the meeting I would like to summarize what I consider to be the most important landmarks some of which we will hear more about and will discuss as the meeting progresses.

IBPGR/IPGRI

The metamorphosis of IBPGR into IPGRI was of course a major event for which I guess we are all grateful.

Phase V ECP/GR

At the TCC/Steering Committee's fifth meeting in Bulgaria in August 1993, it was recommended that the ECP/GR Networks Programme be extended into Phase V, covering the years 1994–1998 and that the existing operational structure for Working Groups on *Allium, Avena,* Barley, *Brassica*, Forages and *Prunus* be maintained as under Phase IV.

At about the same time, IPGRI appointed a full time ECP/GR coordinator (Thomas Gass 1994–1996, succeeded by Lorenzo Maggioni 1996–present).

Technological advances

The technological advances in computerization have been proceeding at pace, and those of us who are fortunate enough to have access to the Internet and Email can now collect and disseminate information regarding genetic resources without having to leave the office. The two most important sites for us are the European Information Platform on Crop Genetic Resources and the European *Avena* database (EADB) although of course there are a number of other genetic resources sites.

The advances in molecular techniques have affected all aspects of biological research, not least genetic resources.

The tools already developed and those developing, will be a tremendous aid in the identification of duplicate accessions within collections and will enhance the speed and ease of transfer of agriculturally desirable traits from wild to cultivated forms. IPGRI has recently published a workshop report on 'Molecular genetic techniques for plant genetic resources' which gives an overview of the methodologies and applications of these techniques.

Various germplasm collections have been screened using differing techniques and our knowledge of the genetic diversity within the genus is increasing almost daily.

5th International Oat Conference, Saskatoon, Canada, 1996

Dr Leggett represented the ECP/GR *Avena* Working Group at the conference and presented a plenary paper Using and conserving *Avena* genetic resources'. Dr van Hintum gave a presentation on Core Collections, and Dr von Bothmer spoke of the Conservation and use of wild relatives of barley.

Funding opportunities

As we all know, funding opportunities for genetic resources are very rare, and we rely mainly on subsistence funding from our respective government agencies. Since the last Working Group meeting, EU funds under regulation 1467/94 'The Conservation, Characterisation, Collection and Utilisation of Genetic Resources in Agriculture' became available.

As some of you will know, I coordinated a proposal in the first round which was unsuccessful, and when the second call was published, it seemed that the sum of money involved was to be even smaller, making it impractical to submit a second modified proposal. The third call supposedly to be published in September last year has surfaced recently. Perhaps Lorenzo can tell us more on this subject.

Collecting activities / wild germplasm collections

As we will hear, Professor Ladizinsky collected an important new tetraploid species of oat *Avena insularis* last year and we need to discuss the possibilities of further collection strategies for other new species in the light of this find and others discovered in the last 20 years or so.

Conservation

From the last meeting we know that EADB had identified 5000-9000 accessions as being unique, and there are many more accessions which are similarly unique and we need to attempt to formulate a policy for multiplication and duplication.

There is absolutely no point in having data for accessions when the accessions themselves may be at risk. I see the main problem here again is lack of finance. We will be discussing this later.

We will perhaps hear from Igor Loskutov of the fate of the collections in the former USSR. In conjunction with IPGRI I believe that we must make some attempt to recover these materials or at least ensure that they are safe.

Before I close, I would like to propose that the Working Group sends a formal vote of thanks to Professor Hugh Thomas (now retired) who previously chaired the *Avena* Working Group Meetings. I had the privilege of working with Hugh for over twenty years, and his contribution to oat research not least in the collection and utilization of genetic resources was immense.

That concludes my overview, but if there are any specific questions which will not be dealt with during the remainder of the meeting, we could address them briefly now.

The Group thanked Professor H. Thomas for his precious activity and his achievements on behalf of the Working Group on Avena.

The European Central *Avena* Database (EADB)

Status of the EADB, adoption of IPGRI/FAO Multicrop passport list, Internet access, identification of duplicates, unique accessions and gaps in the collections

Stefan Bücken introduced himself as the new database manager of the EADB. In 1996 the responsibility of the former genebank of the Institute of Crop Science of the FAL was assigned to the Federal Centre for Breeding Research on Cultivated Plants (BAZ). The official name of the genebank is now 'Federal Centre for Breeding Research on Cultivated Plants (BAZ) - Gene Bank'. Although the name has changed, the genebank is still located in Braunschweig, Germany.

From 1984, the EADB was managed by Dr L. Seidewitz. After Dr. Seidewitz' retirement in 1996, S. Bücken succeeded him as the new documentation officer at the BAZ Gene Bank and is now responsible for the management of the EADB.

The Group thanked Dr Seidewitz for the valuable work he undertook in developing the EADB and his efforts in establishing a skeleton for the Oat descriptors list, which is now an integral part of the documentation system utilized by all those involved in Avena *genetic resources.*

In the spring of 1998 the database manager contacted 27 institutions, asking for an update of the passport, characterization and evaluation data. The address list of *Avena* Working Group members was provided by IPGRI. Unfortunately, this list was not complete because not all the countries had defined a member for the *Avena* Working Group. Prior to the meeting, most of the database managers answered the request. In general, the database manager received passport data but no additional characterization and evaluation data. As a special point of interest S. Bücken pointed out that the Vavilov Institute had been able to send him a set of passport data representing nearly 11,000 accessions of oat.

Because the content of the EADB had not changed significantly since the last meeting of the European *Avena* Working Group in Hungary in 1993, S. Bücken concentrated his talk on the Internet access to the database that had been established in autumn 1997. He gave a brief overview about the datasets and pointed out that there might be some problems of integrity, such as inappropriate attribution of country of origin in several cases. Furthermore, he pointed out that the different taxonomic systems represented in the EADB still cause problems. In this context the database manager showed a prototype of a taxonomic key system that could be published in the Internet as a reference for non taxonomists. The taxonomic key system used in the prototype follows that published by G. Ladizinsky,[2] using photographs of the species as an additional information source. The database manager commended the usefulness of integrating the taxonomic key characters for each accession into the database system as far as data are available.

Concerning the identification of probable duplicates, the EADB database manager reported that identification using only database descriptors might lead to inadequate results. As a result of first investigations, there seem to be a significant number of name duplicates which are not necessarily duplicates by genotype.

The Group thanked BAZ for continuing the long-term commitment of managing the EADB.

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[2] Ladizinsky, G. 1989. Biological species and wild genetic resources in *Avena*. Pp. 19–32 *in* Report of a Working Group on *Avena* (Third meeting). European Cooperative Programme for the Conservation and Exchange of Crop Genetic Resources. IBPGR. International Board for Plant Genetic Resources, Rome.

It recognized how essential it is that the European Avena *database be as complete as possible to ensure the database's integrity. The Group therefore recommended that the members ensure that passport data, as well as any additional characterization and evaluation data, are sent to the EADB manager. These should be forwarded no later than December 1998, in electronic format using the IPGRI/FAO multicrop descriptors for passport data, as far as possible. Other data should be provided in electronic format together with an explanation of the encoding system and the meaning of the descriptors. Use of the evaluation descriptors agreed by the Group during its second meeting is also recommended.*[3]

With regard to the rationalization of existing collections, the Group recommended that no accessions be discarded, based on the identification of probable duplicates by means of database analysis alone, unless there is definitive evidence of genetic duplication. Alternatives for rationalization of collections should be further investigated.

After a short discussion about the problem of taxonomic systems, this problem was delegated to a small task force (I. Loskutov, G. Ladizinsky, S. Bücken) that reached the following conclusions:

- *The taxonomic system based on the biological species concept as published by G. Ladizinsky will remain as the taxonomic reference system of the EADB.*
- *After ongoing update of passport data, the EADB manager will try to establish a taxonomic synonym system to record and present all taxonomic names provided by the contributors. The list will then be forwarded to G. Ladizinsky for validation.*
- *It was agreed to include the taxonomic key descriptors of G. Ladizinsky (approved by the Group during its third meeting)*[4] *in the database to ensure accession integrity.*
- *The approach to establishing a key system on the Internet, integrating pictures of the taxonomic units, was thought to be a positive step. Several members of the Working Group agreed to improve the system by providing photographs. Also the idea of publishing a taxonomic field guide for the species* Avena *should be reactivated.*

S. Bücken and L. Maggioni introduced the subject of the *Multicrop Descriptor List* and the background leading to its compilation. As L. Maggioni pointed out, most of the ECP/GR Working Groups adopted the Multicrop List as a whole or with the inclusion of descriptors considered essential to specific crop groups. The special rationale for this data exchange format is to improve the quality of PGR documentation and to make data exchange in Europe faster and easier.

After a plenary discussion the Group recommended the following:

- *The FAO/IPGRI Multicrop passport descriptors be adopted for data exchange.*
- *A reference to genetic stocks is important. For this reason the Group agreed to the proposal of the Barley Working Group to add this attribute under descriptor "14. Status of sample", by using a separate state 6 (see Appendix I:* Avena *Passport Descriptors).*

S. Bücken suggested that it would be very useful to have a list of all European researchers working with *Avena*, and a short résumé of the projects in which they were involved. Such information would be very useful and might help prevent unnecessary duplication of work.

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[3] See Appendix V: Registration of evaluation data in European Data Base. P. 25 *in* Report of a Working Group on *Avena* (Second Meeting). 1985. IBPGR. International Board for Plant Genetic Resources, Rome.

[4] See IBPGR. 1989. Report of a Working Group on *Avena* (Third meeting). European Cooperative Programme for the Conservation and Exchange of Crop Genetic Resources. International Board for Plant Genetic Resources, Rome.

- *It was agreed that each Working Group member would endeavour to provide such information which could eventually be incorporated into the EADB. The Chairperson will contact Working Group Members with a form to be completed and returned initially to him.*

The Russian *Avena* database

Igor Loskutov presented an overview of the database at VIR. The problem of lack of information in some critical fields in data from other sources was identified. Such omissions instantly reduce the usability of a large number of accessions. However, the information gathered at VIR had enabled the identification of botanical and cultivated species of the genus *Avena* L. utilizing diagnostic keys, which have been used for many years to study the diversity of oat species. The manner in which the database has been constructed makes it possible to survey the global oat collection in terms of biological, agricultural and historical viewpoints.

I. Loskutov presented copies of a booklet that is basically a portable pocket database containing a wealth of information relating to *Avena.*

- *The Working Group agreed that the information contained in this booklet was significant and that IPGRI should look into its translation from Russian to English. The data could then be transferred to a suitable table at the EADB or produced in hard copy.*

EU rating of project EC 1467/94 and opportunities for resubmission to the third call

M. Leggett presented a summary of the project submitted on the first call for proposals which he coordinated entitled “Evaluating EU *Avena* Genetic Resources”. The project involved 12 countries, two of which were non-European. The project had received generally favourable comments from the referees, but was finally rated ‘C’, though there had been some discussion between the referees as to a B or C rating.

At the second call, a coordinator could not be identified, and the information regarding the level of funding for the second call was unclear. In the end, no proposal was submitted.

The third call has been announced in the last two weeks. The closing date for submissions for this call is 9 July 1998. After some discussion, regarding the proportion of finance expected to be allocated to plant as opposed to animal genetic resources:

- *It was recommended that the Group make an attempt to produce a viable submission, since the available finance from all sources directed to* Avena *genetic resources are so scarce. There was an obvious need in the first instance to identify a coordinator.*
- *It was proposed that a suitable topic would be the phenotypic/genotypic assessment of landraces selected from within the EADB but encompassing different member states.*
- *M. Leggett agreed to make an effort to find a coordinator for the project, but would be unable to undertake the task himself.*[5]

Opportunities to include characterization and evaluation data

S. Bücken stated that he had sent out requests for updates to be included in the EADB and had received data from a number of genebanks with regard to passport data, but no evaluation or characterization data had been received.

- *M. Leggett said that he would soon be in a position to re-submit passport data and some characterization/evaluation data which had been sent to EADB many years ago as hard copy.*

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[5] A project on ‘Evaluation and enhancement of *Avena* landrace collections for extensification of the genetic basis of *Avena* for quality and resistance breeding’ was submitted for funding. The Coordinator is Dr Andreas Katsiotis, Agricultural University of Athens, Athens, Greece.

- *NGB will send additional evaluation data before the end of 1998.*
- *VIR will send available characterization and evaluation data before the end of 1998.*

Progress in the evaluation of collected material

Gideon Ladizinsky presented a paper regarding the collections made by Dr Leggett and Moroccan counterparts during 1988. The germplasm is preserved at the National Gene Bank, Institut National de la Recherche Agronomique (INRA), Morocco. The characterization and evaluation of the collected germplasm had been undertaken in 1989 by S. Saidi and J. Agdour following IPGRI descriptors. About 100 populations of different species including *Avena clauda* Dur., *A. eriantha* Dur., *A. atlantica* Baum et Fedak, *A. wiestii* Steud., *A. hirtula* Lag, *A. longiglumis* Dur. and *A. damascena* Raj. et Baum among the diploids, and *A. barbata* Pott ex Link, *A. agadiriana* Baum et Fedak, *A. murphyi* Ladiz. and *A. maroccana* Gdgr. of the tetraploids, together with *A. byzantina* C. Koch and *A. sterilis* L. among the hexaploids, representing all the prospected regions had been evaluated in a hierarchical design during two generations of self-pollination. A summary of the data was presented. A number of the accessions exhibited resistance / tolerance to crown rust, especially accessions of *A. maroccana* and *A barbata*. Resistance / tolerance to BYDV had also been recorded in a number of the populations.

J. Weibull asked if there was any possibility of preserving some or all of the *Avena* species in Morocco by *in situ* conservation.

- *Due to the importance of Morocco as a centre of diversity for the genus, the Group recommends that every effort be made to encourage the participation of Morocco as observers at future ECP/GR* Avena *Working Group meetings.*
- *The Group strongly recommends that every effort be made to look into the possibility of initiating* in situ *conservation projects in relevant areas in Morocco.*

Sharing responsibilities for conservation

L. Maggioni introduced the subject by informing the Group about the discussions that have been held to date within other Working Groups. He explained the concept of 'European Collections', defined during the recent *Secale*, Forages and Barley meetings as decentralized collections comprising accessions that European genebanks would agree to maintain on behalf of all member countries of ECP/GR. With reference to the document on 'sharing of responsibilities for conservation and use', originally prepared by Ruaraidh Sackville Hamilton (Working Group on Forages)[6] and subsequently revised and commented by Jens Weibull for the Working Group on Barley,[7] L. Maggioni summarized the suggested pathway for the establishment of the European Collections and the proposed attribution of responsibilities to the Central Crop Database Manager, the Primary Collection and the genebank hosting safety-duplicates. He emphasized that the mechanism of European Collections would aim at ensuring safe conservation and continuing access to the European accessions. Formalization of sharing of responsibilities would also probably enable each country to reduce its workload and to comply with its obligations under the Convention on Biodiversity to conserve genetic resources.

A key element for the establishment of decentralized European collections was identified as a high level of completion of the Central Databases. A high level of confidence among the countries, as regards the quality of conservation and regeneration procedures in European genebanks, was also mentioned as an essential element to proceeding in this direction.

After some discussion, the Group accepted as valuable the principle of sharing of responsibilities through a system of decentralized European Collections. Formal designation of responsibility for maintaining accessions of national origin was considered a good system to reduce each country's workload. However, the Group recommended that the following items be given further attention before this concept can be fully implemented:

- *further clarify whether the concept of 'trusteeship' can effectively be maintained and perceived as fully distinct from the concept of 'ownership';*
- *address the need to reach a generalized high level of mutual confidence in the quality standards for conservation and regeneration of accessions in storage;*
- *safety-duplicates in 'black boxes' should be accompanied by computerized passport and relevant management data of each accession.*

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6 See Maggioni, L., P. Marum, R. Sackville-Hamilton, I. Thomas, T. Gass and E. Lipman, compilers. 1998. Report of a Working Group on Forages. Sixth meeting, 6–8 March 1997, Beitostølen, Norway. International Plant Genetic Resources Institute, Rome, Italy.

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

The status of the *Avena* core collections

Cultivars

W. Podyma was unable to attend the meeting. Information on the status of cultivars core collection can be obtained directly from him (see list of participants for contact details).

Landraces

S. Bücken reported to the Group that there has not been any progress in developing a core collection on *Avena* landraces since the last Working Group meeting. He explained that this is mainly due to the reorganization process at the Genebank at Braunschweig after the Federal Centre for Breeding Research on Cultivated Plants (BAZ) was established. From 1996 the Genebank has re-intensified its work on *Avena*. S. Bücken introduced the basic concept of these activities to the Group and presented some of the present milestones of this work.

The Working Group recommends that development of core collections for landraces and varieties be continued.

Weedy forms

I. Loskutov presented a paper with regard to wild *Avena* genetic resources held in the major genebanks of the world. He pointed out that many entries were incomplete or offered insufficient information to enable selection to be made. For example, many accessions in one genebank simply listed accessions as *Avena* species, but did not give a biological or taxonomic name.

Development of the amassed data from all of these sources has made it possible to analyze the global diversity of wild oat species with regard to their areas of distribution.

Using the VIR collection as a model, selections were made to form the basis of a core collection based on the available passport data, geographical origin of accessions, electronic maps and the available characterization data.

G. Ladizinsky raised the issue of the validity of producing a core collection. Such a collection, however carefully constructed, would not contain all the available genetic variation. Cultivated varieties have been derived from a very narrow genetic base and much of the variation between different cultivars has already been utilized. The wild species, however, contain a wealth of variation, little of which has been utilized. A core collection selected at this moment in time might not, for example, contain the necessary diversity required by the breeders of the future.

Some discussion followed. However, the Working Group recommended that the construction of a core collection be continued. It must be derived from the world collection and not just from European genetic resources, since the number of accessions held in European genebanks was minute on the global scale and would be non-representative of the available genetic variation.

The Group recommends that the Chairperson and the ECP/GR coordinator explore the possibility of including the data from the Canadian and American genebanks collection data into the EADB.

The quality of national collections

Cyprus

Demetrios Droushiotis sent a contribution to the Group, reporting about the introduction of new oat varieties in Cyprus from abroad for forage production. One medium- and one late-maturing varieties ('Mulga' and 'Algerian') are suggested for hay production spread over a production season longer than was possible before. Locally selected oat accessions were also evaluated for their yield, but they did not seem to be more productive than commercial varieties.

Czech Republic

Frantisek Machán sent a contribution to the Group, presenting the collection of the Agricultural Research Institute Kromeríž, Ltd. which has a working collection of oat and carries out evaluation. The collection comprises more than 1926 accessions. After 3 years of testing, samples are transferred to the Genebank at the Research Institute of Crop Production in Prague-Ruzyne for long-term conservation. The oat collection is evaluated and documented according to the EVIGEZ system (Czech system for the evaluation of genetic resources). The EVIGEZ follows the Descriptor List of the genus *Avena* L. containing 110 descriptors. Results of trials are regularly evaluated, selected accessions are recommended for breeding use and delivered with passport data to the Genebank.

Estonia

Vahur Kukk presented the activity of the Estonian genebank, which is the source of genetic material that Estonian breeders rely on. The collection is now holding old oat varieties of Estonian origin, which were saved from extinction thanks to the activity of the Vavilov Institute. Foreign varieties, mainly of Russian origin, and breeding material are also included in the collection. All the accessions have been characterized and evaluated and their data are available. An agreement for the safety-duplication of all the Estonian accessions is being established with the Nordic Gene Bank.

France

Jean Koenig reported that the French oat collection, totalling 1129 accessions, is kept in two locations: INRA-Rennes (breeding lines and populations) and GEVES-Le Magneraud (old cultivars). A search has already been made for duplicates and these have been identified. Additional oat accessions are probably conserved by private breeders and some of these will be integrated into the National collection. Safety-duplicates are deposited in Clermont-Ferrand. All national accessions will be safety-duplicated by the end of 1998.

Germany

Stefan Bücken explained that the German oat collection is stored in two genebanks at IPK, Gatersleben and BAZ, Braunschweig. *Avena sativa* is the most represented species in both places. The duplication of accessions among the two institutes is no more than 1%. About 50% of the IPK collection is derived from direct collection. Wild species of *Avena* are represented in both collections but there is still need to fill gaps in the collections of wild *Avena* species. The BAZ collection developed over the years according to the germplasm needs of research and breeding programmes. The collection therefore contains a large number of samples acquired from the USA. In addition, collections dispersed in the former West Germany were donated to the BAZ Gene Bank which accepted responsibility for the long-term maintenance, documentation and seed availability. In this context the BAZ Gene Bank was and is functioning as a outsourcing centre for the management of germplasm. The IPK collection in contrast has been intensely used for taxonomy reference as well as a source of genetic diversity for the breeders. Arrangements for safety-duplication of the collections have so far not been made.

Israel

Gideon Ladizinsky reminded the Group that oat is not a crop in Israel. In the past, intensive collecting of wild oat populations were made with support from the USA. Related data are stored at the Israeli Genebank, which maintains a small *Avena* collection for various purposes, including nearly 100 cultivars mostly of US origin. Wild species are maintained at the Institute for Cereal Crop Development, Tel Aviv University, where they are mainly used for plant pathology studies. It is a matter of concern that a few unique wild species sites are being lost due to urbanization. For example small habitats of *A. longiglumis,* in the coastal areas, are in high demand for housing and it is very difficult to convince authorities to set up small *in situ* projects in these cases.

Latvia

Isaak Rashal explained that autonomous plant genetic resources activity in Latvia started after independence was achieved in 1991, prior to which it was taken care of by VIR. A working collection of oat, including 316 accessions, 17 of which of Latvian origin, is maintained at Stende State Plant Breeding Station. The national genebank was created in 1997, with support from NGB, at the Institute of Biology, University of Latvia, Salaspils. Responsibility to maintain accessions of Latvian origin here has been accepted, while foreign accessions will be removed after it has been verified that these are duplicated elsewhere. Complete evaluation of accessions is planned, according to the descriptors agreed by the Baltic Cereal Working Group on PGR.

Lithuania

A report circulated by Alfredas Kulikauskas explained that an inventory of oat accessions stored at the Lithuanian Institute of Agriculture was started in 1994. All the viable accessions (875) are being regenerated and evaluated. Accessions of Lithuanian origin (28) are now stored in long-term conditions and have already been characterized and evaluated.

The Netherlands

A note sent by Loek van Soest informed the Group of the collection of 532 oat accessions conserved at CGN. It includes 492 spring and 22 winter types of *Avena sativa* L. and 18 accessions of eight different wild species. *A. sativa* subsp. *diffusa* (Neilr.) Ascherson and Graebner is with eight accessions the most represented wild species. Other wild species are: *A. brevis* Roth, *A. hirtula* Lag., *A. ludoviciana* Dur., *A. orientalis* Schreb., *A. sterilis* L., *A. strigosa* Schreb. and one unknown wild species. The cultivated oats consists of 313 cultivars, 67 landraces and 121 breeding lines. The population type of 13 accessions is unknown. The collection is largely of European (341 accessions) and North American (117 accessions) origin. Only a limited number of accessions are from the centres of origin of *Avena.* The collection includes ten old landraces from the Netherlands such as 'Zwarte President', 'Naakte Haver uit Overasselt', 'Gele Timmermans' and several 'Tros' oats.

Nordic countries

Jens Weibull referred that the NGB *Avena* collection comprises 640 unique accessions. The whole collection was evaluated back in 1991–1993 by Magne Gullord in Norway. The results have been recently compiled and will be published on the Internet shortly. Oat germplasm with alleged Nordic origin has been repatriated from the USA. All the Nordic material is safety-duplicated at Svalbard.

Poland

Wieslaw Podyma sent a note informing on the oats collection held at the Centre for Plant Genetic Resources of the Polish Plant Breeding and Acclimatization Institute. The collection comprises a total of 1996 accessions. The majority of accessions are *Avena sativa* L. (1810) and other species include *A. agadiriana* Baum et Fedak, *A. barbata* Pott ex Link, *A. byzantina* C. Koch, *A. fatua* L., *A. hirtula* L., *A. maroccana* Gdgr., *A. murphyi* Ladiz., *A. sterilis* L., *A. strigosa* Schreb., and *A. macrostachya* Bal. The collection structure is determined mainly by the requirements of the plant breeders, which prefer more advanced breeding material. However, the accessions collected during expeditions, especially landraces, are an important part of the collection. Registered varieties and lines comprise 62%, local varieties 4.5%, and wild species 2% of the total number of accessions, the rest is unknown. All accessions are described and evaluated. The intraspecific variability of chosen species (*Avena strigosa* and *Avena macrostachya)* is also being studied.

Romania

Georghe Savu explained that two Romanian institutions hold collections of oat. The Agricultural Research Station of Lovrin and the Suceava Genebank hold a total of 772 accessions, of which 147 are of national origin.

Russia

Igor Loskutov reported that the oat collection at VIR is a representative collection of cultivated, wild and weedy *Avena* species. It contains about 10,000 accessions of cultivated species and about 2000 of wild species representing the whole geographical diversity of all known species belonging to the subsection *Euavena*. The whole collection has been characterized for morphological traits and additional research was carried out on agricultural properties and storage protein content.

Spain

Marcelino Pérez de la Vega referred that the Spanish Germplasm Bank includes 1275 accessions of cultivated oats, mainly derived from Spain. A large part of the collection is made up of landraces collected in the 1940s. A small part of the collection has been characterized and evaluated for resistance to *Erysiphe graminis* D.C.

Turkey

A note received by the Group from the Aegean Agricultural Research Institute of Menemen mentioned that work is in progress to characterize and evaluate the whole *Avena* collection.

UK

The status of the wild collection held at IGER has remained basically unchanged. Some further accessions from the original collections in 1985 have been multiplied, either at IGER or at the Vavilov Institute or both. Some evaluation has been undertaken. It is a matter of concern that there are still accessions from the 1985 collection which have not been multiplied, and most of the collection is not held in duplicate elsewhere. Without the injection of financial assistance, there seemed to be little chance of improving this situation.

With regard to the *Avena* collection held at the John Innes Institute, information received from Mike Ambrose indicated that the oat database has been exported out of dBase VI and into Microsoft Access. Flat files of passport data are being prepared (in alphabetical order) to go on our Internet server under BBSRC cereals collections.

Data has not been passed to the EADB in recent years, but this would be noted as a point for future action.

The collection has been updated to receive registered accessions from the British Society of Plant Breeders collection.

Repatriation of stocks to their country of origin was currently in progress in conjunction with the Nordic Gene Bank project and the Irish Seed Saver Association.

Opportunities for a peer review of the quality of *Avena* European collections

The ECP/GR coordinator L. Maggioni presented the idea of establishing an *Avena* Working Group Collection Review Committee. The basic intention would be to set up a system to improve the confidence of the Group in the quality of genebank operations and maintenance of *Avena* collections in Europe, aimed at assisting collection holders in their work. To give a summary of the institutional context, L. Maggioni quoted the example of a recent external review of the CGIAR centres[8] wherein recommendations were given as to the management of germplasm collections. For the specific needs of the *Avena* Working Group, he proposed that the Group could work to identify guidelines that would be preferred and acceptable to all for a rational conservation and regeneration of *Avena* accessions. The group could then internally assign to a few selected members the task to visit the main *Avena* collections in Europe to review the implementation of the group guidelines through an informal peer review mechanism.

He summarized possible Terms of Reference for the Review Committee, as follows:

- appointment of 3–4 members by the WG;
- visits to genebanks holding *Avena* collections for a review of operational standards (according to guidelines developed by the WG, which could be adapted to the needs of the Group from international recommendations[9] and from existing examples prepared by other groups[10]);
- cost reimbursement to be defined as input in kind and support from ECP/GR;
- report back to the WG, requesting recommendations.

L. Maggioni asked the WG to consider this proposal and suggested that, if it was endorsed, the WG would identify committee members and draft Terms of Reference and a possible schedule of activity. A proposal from the *Avena* WG should be ready before the ECP/GR Steering Committee meeting in Braunschweig, Germany, June 1998.

L. Maggioni specified that the *Avena* Working Group Collection Review Committee could be a pilot example to start addressing the issue of quality control.

The WG members questioned the rationale for dividing these reviews into crop- or genus-specific activities. Several members represent multicrop collections and therefore envisaged repeated visits by the review committees if the proposed system would be adopted. Another concern was expressed regarding small collection holders at an early stage of their genebank development.

It seemed more easily acceptable to set up a model system that would not challenge the general administration and mode of operation of a genebank, but would only look into ways to improve procedures agreed within the context of a specific group of experts. While repeated visits to the same genebank should be avoided, the experience offered by a pilot system could help in defining more generalized and acceptable quality control systems in the future.

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8 SGRP. 1996. Report of the internally commissioned external review of the CGIAR genebank operations. International Plant Genetic Resources Institute, Rome, Italy.

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

10 Sackville Hamilton, N.R., K.H. Chorlton and I.D. Thomas. 1998. Guidelines for the regeneration of accessions in seed collections of the main perennial forage grasses and legumes of temperate grasslands. Appendix III. Pp. 167–183 *in* Report of a Working Group on Forages. Sixth meeting, 6–8 March 1997, Beitostølen, Norway (L. Maggioni, P. Marum, R. Sackville Hamilton, I. Thomas, T. Gass and E. Lipman, compilers). International Plant Genetic Resources Institute, Rome, Italy.

There was unanimity among the WG members that some kind of quality support should be implemented in the genebank community to safeguard proper conservation. As one example of this, some genebanks are aiming to certify their operations according to the ISO 9000 standards. A subgroup made up of J. Weibull and S. Bücken met separately and drafted the following recommendations for the attention of the Group:

- *The WG suggests that instead of the proposed review system, a pilot study should be initiated in* Avena *as a model Group, which may have implications for other Working Groups as well. Instead of adopting a normative top-down approach, the WG favours the general concept of the ISO 9000 system. This concept is mainly based on transparency reached through documentation of internal routines. The documentation system is used to provide information to the public (i.e. the genebank community) and to members to be reviewed. All participation should be voluntary. In this case, the purpose of the review committee would be to assist genebanks in their work on improving standards, rather than controlling them.*
- *The WG further recommends that genebanks holding* Avena *collections, willing to take part in a review, as outlined above, should acknowledge their interest to the Chairperson of the* Avena *WG before the ECP/GR Steering Committee meeting (Braunschweig, Germany, 29 June–5 July 1998). Members of the Group agree to rapidly convey this information as appropriate and facilitate timely replies from relevant institutions. On the basis of replies received and the advice of the Steering Committee, the Chairperson of the* Avena *Working Group will initiate, if appropriate, and coordinate the establishment of a task force to formulate Terms of Reference for the review.*

Collecting activities

Collecting wild germplasm in Spain

M. de la Vega informed the Group that a new collection of wild oat species is being established in Spain by the group of the Genetics Department, Universidad de León. To date 291 accessions have been sent to the Spanish Germplasm Bank including diploid, tetraploid and hexaploid species, namely: 12 accessions of *A. hirtula* Lag., 4 of *A. longiglumis* Dur., 89 of *A. barbata* Pott ex Link, 1 of *A. murphyi* Ladiz., 266 of *A. fatua* L., 112 of *A. sativa* L. and 47 still to be classified. Samples were collected and preserved to maintain the genetic structure of the populations. Approximately 100 plants were randomly sampled from larger populations, and the seeds from each plant were stored separately. The isozyme genetic variability of several populations of three species has already been analyzed. Most species are widely represented throughout Spain, but *A. murphyi* is endangered since only a single monomorphic population was found near Tarifa. Further field works will be needed to complete the collection with additional samples from some of these species and other additional species such as *A. prostrata* Ladiz.

- *The Group recommends that the Spanish member looks into the possibility of including* A. murphyi *into the Bern convention list of endangered species. He is also encouraged to establish contacts with suitable Spanish authorities and to raise awareness regarding the precarious nature of some Spanish wild oats.*

Recent collecting missions in Sicily

G. Ladizinsky presented his paper regarding a collection of wild *Avena* germplasm made in Sicily last year. The strategy for the collection was outlined, which involved the use of detailed geological maps together with an intricate knowledge of the genus and the primary habitats of key *Avena* species. The collection was successful and a new tetraploid species of oat *A. insularis* was collected.

G. Ladizinsky described that his subsequent research had shown that this new tetraploid oat is the progenitor of the cultivated hexaploid oat and, as such, is of immense importance. Only four small populations of this oat were collected despite his extensive searching. He emphasized that it was of great importance to attempt further collections of this species. G. Ladizinsky stressed the difficulty in obtaining detailed geographical maps, and it was suggested that IPGRI might be able to help in this respect.

G. Ladizinsky further stressed the need to collect in ecogeographical areas where no collections had previously been made. Information with regard to these geographic ‘gaps’ might be gathered from the information from EADB and the data accumulated from I. Loskutov's combined database.

From the known phylogenetic structure of the genus, it is evident that a diploid species related to the tetraploids which grow in heavy fertile soil areas should exist, but as yet such a species has not been identified.

- *The Working Group agreed that it was essential that further collections of this important tetraploid species should be made, combined with further efforts to collect the missing diploid, and to fill gaps in the geographical collection of all wild* Avena *species.*
- *Due to the uniqueness and importance of* A. insularis*, the Group further recommends that IPGRI tries to identify an Italian contact person to join the* Avena *Working Group. He/she could then encourage the appropriate Italian authorities to protect these unique sites and to take the necessary measures to place* A. insularis *on the Bern convention red list of endangered species.*

Research activities and other ongoing activities

Report of a workshop on *Avena* genetic resources in Germany (January 1998)

In January 1998 the BAZ Genebank organized a meeting of interested German breeders and scientists from governmental institutions as well as Universities to discuss possible German activities regarding the use of *Avena* genetic resources.

The meeting was attended by 29 participants who visited Braunschweig and discussed the topic intensively. All participants agreed that *Avena* is a very interesting crop and has a high value for human nutrition. The participants agreed that in the present situation *Avena* is not a crop that gives much return on investment to most of the breeders, which makes it difficult to raise budgets for research or breeding activities. The participants advised the genebank to concentrate on characterization and evaluation work on *Avena* landraces and to continue in developing a core collection on *Avena* landraces and traditional cultivars. As a result of this meeting, the BAZ Genebank has planted 950 accessions from several genebanks which have been classified as landraces and will be open for interested breeders and others, to observe during the year. If there is enough interest by breeders and researchers, and it is possible to raise additional funds, the Genebank will intensify these activities in the coming years.

Research on wild and cultivated oats at INIA, Spain

M. Pérez de la Vega explained that oats are a minor cereal crop in Spain, therefore interest and effort in breeding new varieties and on basic research is scarce. The main breeding effort has been carried out by Dr Martin Lobo who is undertaking breeding for resistance to fungal diseases and to drought conditions. Many advanced breeding lines are being evaluated and six cultivars have been registered. Dr Fominaya is leading basic research on obtaining DNA probes to identify chromosomes belonging to different oat genomes and also specific probes to distinguish individual chromosomes within them. Several probes have already been obtained. At the Universidad de León the analysis of the genetic structure of populations of *A. barbata* Pott ex Link continues. The current study is aimed at comparing the structure of Spanish populations and Argentinian populations, where this species was introduced from Spain in the colonial period.

Ongoing research in the UK

M. Leggett outlined the screening of *A. fatua* L. and *A. sterilis* L. collections, derived from the Canary Islands, for resistance to mildew *Erysiphe graminis* f. sp. *Avena*. A number of lines had been shown to be resistant/tolerant to the pathogen. One accession of *A. barbata* Pott ex Link appeared to be immune, and this source of resistance would be compared with an accession of the same species collected a number of years ago in Algeria.

A selection of wild species had also been screened for oil, ß-glucan and protein. As expected considerable variation for these traits were observed, and some accessions contained higher levels than cultivated forms.

Conclusion

The Section 'Discussion and Recommendations' of the report was presented to the participants and adopted after some modifications had been made.

The *Avena* Working Group recommends that the Group continues in its efforts with regard to the conservation and utilisation of *Avena* genetic resources. The work accomplished during Phase I to V has been immense, as illustrated by the continued efforts of the participants in providing the relevant data and the characterization and evaluation of this important crop species. Future needs regarding *Avena* genetic resources are outlined in the recommendations of the Group, as illustrated in this document.

Future meetings of the Group will be necessary (every 2–5 years) but it might also be appropriate to convene subgroups in the interim.

Mike Leggett was re-confirmed Chairperson of the Group until the end of next meeting.

On behalf of the Group he expressed thanks to Alma Budvytyte and her collaborators for the excellent organization of the meeting. The warm hospitality of the Lithuanian hosts was also appreciated. The Chairperson finally thanked all the participants for their active cooperation in the activities of the *Avena* Working Group.

The European *Avena* Database (EADB) - state of the art

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The European *Avena* database (EADB) was established at the former Braunschweig Genetic Resources Collection (BGRC) on the initiative of the European Cooperative Program for Conservation and Exchange of Crop Genetic Resources (ECP/GR) in 1984. It is one of the 32 European Central Crop Databases (CCDBs) (van Hintum 1997). Today the EADB is maintained by the genebank of the Federal Centre for Breeding Research on Cultivated Plants (BAZ).

According to Knüpffer (1995) a Central Crop Database can be defined as an instrument centralising information on plant genetic resources accessions of a particular crop, or group of crops, held in several institutions in a region or worldwide. The EADB represents the most important European *Avena* germplasm holdings. As a Central Crop Database the EADB (i) aims to improve the access to germplasm for users and curators; (ii) helps to identify gaps in the combined European collections; and (iii) allows the identification of duplicated samples between the collections (van Hintum 1997).

Because the passport and characterization data have not been changed significantly since 1993, this report gives only a brief overview about the current state of the EADB. Some problems of database integrity will be discussed and the new possibilities of presenting the EADB to potential users and curators using the Internet will be explained. Furthermore, the effect of the workshop on Central Crop Databases held in Budapest (Lipman *et al.* 1997) on the exchange of *Avena* data will be highlighted, as well as some problems related to the identification of duplicates.

State of the Database

Since the last meeting of the ECP/GR *Avena* Working Group in 1993, the number of accessions represented by the EADB has not significantly increased. Between 1993 and today the number of accessions of which passport data are compiled by the EADB increased from 17 451 to 19 315 entries representing the *Avena* collections from 20 European contributors (Table 1). Whereas in the beginning of the database compilation work the number of accessions recorded by the EADB increased rapidly, most of the European germplasm holdings seem to be represented today.

The number of characterization and evaluation data compiled by the EADB has not increased significantly since 1993. This can be explained on the one hand by the moderate characterization and evaluation activities on *Avena* genetic resources in Europe in the last few years. On the other hand, the activities regarding the database declined from 1993 to 1996 because of the reorganization processes of agricultural research in Germany, which have had strong effects on the former genebank working group (BGRC) of the Institute for Crop Science at the FAL. Furthermore, the former EADB database manager, Dr L. Seidewitz, retired in 1996. In summer 1996 the responsibility for the former BGRC was assigned to the Federal Centre for Breeding Research on Cultivated Plants (BAZ). The genebank is now called the 'BAZ Gene Bank'. In late 1996 the work on the EADB has been intensified again.

First investigations of the database showed that there might be an inappropriate use of some of the important descriptors like 'Country of Origin' or 'Scientific Name'. For instance, strong evidence exists that more than 385 samples of the European *Avena* Collection are originally from the former USSR or Poland. For this reason the database manager contacted 27 institutions in Europe and asked to assist in updating passport, characterization and evaluation data of the EADB.

Table 1. Passport record set numbers of the on-line EADB by donor institute and donor country (May 1998)

Donor Institutions EADB on-line	Country	Number
The N.I. Vavilov All-Russian Scientific Research Institute of Plant Genetic Resources	SUN	4127
Plant Breeding Institute Maris Lane, Trumpington	GBR	2577
BAZ Gene Bank (Former: Institut Für Pflanzenbau und Pflanzenzüchtung der FAL)	DEU	1941
Plant Breeding and Acclimatization Institute	POL	1529
Research and Plant Breeding Institute of Cereals	CSK	1438
Institut Für Pflanzengenetik und Kulturpflanzenforschung	DEU	1065
Centro Regional de Investigacion y Desarrollo Agrario, Banco de Germoplasma Vegetal, Finca El Encin	ESP	1027
National Institute for Agricultural Variety Testing, Research Centre for Agrobotany	HUN	1024
Station d'Amélioration des Plantes	FRA	824
Plant Genetic Resources Research Institute, Menemen-Izmir	TUR	693
Station d'Amélioration des Plantes	BEL	624
Nordic Gene Bank	SWE	572
Centre For Genetic Resources, The Netherlands	NLD	542
Institute of Introduction and Plant Genetic Resources	BGR	356
University College of Wales, Welsh Plant Breeding Station	GBR	231
Landwirtschaftlich-Chemische Bundesversuchsanstalt	AUT	170
Institut for Small Grains of Kragujevac	YUG	166
Bundesanstalt Für Pflanzenbau und Samenprüfung	AUT	74
Estaçao de Melhoramento de Plantas	PRT	41
North Greece Agricultural Research Center, Greek Gene Bank	GRC	22

Internet access to the EADB

Since the last meeting the Internet has become a powerful tool for the distribution of data and information on plant genetic resources collections worldwide. Thanks to the World Wide Web (WWW), a communication system using the Internet technology, it is easy to publish data and information in a user-friendly way.

In 1996 on-line access of the EADB was established as part of the ECP/GR European Information Platform at http://www.cgiar.org/ecpgr/platform. From this information platform the home page of the European *Avena* Database is easily accessible (Fig. 1).

The home page of the European *Avena* Database is divided up into different information sections. One option is to search the database on the WWW accessing the on-line searchable version of the EADB. This database is physically located at the German Centre for Documentation and Information in Agriculture (ZADI) at Bonn, Germany, and published in cooperation with the Information Centre for Genetic Resources (ZADI-IGR). Another option is to download a file containing the data of the EADB in dBaseIV format. The third option is to order an off-line copy of the database from the acting database manager at Braunschweig, Germany. The left side of the information sections gives additional information on the database. The database follows the principles of the FAO/IPGRI *Multicrop Passport Descriptor List* adopted at the ECP/GR Workshop on Central Crop Databases in Budapest (Lipman *et al.* 1997).

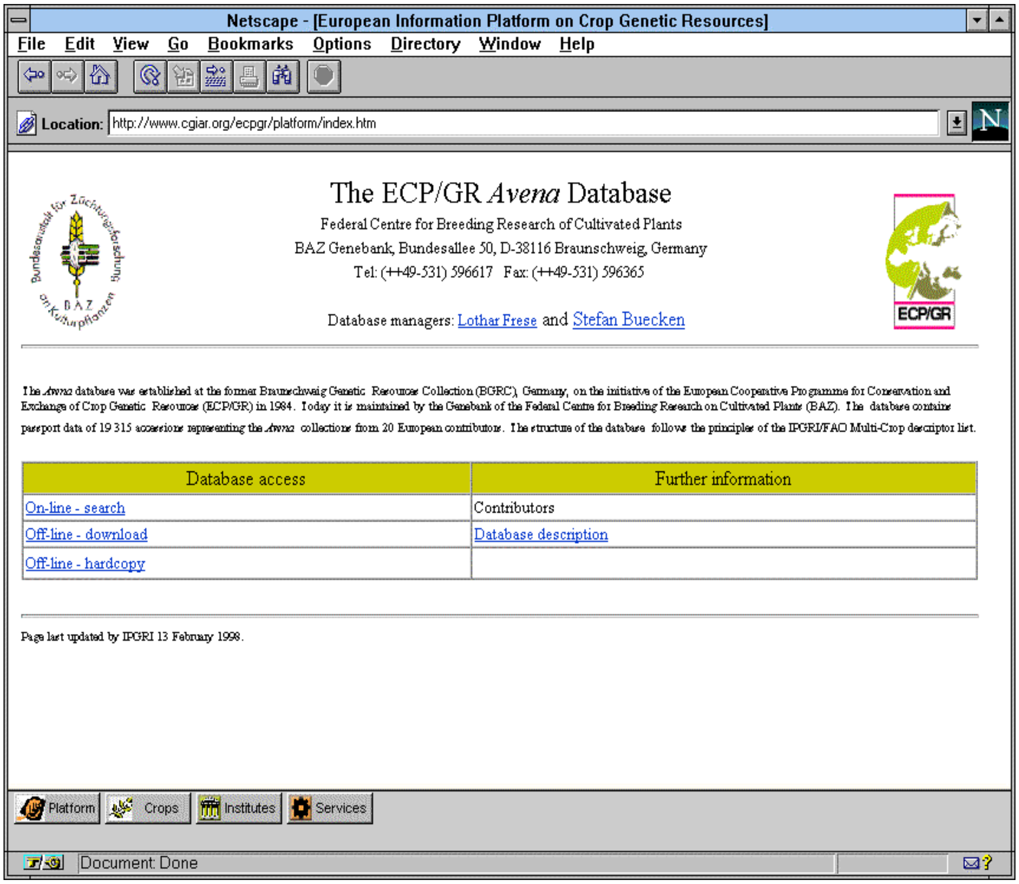

Fig. 1. Homepage of the European *Avena* Database at the Internet European Information Platform on Crop Genetic Resources (accessible at http://www.cgiar.org/ecpgr/platform).

Multicrop passport descriptors

The FAO/IPGRI *Multicrop Passport Descriptor List* has been introduced to the managers of Central Crop Databases at the Budapest meeting (Hazekamp *et al.* 1997). The *Multicrop Passport Descriptor List* contains the most basic descriptors for genebank accessions. It aims to make data exchange faster and easier. It has become a valuable tool for data exchange within the ECP/GR networks. As an example for the usefulness of a standardized data exchange format, Fig. 2 shows some of the data structures received by the database manager of the EADB from partners. It is obvious that a lot of time has to be invested into harmonizing this heterogeneous set of data structures before the data can be integrated into the EADB. First proposals to standardize the exchange format for passport, characterization and evaluation as well as a uniform taxonomy have been adopted by the *Avena* Working Group in previous Working Group meetings. Most of the minimum descriptor list for the exchange of passport data designed by the *Avena* Working Group (IBPGR 1984, 1986) is similar to the new FAO/IPGRI *Multicrop Passport Descriptor List*. Hence, it is sensible to accept the new format by the *Avena* Working Group and to use these standardized data structures for passport as well as characterization and evaluation data exchange more intensively in the future.

FAO/IPGRI **Multicrop**	**Donor a**	**Donor b**	**Donor c**	**Donor e**	**Donor f**	**Donor g**	**Donor h**
INSTCODE	RECORDNUM	ANR	ACCENUMB	GBKACCNUM	INSTCODE	INSTCODE	CULTNAME
ACCENUM	ACCNUM	SCNR	GENUS	TAXNAM	ACCENUMB	ACCENUMB	COLLNUMB
COLLNUMB	COLLNUM	D_ADDR	SPECIES	CULTYP	ART	GENUS	BOTNAME
GENUS	SPECIES	SPECIES	ACCNAME	SUBTYP	ACCNAME	SPECIES	CRONAME
SPECIES	SUBTAXA	NAME	ORIGCTY	ACCNAM	LOCALNAME	SUBTAXA	ORIGCODE
SUBTAXA	ACCNAME	SEC_NAME	COLLSITE	ACCRSP	FM	ACCNAME	ORIGCTY
ACCNAME	ORIGCTY	O_TYPE	LATITUDE	ORICOU	DONORCODE	ORIGCTY	SAMPSTAT
ORIGCTY	COLLSITE	O_CNT	LONGITUDE	GBKDAT	DONORNUMB	SAMPSTAT	LIFFOM
COLLSITE	COLLDATE	DISTRICT	ACQDATE	OTHACCNUM	FAMILIE	YEAR_INCL	COLLDATE
LATITUDE	DONCODE	LOCATION	SAMPSTAT	ACCREM	GENUS	GR_CLASS	
LONGITUDE	DONNUM	LONGI	DONORCODE	DONCOU	SPECIES	PLOIDY	
ELEVATION	OTHERNUM	LATI	INSTITUTE	DONINSACR	SUBTAXA	DONORCODE	
COLLDATE	DEF_N	ANCEST	OTHERNUMB	DONACCNUM	ZULASSUNG	DONORNUMB	
SAMPSTAT	DEFNUM	O_YEAR	STORTYPE	DONDAT	STREICHUNG	OTHERNUMB	
COLLSRC	LEBENSFORM	O_ADDR	AVAILABLE	BRECOU	ACQDATE	REG_BEGINN	
DONORCODE	LAND	P_REMARK		BREINSACR	COLLNUMB	REG_END	
DONORNUMB	SSP			CULPED	BREEDER	BREEDERCOD	
OTHERNUMB	VAR			COLDAT	COLLDATE	PEDIGREE	
REMARKS	DON_KF			COLPERNAM	ORIGCTY	SYNONYM	
DUPLSITE	NR_P			COLACCNUM	COLLSITE	DUPLSITE	
PASSAVAIL	NR_N			LOCREGNAM	COLLSRC	NOTES	
CHARAVAIL	NR_S			LOCCOLPLA	SAMPSTAT		
EVALAVAIL	EXP_ACR			LOCLATTUD	TYP		
ACQTYPE	EXP_KF			LOCLONTUD	DISTRIBUT		
STORTYPE	SAMNR_P			LOCALTTUD	DUPLSITE		
	SAMNR_N				REMARKS		
	SAMNR_S				ACQTYPE		
	SAMNUM				STORTYPE		
					OTHERNUMB		
					LATITUDE		
					LONGITUDE		
					ELEVATION		
					PASSAVAIL		
					CHARAVAIL		
					EVALAVAIL		

Fig. 2. Examples of the received data structures by fieldnames (update 1998).

Identification of duplicates

The identification of duplicates by means of database analysis is one of the main objectives of CCDBs. However, there are some basic problems in the identification of truly duplicated genotypes which are still not solved. Analyzing the degree of duplication within the EADB data field 'ACCNAME' (accession name), it is possible to identify 8854 duplicated datasets of 19 315 datasets in total. This means that at least 4427 accessions share one or more names spelt exactly in the same way. Analyzing the duplicates more closely, the duplicated accession names can be split up into the different accession names duplicated with different frequencies (Table 2). Some accession names are duplicated often whereas other names of the identified duplicates occur only twice. Analyzing these duplicated accession names in more detail, it becomes obvious that most of the duplicated accession names with more than one repetition within the database are originally from one donor dataset. This means that the identified duplicates within the EADB probably represent, to a high extent, duplicated accessions within a genebank (Table 3). Analyzing this problem in more detail it becomes clear, that such duplicates arise from accession names like 'Local', 'Flughafer' and other names mostly representing local names for the species, or designations having had some other important meaning to the collector or donor of the germplasm. If the duplication analysis takes additional descriptors into account, like the identification number of the accession, within a genebank the number of duplicates becomes rare. Duplication analysis only based on the descriptor 'accession name' identifies at least 2046 distinct accession names. Passport descriptors with a higher diagnostic value for identification of probably duplicated accession like the 'collection number' or 'latitude' and 'longitude' of the collection site are often not known. For this reason the reorganization and rationalization of existing *Avena* collections should not be based on database analysis only. We should wait until the EADB contains sufficient and reliable characterization data allowing a more precise analysis of the duplication problem.

Table 2. Number of duplicates by distinct accession names (ACCNAME)

Number of duplications	Distinct accession names	Number of duplicated accessions
189	1	189
30	1	30
27	1	27
25	1	25
24	2	48
23	1	23
22	1	22
21	1	21
20	3	60
19	1	19
17	4	68
16	3	48
15	6	90
14	9	126
13	11	143
12	21	252
11	25	275
10	37	370
9	44	396
8	77	616
7	94	658
6	147	882
5	172	860
4	236	944
3	368	1104
2	779	1558
Total	**2046**	**8854**

e.g. 1 distinct name is duplicated 189 times, 779 names are duplicated twice, etc.

Table 3. Frequency of internal duplication of data sets by donor institutes and accession name (ACCNAME)

Code of the donor institute	Number of duplicates within data sets	Probable number of duplicated accessions	Average accession number per duplication
*GBRPBI	362	853	2.36
*HUNRCA	269	623	2.32
*DEUBGRC	67	226	3.37
*SWENGB	63	132	2.10
*POLIHAR	56	120	2.14
*RUSWIR	49	336	6.86
*DEUIPK	29	64	2.21
*CSKKROME	18	42	2.33
*BGRIIPR	17	36	2.12
*ESPINIAMAD	11	63	5.73
*BELCRAGXAP	8	20	2.50
*FRAINRA	8	16	2.00
*YUGISG	6	12	2.00
*AUTBAUWIEN	5	10	2.00
*GBRWPBS	5	16	3.20
*NLDCGN	4	8	2.00
*GRCGGB	2	5	2.50
*AUTBVAL	1	2	2.00
Total	**980**	**2584**	**2.76**

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Database and taxonomy of VIR's world collection of the genus *Avena* L.

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The establishment of a comprehensive passport database on any crop preserved in a genebank is a priority. The value of a given collection is set by the extent of passport data on each accession. A well compiled passport database presents information of practical value for users of various fields, not only biological and agricultural (Loskutov 1996, 1998).

Recently there have been many publications and discussions on the establishment of the structure of databases on plant genetic resources. A number of advanced training courses have been dedicated to this problem. At the same time, with a glimpse at the real databases available in the largest genebanks, it can be seen that the volume of information incorporated in these bases is extremely small.

For example, in the American Collection, more than 41% (over 9000 accessions) are designated as *Avena* spp. (botanical varieties are not used at all), more than 33% (over 7000) have unknown country of origin (Wesenberg *et al.* 1992).

If we look at the European *Avena* Database, 6% accessions are not attributed to any species, 12% have no indication of the country of origin, while in the cultivated species over 70% accessions have no botanical variety. All these data would acquire the greatest importance in establishing core collections involving different groups of accessions (local varieties, modern cultivars and wild species). Frequently there is a confusion in systematic units. For example, all cultivars traditionally referred to the species *Avena sativa* L. in some cases are attributed to *A. fatua* L., but their subspecies and variety are simply ignored. There is a good deal of confusion with diploid and hexaploid naked oat. One can find in the European Database such entries as NUDA, SATIVA NUDA, STRIGOSA NUDA, NUDIBREVIS without any reference to the ploidy level: all these names are the names of different species. On the other hand, the diploid species *A. nuda* L. cannot be regarded as a full-scale species, because it differs from *A. strigosa* Schreb. by only one gene responsible for multiplicity of flowers, which was proven long ago in the 1920–1930s in genetic and cytogenetic studies by N.I. Vavilov, A.I. Malzev, A.I. Zigalov and others, and because naked oats have no area of distribution of their own (Mordvinkina 1936). The situation is similar with hexaploid naked oat, which is a subspecies of sativa oat.

Below we are offering keys for identifying specific and especially botanical varieties of cultivated species of the genus *Avena* L. (Rodionova *et al.* 1994) which have been used in VIR for several decades for the conservation and study of the whole diversity of oat species (Tables 1–5). These keys are based on characteristics of kernels and spikelets; in most cases we use it for conservation and multiplying, and they can be tested in the fields and in the laboratory. Therefore, the botanical varieties must be important for each accession.

We worked hard with the structure of our database and decided that the best and most informative database must have the following structure. We have a passport database for the genus *Avena* L. consisting of four parts, which can be added mutually to each other using the Paradox for Windows software.

The first part is the passport database of cultivated oat amounting to 9876 accessions, which has the following structure. There are 27 fields: for different numbers – 3 fields; geographical origin - 4 fields; information about donors - 4 fields; very important fields with information about species, subspecies and botanical varieties - 2 fields; name of accessions - 1 field; year of entry - 1 field; pedigree, status of accessions, storage information - 7 fields; information about identified genes - 1 field. Most of them are completely full. We collected some of this information from seed missions reports and VIR's archives.

The second one is the passport database of wild species comprising 1915 entries in 24 fields. The structure of this data base is formed of 5 blocks: (1) different numbers identifying an accession in different genebanks - 8 fields; (2) specific attribution - 2 fields; (3) geographical origin of an accession - 5 fields; (4) date of entry in the collection and donor institution - 4 fields; and (5) data needed for the distribution of seed samples of the accession and data on the presence of identified genes. We had the same sources of information as above, plus information from passport databases of different genebanks.

The third part is the database of the herbarium of cultivated oat species stored in the Vavilov Institute (1594 herbarium specimens) with the following structure of 21 fields: information about the specimen (VIR catalogue number, box number, etc.) – 5 fields; specific attribution - 3 fields; name of accession - 1 field: new systematics - 2 fields; donor of this specimen - 1 field; geographical origin - 6 fields; year of collection, collector and identifier - 3 fields.

The fourth and last is the herbarium database of wild oat species (589 specimens) with the following structure: 18 fields, structure as above, only without the fields donor, name, new botanical varieties.

This structure enables us to hold complex information about the detailed origin of an accession and its area (for wild species) in the past and nowadays.

Thus, the development of comprehensive passport data with the use of some archive materials and reports of collecting missions makes it possible to regard the worldwide oat collection from biological, agricultural and historical viewpoints.

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Table 1. Speciation in the genus *Avena* L.

Ploidy	Genome	Wild species		Cultivated species
2n - 14	**CpCp**	*A. clauda* Dur.	*A. pilosa* M.B.	
	CvCv		*A. ventricosa* Bal.	
			A. bruhnsiana Grun.	
	ApAp	*A. prostrata* Lad.		
	AlAl	*A. longiglumis* Dur.		
	AdAd	*A.damascena* Raj. et Baum		
	AcAc		*A. canariensis* Baum	
	AsAs	*A. wiestii* Steud.	*A. atlantica* Baum	*A. strigosa* Schreb.
		A. hirtula Lag.		
2n – 28	**AABB**	*A. barbata* Pott.	*A. agadiriana* Baum et Fedak	
		A. vaviloviana Mordv.		*A. abyssinica* Hochst.
	AACC		*A. magna* Murphyi et Terr.	
			A. murphyi Lad.	
	AAAA	*A. macrostachya* Bal.*		
2n - 42	**AACCDD**	*A. fatua* L.	*A. sterilis* L.	*A. byzantina C.* Koch.
		A. occidentalis Dur.	*A. ludoviciana* Dur.	*A. sativa* L.

* perennial species.

Table 2. Key for the identification of *Avena* species

1. Perennial plants..***A. macrostachya* Bal.**
- Annual plants...2
2. Lemma tips biaristulate...3
- Lemma tips bidentate...13
3. Glumes very unequal, lower glume one-half of upper one.......................................4
- Glumes equal or nearly so..5
4. All florets disarticulating at maturity...***A. clauda* Dur.**
- Lowermost floret only disarticulating...***A. pilosa* M.B.**
5. Callus very long and awl shaped, 5–10 mm..6
- Callus short, about 2 mm..8
6. All florets disarticulating at maturity..***A. longiglumis* Dur.**
- Lowermost floret only disarticulating..7
7. Callus 5 mm long, glumes 25–30 mm long...***A. ventricosa* Bal.**
- Callus 10 mm long, glumes 40 mm long...***A. bruhnsiana* Gruner.**
8. All florets disarticulating at maturity..9
- Non-shattering panicle..13
9. Lemma tips biaristulate, glumes with 9–10 veins...***A. barbata* Pott.**
- Lemma tips biaristulate with or without 1–2 denticula, glumes with 7-9 veins 10
10.Lemma tips biaristulate with 1 denticulum, and lemma tips longer than the glumes; first floret scar narrow elliptic..***A. hirtula* Lag.**
- Lemma tips biaristulate with 2 denticula, lemma and glumes equal or nearly so; first floret scar oval 11
- Lemma tips biaristulate without denticula, first floret scar round....................................12
11.Lemma tips biaristulate 3–6 mm long..***A. wiestii* Steud.**
- Lemma tips biaristulate 1 mm long...***A. vaviloviana* Mordv.**
- Lowermost floret only disarticulating...***A. atlantica* Baum**
12. Spikelets very small 12–15 mm ....***A. prostrata* Lad.**
- Spikelets 20 mm long...***A. damascena* Raj. et Baum**
13. Lemma tips biaristulate with 1 denticulum, lemma and glumes equal or nearly so..***A. strigosa* Schreb.**
- Lemma tips biaristulate with 2 denticula, and lemma tips shorter than the glumes...***A. abyssinica* Hochst.**
14. All florets disarticulating at maturity...15
- Lowermost floret only disarticulating...16
- Non-shattering panicle..18
15.Spikelets with 2–3 florets, glumes 15–20 mm long...***A. fatua* L.**
- Spikelets with 3–4 florets, glumes 25–30 mm long.................................***A. occidentalis* Dur.**
16.Spikelets very large with 3-5 florets, glumes 30–40 mm long.......................................17
- Spikelets medium size with 2, rarely 3 florets, glumes 25–30mm long...***A. ludoviciana* Dur.**
- Spikelets small size with 2–3 florets, glumes 15–17 mm long ....***A. canariensis* Baum**
- Spikelets very small size with 2 florets, glumes 13–15 mm long ....***A. agadiriana* Baum et Fedak**
17. Lemma highly pubescent..***A. magna* Murphy et Terr.**
- Lemma slightly-moderate pubescent...***A. sterilis* L.**
- Lemma glabrous, macrohairs around the scars...***A. murphyi* Lad.**
18.Shape of scar first floret linear...***A. sativa* L.**
- Shape of scar first floret slanting...***A. byzantina* Koch.**

Table 3. Botanical varieties of *A. strigosa* Schreb. and *A. abyssinica* Hochst.

Shape of panicle	**Hairiness of lemma**	**Lemma colour**	***A. strigosa* varieties**	***A. abyssinica* varieties**
equilateral	glabrous	white	*albida*	*chiovendae*
		yellow		*sehimperi*
		grey	*typica*	*hildebrantii*
		brown	*gilva*	*brauni*
		black	*melanocarpa*	
	hairiness of awn insertion	white		*typica*
		yellow	*kewensis*	
		grey	*intermedia*	
		black	*nigra*	
	pubescent	white	*alba*	*solidiforma*
		grey-brown	*fusca*	
flagged (brevis)	glabrous	white	*candida*	
		grey	*tephera*	
		brown	*hepatica*	
		black	*nigricans*	
	hairiness of awn insertion		*semiglabra*	
	pubescent		*trichophora*	
unilateral			*secunda*	
grains naked			*nudibrevis*	

Table 4. Botanical varieties of *A. byzantina* C. Koch.

Lemma colour	**Hairiness of lemma**	**Awnedness**	**Varieties**
white	glabrous	no awns	*albomutica*
	pubescent	one awn	*alba*
cream	pubescent	two awns	*cremea*
red-brown	glabrous	no awns	*anolpa*
		one awn	*rubra*
		two awns	*culta*
	pubescent	one awn	*monathera*
		two awns	*solida*
grey or black	glabrous	one awn	*incana*
		two awns	*nigra*
	pubescent	one awn	*maroccana*
brown	glabrous	one awn	*ursina*
	pubescent	two awns	*cinnamomea*

Table 5. Botanical varieties of *A. sativa* L.

Spikelets characters	Lemma colour	Awnedness	Shape of panicle	
			Equilateral	**Unilateral**
all florets thresh	white	no awns	*mutica*	*obtusata*
		awns	*aristata*	*tartarica*
	yellow	no awns	*aurea*	*flava*
		awns	*krausei*	*ligulata*
	grey	no awns	*grisea*	*borealis*
		awns	*cinerea*	*armata*
	brown	no awns	*brunnea*	*tristis*
		awns	*montana*	*pugnax*
only the lowest floret threshes	white	no awns	*volgensis*	
		awns	*kasanensis*	
	yellow	no awns	*segetalis*	
		awns	*bashkirorum*	
	brown	awns	*armeniaca*	
glumes up to 30 mm long	white	awns	*iranica*	
	yellow	awns	*persica*	
	brown	awns	*asiatica*	
lemma pubescent	grey	awns		*homomala*
	brown	no awns	*setosa*	
		awns	*Hausknechtii*	
grains naked	white	no awns	*inermis*	
		awns	*chinensis*	
	white with dark spot	no awns	*maculata*	
		awns	*mongolica*	

Summary of the Moroccan oat germplasm evaluation

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Characterization and preliminary evaluation

The genetic material was collected in 1988 by Leggett (Leggett *et al.* 1992). The oat germplasm is conserved at INRA National Genebank, Morocco. The characterization and evaluation of the collected material was undertaken by Saidi (1989) and Agdour (1990) following the IPGRI descriptors. About a hundred populations of different species representing all the prospected regions, were evaluated in a hierarchical design over two generations of self-pollination.

Data analysis has shown that the populations were genetically distant within species. The polymorphism was high, about 60% for many characters such as number of seeds per plant, number of tillers per plant, flowering period and plant height. A high level of heterozygosity was observed for the majority of the populations, for some of the abovementioned characters. A higher level of polymorphism was observed for the local species *Avena magna* Murphyi et Terr. *(A. maroccana* Gdgr.*)* and *A. murphyi* Ladiz., than for the common species *A. barbata* Pott ex Link and *A. sterilis* L.

Table 1. Distribution of crown rust resistance according to species and level of ploidy in the local oat collection evaluated in 1995 at Tangier, Gharb and Doukkala

Level of ploidy and species	Genome	Number of accessions	
		Evaluated	Resistant
Diploids		**74**	**9**
A. clauda Dur.	CpCp	20	0
A. eriantha Dur.	CpCp	10	0
A. atlantica Baum et Fedak	AlAl	10	0
A. wiestii Steud.	AsAs	7	1
A. hirtula Lag.	AsAs	9	0
A. longiglumis Dur.	A_1A_1	10	4
A. damascena Raj. et Baum	AdAd	8	4
Tetraploids		**236**	**43**
A. barbata Pott ex Link	AABB	100	17
A. agadiriana Baum et Fedak	AABB	20	0
A. murphyi Ladiz.	AACC	16	0
A. maroccana Gdgr.	AACC	100	26
Hexaploids		**150**	**4**
A. byzantina C.Koch.	AACCDD	50	0
A. sterilis L.	AACCDD	100	4
Grand total		**460**	**56**

Evaluation for BYDV resistance

The populations belonging to *A. sterilis* L., *A. byzantina* C. Koch, *A. magna (A. maroccana), A. murphyi, A. barbata* and *A. longiglumis* Dur., which did not show any symptom of BYDV during field evaluation, were inoculated in the laboratory by PAV strain of the common BYDV of Morocco (Saidi and El Yamani 1994).

Among the tested populations, 7.7% have shown a high degree of resistance. Around 20% of the populations, which belonged to *A. sterilis* and *A. barbata,* were moderately resistant. The geographical origin had no influence on the degree of resistance of the populations.

Evaluation for crown rust resistance

The collection was tested under natural inoculation at three sites where crown rust (*Puccinia coronata* f.sp. *avenae*) is permanently occurring: Sidi Allal Tazi (Gharb), Boukhalef (Tangier) and Khemis Zemamra [Doukkala (Saidi, unpublished data)]. The results are presented in Tables 1 and 2.

Table 2. Distribution of crown rust resistance according to geographical origin in the local oat collection evaluated in 1995 at Tangier, Gharb and Doukkala.

Species/Region	Middle Atlas	Oulmes	Atlantic coast	Zaers	Northern West	Total
Diploids						
A. longiglumis			2		2	4
A. damascena			2		2	4
A. wiestii					1	1
Tetraploids						
A. barbata	1		2	4	10	17
A. maroccana	2	19		4	1	26
Hexaploids						
A. sterilis			3		1	4
Grand total	**3**	**19**	**9**	**8**	**17**	**56**

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The status of the *Avena* core collections

Establishment of the core collection of *Avena* wild species

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Following the recommendations of the fourth meeting of the *Avena* Working Group (1993) concerning the establishment of core collections of *Avena* wild species, an inventory of all collection databases has been prepared with the purpose of producing a comprehensive list of wild oat species preserved in genebanks all over the world.

To obtain all the information about the potential of the genus *Avena* L. it seemed expedient to use the databases of the largest existing genebanks. The basic sources of information were the European *Avena* Database compiled within the framework of the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) in the Institute of Crop Science (FAL), Braunschweig, Germany, which harbours data of over 5000 records; the Canadian database of Plant Genetic Resources of Canada representing over 7000 accessions; the US database (over 5000 entries) of the USDA/ARS genebank in Beltsville, Maryland; and a smaller but specifically very diverse database of the Institute of Grassland and Environmental Research (IGER) in Wales, UK.

The first step was to identify all duplicates stored in various genebanks under different numbers. With this in view, all databases were merged into one. The information stored in the 'DONOR_NUMBER' field was transferred, depending on the donor institution, into five separate fields: USAUSDA, a field with the number of the US genebank; GBRWPBS and GBRPBI, fields with the number of the British genebanks (Welsh Plant Breeding Station, Aberystwyth, and Plant Breeding Institute, Cambridge); DEUBGRC, a field with the number of German genebanks in Braunschweig (Institut für Pflanzenbau) and Gatersleben (Institut für Pflanzengenetik); SUNWIR, a field with VIR catalogue number. The abovementioned institutes are the largest keepers of worldwide genetic diversity of wild plant species. This approach has shown that one and the same accession may have up to five different numbers and be preserved in different genebanks. This structure of the database has made it possible to discard duplicates and thus reduce the total collection by half.

Finally, when Paradox for Windows software was applied, the database contained over 11000 records in 14 fields, including over 3000 entries of diploid and tetraploid species and nearly 8000 entries of hexaploid species.

Such a detailed database structure and wide geographical diversity of all species from their centres of origin made it possible to analyze the whole global diversity of wild oat species with respect to their areas of distribution (Loskutov 1997). The basic challenge of this work was the fact that the fields 'ORISIT' or 'ORILOCAT' in most cases were empty, except for the data from the Canadian genebank. The biggest difficulties were associated with the US genebank accessions, since some species of Mediterranean origin were registered in the field of 'ORIGIN' as 'USA' or 'unidentified'. In addition, a large number of accessions of Israeli origin had no indication of their collection sites or location. The American genebank has over 30% of such accessions, both cultivated and wild (Wesenberg *et al.* 1992).

As a result of this analysis, it was found that the richest diversity of diploid species with genome C occurred in Algeria (Oran area), Cyprus (*A. ventricosa* Bal.) and Azerbaijan (Apsheron Peninsula) (*A. bruhnsiana* Grun.); other species such as *A. eriantha* Dur. and *A. clauda* Dur. were widespread in Algeria (Batna area), Iran (Bistoon, Kermanshah, Shah-Pasand), Turkey (Cardak, Ceylapinar, Van lake), Azerbaijan (Apsheron Peninsula, Shemakha Plateau), Iraq and Morocco. Diploid species with genome A were widely spread on the African coast. Among wide diversity species *A. longiglumis* Dur. occurred mostly in Morocco (Rabat area), and in Spain and Portugal; *A. hirtula* Lag. mostly in Greece (Crete), and in Turkey and Morocco; *A. wiestii* Steud. in Azerbaijan (Apsheron Peninsula and Lenkoran Lowland), Iran (Chalus, Ghazvin), Israel (Oorim, Misaf Haneger), and in Algeria. Other diploid species are endemic for small areas of the country - *A. prostrata* Lag. (south coast of Spain), *A. damascena* Raj. et Baum (Syria, Damascus area and Morocco), *A. canariensis* Baum (Spain, Canary, Fuerteventura Island) and *A. atlantica* Baum (coast of Morocco).

The tetraploid species *A. barbata* Pott ex Link had the richest diversity in all centres of origin and distribution of *Avena* wild species. The Canadian, American (origin mostly from Israel) and Australian genebanks contained representative collections of this species. The highest diversity was collected in Israel, Turkey, Tunisia and Morocco. Other tetraploid species are endemic: *A. vaviloviana* Mordv. (Ethiopia), *A. agadiriana* Baum et Fed. (Morocco, Agadir area), *A. maroccana* Gdgr. (coast of Morocco) and *A. murphyi* Ladiz. (coast of Spain and Morocco); and the unique perennial cross-pollinated species *A. macrostachya* Bal. occurred only in Algeria in the Djurdjura mountains.

The most interesting collections of the hexaploid wild species *A. fatua* were collected on the territory of the USA (more than 1000 entries), Australia, Japan and the former USSR. *A. sterilis* L. was collected in Israel, Iran, Morocco, Turkey and other countries. In Canada, the USA (origin mostly from Israel) and Russia have the largest collections of this species. The very rare hexaploid species *A. occidentalis* Dur. occurred on Canary Islands (Spain) and partly in Morocco.

Analysis of the global database with respect to geographical distribution of *Avena* wild species resulted in a comprehensive view of the whole *Avena* genetic diversity worldwide. The global database of *Avena* wild species produced was accepted as a keystone in establishing a core collection. According to geographical principles a collection was set up for the evaluation of all species (van Hintum 1994). For such reasons, all regions inside each country were classified into groups according to the frequency of occurrence of accessions of each species, and a representative part of accessions was identified in every group.

For this work we used the PC software programme ‘MapInfo’. For example, we took the map of the Caucasus mountains and Crimea Peninsula with the distribution of *Avena* wild species. The highest diversity of these species were in several districts of Azerbaijan: on Apsheron Peninsula, Lenkoran Lowland, Shemakha Plateau, and the territory near the border of Daghestan; in Armenia: near Sevan lake; on the lowlands of Georgia; and on the coast of Crimea and Russia.

The next task was to characterize and evaluate the accessions of this collection according to various traits. To make an in-depth study of the whole diversity, VIR's germplasm collection was taken as a model. The world-scale collection of VIR was formed on the basis of the samples of *Avena* wild species collected in the former USSR and abroad, accessions of Dr Baum's collection transferred from Canada to VIR, and on the germplasm received lately by mail requests from the largest genebanks of Canada, USA, UK, Germany and other countries. The collection of VIR incorporates over 500 original samples collected by N.I. Vavilov, A.I. Malzev, P.M. Zhukovsky, A.I. Mordvinkina, V.F. Dorofeyev and other scientists of the Institute's staff. At present, the collection stored at VIR is a representative collection of wild and weedy *Avena* species. It harbours about 2000 accessions representing the whole geographical diversity of all known species (21 species) with different ploidy levels, which belong to the subsection Euavena (Griseb.).

Initially, the whole collection was evaluated by morphological characters associated with the caryopsis, i.e. such traits of the lemma were identified as colour, hairiness of lemma and colour of pubescence. These characters continue the homological series in variation observed in different species of cultivated oat and have a wide range of variability in wild species.

At the same time, these traits are extremely important for preserving the purity of such accessions during storage and regeneration. Specifying characteristics of the lemma in the first phase may replace botanical varieties, which are so important for cultivated species. Additional research was conducted on morphological characters, agricultural properties and electrophoretic spectra of storage proteins (avenine). All data were processed by means of cluster analysis.

All these data were used in taxonomic research, while a number of morphological traits and storage protein (avenine) spectra were involved in the process of selecting accessions for core collections.

This work included agricultural characters such as duration of the vegetation period, plant height, resistance to various pathogens (crown and stem rust, BYDV, *Helmintosporium*, *Septoria*, mildew etc.) (Loskutov 1998) and qualitative grain parameters (composition and content of proteins and oils), several morphological traits having great intraspecific variability (panicle length, length of the lower lemma, etc.), as well as storage protein (avenine) spectra. Besides, we took into account the presence in the accessions of identified genes of various traits (Loskutov and Merezhko 1997).

Thus, we started to select the accessions for the core collection of *Avena* wild species, using the passport database, the geographical origin of accessions, geographical and electronic maps and the results of characterization and evaluation of these materials.

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The Quality of national collections

Forage oat genetic resources in Cyprus

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New oat varieties for forage production

Under Mediterranean climatic conditions and systems of agriculture, small grain cereals, especially barley, and to a lesser extent oats, are important forage crops. They are, in general, more drought- and cold-resistant than forage legumes and do better under conditions of long dry summers and cool wet winters.

Previous studies with several oat varieties introduced from abroad showed that 'Montezuma', a variety introduced from California (USA), gave a 12% higher dry matter yield (6.35 t/ha) than the locally grown variety 'Palestine'.

Recently, a number of new forage oat varieties were introduced from various countries over a period of ten years and their performance was evaluated.

The dry matter yield of 'Mulga' (8.9 t/ha), the best selected forage variety, was 10% higher than that of 'Montezuma'. There were no significant differences between the two varieties in digestibility, digestible organic matter and crude protein yields. 'Mulga' is on average 11 cm taller than 'Montezuma' (99 cm), while seed production of the two varieties is similar. 'Mulga' is more resistant to lodging and rust. Varieties that lodge are difficult to harvest and lodged oats are often severely infected with rust.

Both 'Montezuma' and 'Mulga' are medium-maturing varieties and reach the milk stage of grain around mid-April (± 1 week). 'Mulga' has thick stems, many large broad leaves and is palatable to livestock. It is recommended to be grown only in pure stands and not in mixtures with legumes, as it is very competitive, depressing the legume component, particularly in the early stages of growth. In addition, the milk stage of grain of 'Mulga' does not always coincide with the full pod formation stage of legumes, which would optimize forage production.

On the other hand, the two late varieties 'Algerian' and 'Local' reach the milk stage of grain on average 9 days later than 'Mulga'. 'Algerian', a variety introduced from Australia in 1979, is recommended to replace 'Local' since it produces 19% (8.9 t/ha) more dry matter and 38% (2.9 t/ha) more grain yields than 'Local'. 'Algerian' is on average 88 cm tall, while 'Local' is 74 cm tall. 'Algerian' has fine stems and leaves which are often considered quality factors in oat hay, although their direct relation to hay quality is not yet known. In addition, 'Algerian' combines well with legumes since it is not as competitive as 'Mulga', permitting more legume growth in mixtures. 'Algerian' can also be used for hay making in pure stands as a complementary variety to 'Mulga'.

By using two varieties for hay making, a medium- ('Mulga') and a late-maturing one ('Algerian'), hay production can be spread over a longer period for easy curing.

Evaluation of locally-selected genetic material of oats

The seed of ten oat accessions, which were collected from several parts of Cyprus in 1995, was multiplied and replicated trials were established during 1997. The two most productive forage oats, 'Mulga' and 'Algerian' served as controls.

The forage yield of the varieties/accessions tested ranged from 4000 kg/ha to 7532 kg/ha. The yield of the best accession was that of 'Peristerona', at 6166 kg/ha, while the yield of the commercial variety 'Algerian' was 7532 kg/ha (SE ±1205).

Progress in the Czech *Avena* collection

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Oat ranks fourth among cereal crops in the Czech Republic. In 1997, its sowing area was 77 800 ha, i.e. 4% of the total area occupied by cereals. The Czech Republic is in twelfth place in Europe with a grain yield of 3.34 t ha^{-1} (FAO 1997).

Collecting, evaluation and mid/long term conservation started in Kroměříž in 1952. The Agricultural Research Institute (ARI) Kroměříž, Ltd. is currently engaged in these activities. The main goal is to acquire new oat cultivars, breeding material and gene resources from world collections for testing, utilization for breeding and maintenance of germinative ability. After testing, samples are provided to the Genebank at the Research Institute of Crop Production in Prague-Ruzyně for long-term conservation.

The *Avena* collection of ARI Kroměříž, Ltd. contains over 1926 accessions. Among them 60 accessions are black-coloured cultivars and more than 35 naked oats. Table 1 shows the number of accessions per year.

Table 1. Oat genetic resources at ARI Kroměříž, Ltd. (30 November each year)

Year	Number of accessions	
	Total	Czech cultivars
1992	1750	145
1993	1756	145
1994	1800	146
1995	1863	146
1996	1903	146
1997	1926	146

Most of these accessions are cultivated oats *Avena sativa*, but 89 of them are *A. abyssinica* forms. According to the ploidy, the majority of accessions in the collection can be classified as hexaploids, three accessions are tetraploids, and one accession is a diploid (Table 2).

All groups of species were divided into varieties, as follows: 6 04 000 - 034 *Avena sativa* L. means that all accessions of *A. sativa* could be classified into 34 groups of varieties, e.g.:

6 (ploidy) 04 (species) 001 (varieties) = *Avena sativa* L. var. *affinis* Körn,
6 04 002 = *Avena sativa* L. var. *aristata* Krause, etc.

Avena sativa represents the largest part of the collection. Most accessions are of local origin.

The collection mostly comprises spring type cultivars. The number of winter forms is low with regard to winter climatic conditions of the location Kroměříž and they have lower winter hardiness.

The Descriptor List of the genus *Avena* L. (Machán *et al.* 1986) is used for the evaluation of oat genetic resources. This descriptor list was developed as a basic guideline for documentation, characterization and evaluation in the Czech oat collections. It was published within the framework of the National Programme of Conservation and Utilization of Plant Genetic Resources and it will be used for the central documentation of plant genetic resources (EVIGEZ). The Descriptor List is assigned for the whole genus and comprises both cultivated and wild forms. The 9-1 scale (1 = the lowest or worst value) enables us to score individual traits in greater detail.

Table 2. Survey of oat accessions stored at ARI Kroměříž, Ltd. and classified according to the botanical taxons of the Descriptor List Genus *Avena* (Machán *et al.* 1986) (see text)

Group of accessions	Number of accessions	Ploidy	Species	No. of varieties	Examples
1 – Wild	1	2	09	000-020	*A. strigosa* Schreb.
2 – Landraces	81	4	01	000-008	*A. abyssinica* Hochst.
			05	000-005	*A. vaviloviana* (Malz) Mordv.
		6	01	000-018	*A. byzantina* C. Koch
			02	000-009	*A. fatua* L.
			03	000-003	*A. ludoviciana* Dur. (*A. sterilis* ssp. *ludoviciana* (Dur) Gillet et Magne
			04	000-034	*A. sativa* L.
			05	000-007	*A. sterilis* L.
3 – Varieties	1047	4	01	000	*A. abyssinica* Hochst.
			05	000	*A. vaviloviana* (Malz) Mordv.
			01	000	*A. byzantina* C. Koch
			04	000	*A. sativa* L.
			05	000	*A. sterilis* L.
4 – Breeding source	36	6	01	000	*A. byzantina* C. Koch
			04		*A. sativa* L.
5 – Gene source	3	4	02	000	*A. barbata* Pott ex Link
			03		*A. magna* Murphyi et Terrell
6 – Not classified	758	-	-	-	
Total	1926				

The Descriptor List includes 110 characterization and evaluation descriptors, four additional descriptors of environmental characteristics and the national accession number (ECN), the unique identifier within the Czech collection of oats. The IBPGR Descriptor List (1985), the UPOV guidelines (1981), the Descriptor for the genus *Avena* L., VIR Leningrad (Velikovsky *et al.* 1984) and the Descriptor List of the genus *Avena* L. (Foral *et al.* 1969) were used as sources. This Descriptor List includes passport data, characterization and description characteristics. Also, it can be fully used in cultivar testing and evaluation with respect to legal protection where, however, a limited number of selected descriptors is used (Stehno 1997).

Recently, the system of genetic resources registration has been updated in order to be in accordance with new terms of cooperation with IPGRI. The new version was published within the abovementioned programme to serve the system of registration of genetic resources, EVIGEZ.

To evaluate genetic resources, trials are conducted each year. Results obtained using new samples of the world collection (1988–1990) show that the best performance under conditions of the Czech Republic was exhibited by cultivars of Central-European provenance, particularly from Poland, Germany, and Austria. These cultivars yielded more than 8 t ha^{-1} and demonstrated balanced yield components. Good productivity of panicle was assessed in some cultivars from the Netherlands, France, and Sweden (Machán 1996). Some cultivars from the USA, Canada and Australia were recommended for breeding. Though they did not reach high yield potential, they are donors of some new types of resistance to nematodes and fungal or virus diseases.

In 1991–1992, we tested collected genetic resources in our trials (Machán 1993). Domestic cultivars of hulled ('Zlatak', 'Ardo', 'Auron', 'Flamingsnova') and naked oat

('Adam', 'Abel'), and other new materials tested in trials of the Central Institute for Agriculture Supervision and Testing meet agronomic and quality requirements. In new cultivars more emphasis is placed on the evaluation of food quality of samples, particularly contents in starch, bran, β-glucans, oil, fats, wax, vitamins, mineral substances, etc., considering their potential use for healthy nutrition and pharmaceutical industry. An important use of oat in our country is industrial processing which is not sufficiently appreciated so far.

In 1995–1997, we tested productivity and other agronomic characteristics in 30 black-coloured oat cultivars. This type of oat is not bred in the Czech Republic. Light cultivars registered in the Czech Republic were used as standards. The level of grain yield in black-coloured cultivars was about 75% of that given by standards, particularly due to lower grain weight. French cultivars were superior in grain yield. They had longer stem, lower resistance to lodging and decreased aminoacid content in grain. An expected level of metabolized energy in black-coloured oats assessed for horses was not confirmed either because the values obtained in both groups of cultivars were only insignificantly higher. These cultivars exhibited higher content in protein, fats and fibre in grain. On the average, black-coloured cultivars showed 1.5 times higher resistance to stem and crown rusts (Machán 1998). Values of agronomic and quality traits of these materials will be recorded within the oat collection in the Czech Republic.

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The *Avena* collection at the Estonian Genebank

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Introduction

Activities on plant genetic resources conservation in Estonia were initiated in cooperation with the Nordic Gene Bank in 1994.

In 1997 the Committee on Plant Genetic Resources for Agriculture was founded. The Committee will link all institutions dealing with the conservation of plant genetic resources for agriculture into the Estonian National Network and develop conservation strategies.

The Estonian Genebank is held by the Jõgeva Plant Breeding Institute which is the main national institution involved in several plant breeding activities.

The Jõgeva Plant Breeding Institute has the mandate to maintain cultivars, breeding material and landraces of cereal crops, potatoes, forage grasses, legumes and vegetables.

Status of the *Avena* collection

Conservation

The collection of varieties and breeder's lines of *Avena* is part of the National Genebank.

To date the *Avena* collection consists of 129 accessions of varieties and breeder's lines of Estonian and foreign origin. It also includes 85 breeders lines of local origin. The accessions originate from 20 different countries (Table 1).

Table 1. *Avena* germplasm classified by country of origin

Country of origin	Total no. of accessions
AUS	4
BEL	1
BLR	4
CAN	4
CZE	3
DEN	1
EST	12
FIN	1
FRA	2
GBR	5
GER	5
HOL	3
JPN	1
LAT	3
POL	2
POR	2
RUS	54
SWE	9
UKR	10
USA	3
Total	**129**

Most of the accessions belong to the species *A. sativa* L. (represented by 121 accessions). There are also six accessions belonging to the species *byzantina* C. Koch and two accessions representing a mixture of *sativa* and *byzantina*.

The collection has been maintained in acceptable conditions for long- and medium-term conservation. Aluminium foil packs are used for packaging.

Evaluation and characterization

Accessions of Estonian origin are completely evaluated and characterized; all relevant information is available. Accessions of foreign origin are partially evaluated.

Documentation

Information on passport, characterization and evaluation data is available. Most accessions are documented either electronically or manually. It is planned to merge all relevant information into a single database for more efficient use.

Plans for the future

The following activities on the *Avena* collection shall be carried out:

- completion of national inventories of existing *ex situ* collections, including the assembly of passport data;
- continuation of the collection, preservation, identification, characterization, evaluation and documentation of accessions;
- provision at the seed storage centre at Jõgeva with the necessary technical equipment to ensure long-term preservation;
- extension of cooperation and exchange of genetic material with other holders of plant genetic resources;
- monitoring of other national germplasm collections to identify and exclude unwanted duplicates or other redundant genetic material;
- to transfer and deposit a safety-duplicate collection of Estonian seed propagated material in the base collection of the Nordic Gene Bank.

Avena genetic resources in France

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Since INRA terminated its Research programmes on *Avena*, a new organization has been defined for genetic resources management which will be set up progressively in the coming years.

Avena Genetic Resources are kept in two different genebanks: INRA-Rennes (Maxime Trottet) is responsible for breeding lines and populations; and GEVES-Le Magneraud (Gérard Sauvion) is responsible for cultivars which have been struck off the official catalogue.

Priority is given to maintaining French genetic resources. Foreign cultivars which are duplicates from other genebanks will no longer be regenerated.

Presently 1129 accessions are maintained, including 373 old cultivars and 756 breeding lines.

Seeds from the active genebank are kept at 4°C in a cold chamber for distribution. In Le Magneraud, 100 g is kept for each accession and 20 g as maintenance stock used for seed regeneration after 15 years. A germination test will occur every 6 years on a 10 g sample and seed will be regenerated if germination rate is less than 85%. In Rennes, 15–20 g is kept for each accession.

At Le Magneraud, long-term conservation is organized for safety-duplicates in deep-freeze chambers for accessions from INRA-Rennes. Safety-duplicates from Le Magneraud are conserved at INRA-Clermont-Ferrand (Jean Koenig) in a deep-freeze chamber.

This scheme seems to be working quite well, but the issue of landraces, which should be prospected before they are lost, is still a problem.

Status of the national *Avena* collections in Germany

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The German *Avena* collection consists of 4761 accessions in total. Table 1 gives an overview of the collections by species and holding genebank. Table 2 provides the composition of the collections by country of origin.

The IPK Genebank is located in the eastern part of Germany at Gatersleben in Saxony-Anhalt. Since its foundation in 1943, this genebank has emphasized taxonomic work on collections and is known for its high number of originally collected samples (Hammer 1993). About 50% of the *Avena* collection is the result of its own collecting activities.

The former genebank of West Germany in Braunschweig (Lower Saxony) has been established as a service unit and integrated element of breeding research and commercial plant breeding (Bommer 1972). Furthermore this genebank worked as an information and germplasm acquisition centre, that resumed responsibility for the long-term maintenance of collections received from many institutions in Germany and abroad. In principle this genebank functioned as an outsourcing facility which managed seed collections and data sets linked with it for the benefit of research institutes and breeders. Both genebanks assisted German breeders as well as researchers in providing interesting genetic material. Since 1996 the responsibility of the former West German genebank has been assigned to the Federal Centre for Breeding Research on Cultivated Plants (BAZ). The new name is 'BAZ Gene Bank'. Due to the responsibility for the European *Avena* Database, the genus *Avena* is one of the priority crops of the BAZ Gene Bank while within the cereals group the IPK Genebank is concentrating its research activities on barley. On the technical level both genebanks work closely together. However, whether both *Avena* collections will be merged in the near future is still under discussion.

The collection at the BAZ Gene Bank has not changed significantly over the past few years. Today there are fewer accessions maintained than in 1993 due to the identification of clearly duplicated accessions between the two German genebanks. Contrary to the collection at the BAZ Gene Bank, the representation of IPK in the European *Avena* Database has been increased from 1073 accessions in 1993 to 2834 accessions in 1997. Much of this increase has been caused by the intensified computerization of data and database updates, and 275 new *Avena* accessions entered the genebank since 1993.

Both collections are of high quality in terms of germinability and they are maintained in storage rooms at temperatures of –15°C (Gatersleben) and –10°C (Braunschweig). Until recently, *Avena* seeds were kept at 0°C in Gatersleben. However, investigations on seed germinability after long-term storage have shown that *Avena sativa* L. seeds, already having a lower germinability at the beginning of storage than, for example, wheat and barley, decline faster during storage at 0°C (Specht *et al.* 1997). Therefore, it was decided to transfer oat samples to a reconstructed cold chamber under –15°C. Safety-duplicates of the *Avena* collections have not been deposited elsewhere. The organization and implementation of safety-duplicate storage is considered a high priority task for the near future.

Table 1. Overview of the two German *Avena* collections by species as of June 1998

IPK Genebank		BAZ Gene Bank	
Species	**Number of accessions**	**Species**	**Number of accessions**
Avena sativa L.	2097	*Avena sativa*	1370
Avena byzantina Koch	372	*Avena sterilis*	301
Avena sp.	175	*Avena strigosa*	27
Avena fatua L.	92	*Avena abyssinica*	25
Avena sterilis L. *s.l.*	51	*Avena fatua*	24
Avena strigosa Schreb.	35	*Avena barbata*	23
Avena barbata Pott ex Link	34	*Avena* sp.	16
Avena maroccana Gdgr.	16	*Avena maroccana*	15
Avena canariensis Baum, Raj.		*Avena canariensis*	10
et Samps.	7	*Avena brevis*	8
Avena brevis Roth	6	*Avena clauda*	7
Avena abyssinica Hochst.	5	*Avena wiestii*	5
Avena longiglumis Dur.	4	*Avena* x *sativa*	5
Avena wiestii Steud.	6	*Avena hirtula*	4
Avena nuda L.	4	*Avena damascena*	3
Avena murphyi Ladiz.	2	*Avena longiglumis*	3
Avena hybrida Peterm.	1	*Avena nuda*	2
		Avena chinensis	1
		Avena murphyi	1
		Avena nuda biaristata	1
		Avena orientalis	1
		Avena prostrata	1
		Avena ventricosa	1
Total	**2907**	**Total**	**1854**

Table 2. Overview of the two German *Avena* collections by country of origin as of June 1998

IPK Genebank		BAZ Gene Bank	
Country of origin	**Number of accessions**	**Country of origin**	**Number of accessions**
Slovakia	712	Germany	416
Germany	298	United States	362
Italy	242	Turkey	219
(unknown)	218	(unknown)	164
United States of America	178	Israel	124
Poland	113	former USSR	65
Greece	98	Sweden	65
former Czechoslovakia	79	Iran (Islamic Republic)	45
Albania	72	Canada	37
Hungary	61	France	32
United Kingdom	59	Italy	32
France	57	United Kingdom	31
Romania	57	Spain	27
former USSR	57	Ethiopia	24
Spain	51	Netherlands	20
Sweden	46	Australia	19
Austria	39	Argentina	19
Canada	37	Finland	17
Georgia	31	Morocco	15
former Yugoslavia	31	former Yugoslavia	14
Ethiopia	24	Austria	10
Netherlands	23	Hungary	10
Australia	22	Algeria	10
Portugal	22	Greece	9
Turkey	22	Belgium	9
Bulgaria	17	Poland	6
Morocco	17	China	5
Libyan Arab Jamahiriya	16	Uruguay	5
Belgium	15	Syrian Arab Republic	5
Finland	14	Iraq	4
Iran	14	former Czechoslovakia	4
India	13	Tunisia	3
Tunisia	13	Romania	3
Croatia	12	Portugal	3
Israel	11	Kenya	3
Mongolia	11	Cyprus	2
Argentina	9	India	2
Czech Republic	9	Denmark	2
Tajikistan	9	Libyan Arab Jamahiriya	2
Canary Islands	8	Brazil	2
Afghanistan	6	Colombia	1
Algeria	6	Bolivia	1
China	6	Peru	1
Uzbekistan	6	South Africa	1

Table 2 (cont.)			
IPK Genebank		**BAZ Gene Bank**	
Country of origin	**Number of accessions**	**Country of origin**	**Number of accessions**
Democratic People's Republic of Korea	5	Norway	1
Denmark	5	New Zealand	1
Uruguay	5	Afghanistan	1
Japan	4	Lebanon	1
Mexico	3		
Norway	3		
Russian Federation	3		
South Africa	3		
Cyprus	2		
Iraq	2		
Ireland	2		
Latvia	2		
Switzerland	2		
Bahrain	1		
Estonia	1		
Syrian Arab Republic	1		
Turkmenistan	1		
Ukraine	1		
Total	**2907**	**Total**	**1854**

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Status of oat collections in Latvia

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There are two collections of cultivated oat in Latvia: a working collection at the Stende State Plant Breeding Station and the Latvian Gene Bank at the Institute of Biology. The working collection was created during the Soviet time when access to new foreign varieties could be realized only through the Vavilov Institute in St. Petersburg. Therefore many varieties were kept in the collection; however, they were not used in breeding. There are 316 accessions altogether in the working collection. Among them are 17 of Latvian origin: 9 registered varieties and 8 breeder's lines. Passport data of those 316 accessions were included in the Latvian Plant Genetic Resources database during the inventory of Latvian Plant Genetic Resources (PGR) (Rashal 1995).

The Latvian Gene Bank was created in 1997 at the Institute of Biology of the University of Latvia with the financial and technical aid of the Nordic Gene Bank in the framework of the Nordic-Baltic cooperation in PGR (Rashal and Weibull 1997). In the Latvian Gene Bank only accessions of Latvian origin will be kept. All accessions included in the Gene Bank will be classified in three groups of priority with different number of seeds preserved (Table 1).

Table 1. Classification of accessions

Group of priority	Base collection	Active collection	Safety-duplicate collection (Nordic Gene Bank)
1	10000	5000	2000
2	3000	3000	-
3	-	2000	≤ 2000

All nine Latvian oat varieties with available seeds are accepted for inclusion in the Latvian Gene Bank with the highest priority. Seeds of these varieties are already prepared for long-term storage. Among these varieties, one was developed as a selection from a local population ('Stendes mazãs agrãs', in commercial use from 1930–1967); another was created from hybridization, including local material. From the literature five additional oat varieties of Latvian origin are known from the 1920–1940s, now lost in Latvia.

The breeder's lines have been kept in the working collection for more than 10 years. Reasons for including them in the collection are unknown. The decision about acceptance of those lines for inclusion in the Latvian Gene Bank will be considered later on, after additional evaluation.

Evaluation and observation data for accessions included in the Latvian Gene Bank will be collected in field experiments in 1998–1999 according to the descriptor list accepted by the Baltic Cereal Working Group.

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Collection of *Avena* in the Lithuanian Institute of Agriculture

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In 1974 oat accessions numbering 1512 were maintained in the Lithuanian Institute of Agriculture. Of them, 30 were old Lithuanian varieties and breeder's lines; 120 accessions were collected by Professor D. Rudzinskas before World War II. The rest of them were received from VIR and from other breeding stations of the former USSR.

In 1994, when the national plant genetic resources programme was initiated, the collection was inventoried. Some accessions were discarded because they had lost viability. Regeneration of the survived accessions (875 accessions) was started, and will be completed in 1998. Measures were taken to protect the working collection from future losses. Accessions of the working collection will be replanted every four years. The material of Lithuanian origin has been put in long-term storage (28 accessions).

The evaluation and multiplication of the working collection is carried out in 2 m^2 plots without replication. Five hundred seeds are planted in each plot. The standard variety 'Jaugila' is planted after every nine accessions. Heading and maturity time, lodging and disease resistance, plant height, productivity, tillering capacity and number of seeds per plant are evaluated during the growing season. The best accessions are used in the breeding programme.

The material of Lithuanian origin stored in long-term conditions is characterized and evaluated according to IPGRI descriptors (Table 1).

Data about the *Avena* collection are presented in the first Lithuanian PGR catalogue, published in 1998 (Table 2). The Nordic Gene Bank will finance the publication of the Baltic PGR catalogue in 1998, but only varieties of Baltic origin will be included in this book.

Table l. Descriptors for oat

PASSPORT
Accession number
Pedigree/cultivar name
Botanical variety
Donor name
CHARACTERIZATION
Plant height
Stem thickness
Shape of panicle
Lemma colour
Kernel covering
Awnedness
Lodging at immature stage
Days to heading
Days to harvest
Number of seeds in panicle
1000-grain weight
Test weight
Percentage of husk
Percentage protein content
Percentage oil content
Pest and disease susceptibility

Table 2. Descriptors included in the catalogue for oat accessions of foreign origin

Catalogue number
LTU institute catalogue number
Number of the accession in the donor institute
LTU institute code
Donor institute code
Genus
Species
Subtaxa
Accession name
Country of origin
Sample status

Present status of the Nordic Gene Bank *Avena* collection

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Since the last meeting of the ECP/GR *Avena* Working Group some minor changes have taken place with respect to the status of a number of accessions, primarily of Nordic origin. The whole collection has now been reviewed, in particular the material consisting of foreign accessions which was donated by the Royal Agricultural College in Copenhagen. Nordic duplicates have been identified, thereby reducing the total figure to 640 accessions. Tables 1 and 2 present detailed information about the collection as to the number of accessions and country of origin; it should be noted, however, that duplicated Nordic accessions have been excluded from this list.

The Nordic Gene Bank (NGB) oat collection has already been evaluated from 1991–1993 by Magne Gullord in Norway but the results have only been compiled recently. It is foreseen that all characterization and evaluation data will be published on the Internet in the near future. At the moment no particular investigations are being carried out with the oat collection.

Table 1. Number of *Avena sensu lato* accessions held at the Nordic Gene Bank as divided between country of origin and type of germplasm (duplicate Nordic accession excluded)

Country	Breeding material	Cultivars	Non-Nordic introductions	Locally cultivated	Wild/ semi-wild	Total
AUS		1	16			17
BEL			3			3
CAN			3			3
CSK			1			1
DEU			8			8
DNK	4	18		3		25
EST			1			1
FIN	5	22		7		34
FRA			12			12
GBR	4		27			31
GEO			1			1
IRL			2			2
LTH			1			1
NLD		6	12			18
NOR		24				24
NZL			1			1
RUS			6			6
SWE	25	77	1	19		122
TUR	1					1
URY			1			1
USA	3		17			20
ZAF			1			1
???*	6	2	123	6	8	145
Total	**48**	**150**	**237**	**35**	**8**	**478**

* Unknown

Some oat germplasm with alleged Nordic origin has been repatriated from the National Small Grains Collection (NSGC) in the USA and is now in the process of being multiplied for comparative investigations of material having similar accession designations. Moreover, the NGB has recently initiated a project to study how to carry out repatriation on a routine basis. This project, managed by former curator Birgitte Lund at the Royal Agricultural College in Copenhagen, is presently concentrating on *Hordeum* but may stand as model for repatriation of any crop species. Information about the progress of this project will be provided at a later date.

During the last few years the NGB has noted an increased interest in *Avena* landraces or local cultivars. Several local and/or non-governmental organizations showing particular interest in the history of cultivation or of rural life, such as open-air museums, now grow this redundant material for demonstration. This has opened up possibilities for new conservation regimes (cf. on-farm conservation) for this kind of heterogeneous germplasm.

Table 2. Number of *Avena* accessions as in Table 1 but divided into separate species

Species	Origin	Breeding material	Cultivars	Non-Nordic introductions	Locally cultivated	Wild/ semi-wild	Total
Avena barbata Pott	???*					2	2
Avena brevis Roth	???*	1				1	2
Avena byzantina C. Koch	???*	1				1	2
Avena nuda L.	DNK				1		1
	???*	3					3
Avena sativa L.	AUS		1	16			17
	BEL			3			3
	CAN			3			3
	CSK			1			1
	DEU			8			8
	DNK	3	18		2		23
	EST			1			1
	FIN	5	22		7		34
	FRA			12			12
	GBR	4		27			31
	GEO			1			1
	IRL			2			2
	LTU			1			1
	NLD		6	12			18
	NOR		24				24
	NZL			1			1
	RUS			6			6
	SWE	25	77	1	19		122
	TUR	1					1
	URY			1			1
	USA	3		17			20
	ZAF			1			1
	???*	1	2	123	6		132
Avena sterilis L.	DNK	1					1
	???*					2	2
Avena strigosa Schreber	???*					2	2

* Unknown

Status of the oats collection in Poland - conservation, characterization and documentation

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Introduction

In Poland oat is grown on an area of 625 thousand ha, i.e. 9.6% of the area occupied by all crops. The relatively high contribution of oat in the total area of crops and the slow decrease of the cultivated area are specific to Polish agriculture. An important decrease in the growing area started in 1965 and the process increased again after 1975 (Fig. 1). Simultaneously, the importance of oat has grown in cereal mixtures, of which the area nearly doubled during the last 20 years. In Poland oat is grown in all regions and is more important in submountainous and mountainous areas. It is the only cereal grown above 700 m a.s.l. The main constraint in oat production is its low yield, about 0.3 t/ha, which did not increase during the last 20 years even though in registration trials it is over 0.6 t/ha. The National List of Varieties contains 16 Polish varieties and one variety of German origin. The variety ‘Akt’ was the first Polish naked oat registered in 1997.

Germplasm collection, preservation and utilization

In 1979 the Centre for Plant Genetic Resources (formerly The National Department for Plant Genetic Resources) was organized as an official governmental project at the Plant Breeding and Acclimatization Institute. Prior to 1979, many researchers held their own

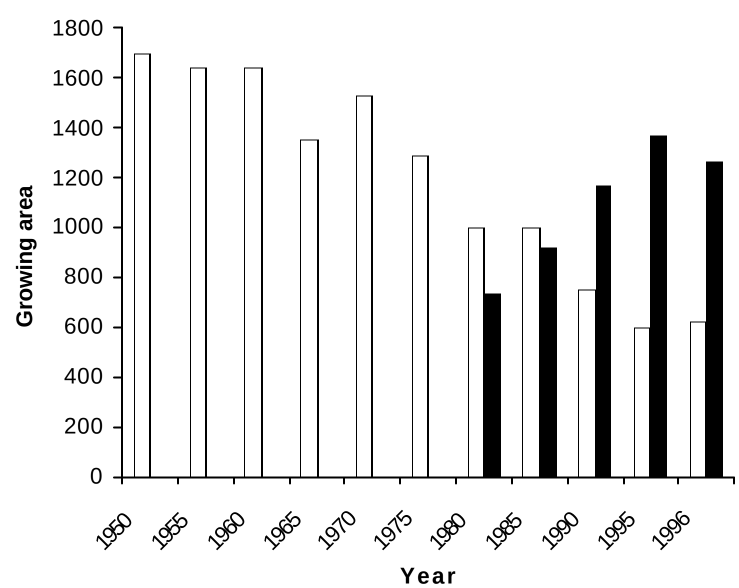

Figure 1. Changes in growing area of oat and cereals mixtures in Poland. □, Oat; ■ , cereal mixtures.

collections, but no central organized programme existed. After the National Crop Genetic Resources Programme establishment, many of these individual collections were submitted to the national collections. Some of them were established at the beginning of the century. The species composition of the *Avena* accessions in the Centre for Plant Genetic Resources is shown in Table 1.

Table 1. Species composition of *Avena* accessions in the Centre for Plant Genetic Resources

Species	Number of accessions
A. agadiriana Baum et Fedak	3
A. barbata Pott	5
A. byzantina C. Koch	72
A. fatua L.	10
A. hirtula Lag.	5
A. maroccana Gdgr.	1
A. murphyi Ladiz.	1
A. sativa L.	1810
A. sterilis L.	14
A. strigosa Schreb.	66
A. macrostachya Bal.	9
Total	**1996**

A total of 1996 accessions is maintained in the collection, and about 50 new entries are provided every year (Figure 2). The collection structure is determined mainly by the requirements of the plant breeders, which prefer more advanced breeding material. However, the accessions collected during expeditions, especially landraces, are an important part of the collection. In the *Avena* collection registered varieties and lines comprise 62%, local varieties 4.5%, and wild species 2% of the total number of accessions; the genetic background of the remaining materials is unknown. About 5% of the total number of accessions stored are rendered annually to other collections or breeders (Fig. 2). The samples are requested mainly by plant breeding stations and institutes. About 30% of the samples are sent abroad.

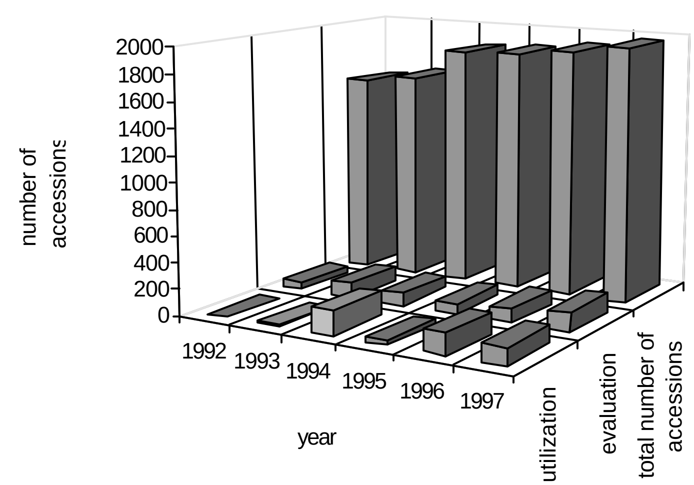

Fig. 2. total number of accessions, evaluation and utilization of the *Avena* collection.

All accessions stored in the collection are described and evaluated. The accessions are examined, in three subsequent years, on the field plots and in the laboratories. About 100 accessions are investigated annually. The intraspecific variability of chosen species, e.g. *Avena strigosa, Avena macrostachya,* is also being studied. The evaluation results are available in form of reports and catalogues. The results of the analyses can be sent upon request.

The Romanian *Avena* collection

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After 1989, in Romania, a dramatic decrease of the surface sown to oat was registered at the same time as the change in the form of land property. Thus, if in 1989 the whole surface sown to oat was 90 000 ha, in 1997 it was reduced to 40 000 ha, because of the reduction of livestock and the lack of advanced technology in oat processing as human food.

In Romania, 70% of the whole surface cultivated to oat lies in Transylvania (western part) and the northern part of Moldavia. The most important cultivated species is *Avena sativa* L. (common oat) which includes a large diversity of bred forms and varieties, which have a broad ecological plasticity.

In this country the oat cultivars belong to the ‘Mutica’ and ‘Arista’ varieties with white and large grains.

According to the Food and Agricultural Ministry's data, the following oat varieties are currently cultivated: ‘Solidor’ (from Germany), ‘Hermes’ and ‘Pan’ (from Czech Republic), ‘Cory’ (from France) and the Romanian ‘Muresan’ and ‘Somesan’ created in the Agricultural Research Station of Turda; all of which are spring varieties.

In 1987, at the Agricultural Research Station of the Lovrin-Timis district, the ‘Florina’ autumn oat variety was created and homologated. This variety is cultivated in the south and southwestern parts of Romania (Oltenia and Banat regions).

The national oat breeding program is coordinated by the Agricultural Research Station of Lovrin. In 1990, the Suceava Genebank initiated and carried out the collection and conservation activity of a large number of local oat forms in Romania, representing valuable gene sources, even those of little importance at the moment.

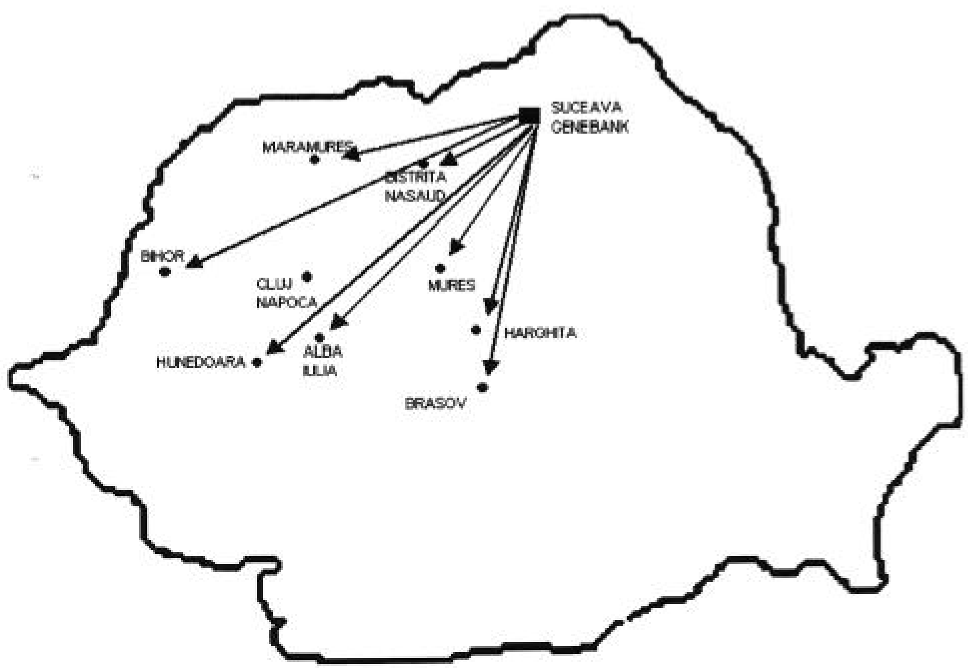

Fig. 1. The number of oat samples collected from Romanian territory. Locations and number of accessions were: Bistrita-Nasaud = 28, Cluj-Napoca = 13, Harghita = 2, Brasov = 2, Alba Iulia = 13, Hunedoara = 16, Bihor = 2, Mures = 3, Maramures = 21.

The two institutions (Agricultural Research Station of Lovrin and Suceava Genebank) hold about 772 accessions (Table 1).

Table 1. Number of accessions in the Romanian oat collection

	Lovrin	Suceava
Indigenous		
Wild	-	-
Landraces	-	100
Cultivars	3	-
Breeding lines	41	-
Other	-	3
Total 147	44	103
Foreign		
Wild	-	-
Landraces	-	-
Cultivars	525	3
Breeding lines	97	-
Other	-	-
Total 625	622	3

Regarding oat diseases and pests in Romania, the most frequent and damaging are: *Ustilago avenae, Puccinia coronata* var. *avenae, Puccinia graminis* f. sp. *avenae* and *Lema melanopa.*

The main descriptors used for Romanian oat populations are:

1. Growth habit of plant
   3. erect
   5. semi-prostrate
   7. prostrate
2. Plant height (cm)
   3. short
   5. medium
   7. high
3. Thickness of stem
   3. thin
   5. intermediate
   7. thick
4. Rigidity of flag leaf
   3. bent
   5. lightly bent
   7. stiff
5. Type of panicle
   Panicle form
      1. unilateral panicle
      2. equilateral or open panicle
6. Tillering capacity
   3. low
   5. intermediate
   7. high
7. Days to panicle
8. Time of maturity
9. Number of spikelets per panicle
10. Number of seeds per spikelet
11. Thousand grains weight (1000 g)
12. Protein content in grain
13. Fats content in grain

14. Stress susceptibility
    3. low susceptibility
    5. medium susceptibility
    7. high susceptibility
  14.1. Cold susceptibility
  14.2. Drought susceptibility
15. Pest and disease susceptibility
  15.1. *Ditylenchus dipsaci*
  15.2. *Heterodera avenae*
  15.3. *Lema melanopa*
  15.4. *Oscinella frit*
  15.5. *Erysiphe graminis avenae*
  15.6. *Puccinia coronata avenae*
  15.7. *Puccinia graminis avenae*
  15.8. *Septoria avenae*
  15.9. *Ustilago avenae*
  15.10. *Ustilago kolleri*

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Ongoing evaluation of VIR's oat collection

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During the past five years the oat collection has been replenished with 500 new accessions of cultivated species and over 100 wild accessions (for the structure of VIR's oat collection see Loskutov 1993). These accessions were received from the Canadian, German and Australian genebanks and other institutions. We have continued to study the collection with respect to agricultural and morphological traits.

In our work with cultivated oats we have concentrated on a complex study of accessions. The high yielding potential of cultivars, in combination with lodging and resistance to crown and stem rust, is the basic criterion of breeding effectiveness (Loskutov and Chmeleva 1997). The use of an effective method of artificial crown rust inoculation allows the evaluation of 100 accessions per year for resistance to this disease, the most efficient genes for our environments being *Pc-36, Pc-37, Pc-3* and *Pc-39*. In the last few years we actively evaluated stem rust and other diseases. We were involved in the programme for evaluation in European Diseases Nursery headed by Dr Shebesta from the Czech Republic for several main diseases of oats.

We continue to find out new sources of dwarfing genes (*Dw-4, Dw-6* and *Dw-7*) among adapted and exotic cultivars and wild species. As a continuation of the study of the genetic collection with reference to plant height, we have started to examine wild species of oat for gibberellic acid. Preliminary results show the availability of identified accessions with all ploidy levels which show different reactions to gibberellin.

Worth mentioning is the joint work of VIR and IGER (UK) on the regeneration and study of accessions belonging to the species *A. occidentalis* Dur. from Spain (Canary Isles). These accessions were collected by M. Leggett during his explorations in 1985 and placed in IGER. In 1995, they underwent linear regeneration and were studied in the field at Pushkin Laboratories (VIR, St. Petersburg). About 70 lines of these accessions have been studied for 3 years with reference to their 22 morphological and agricultural characters. To analyze the polymorphism of reserve proteins, all the accessions were examined by means of electrophoresis of storage protein. This method finally helped to confirm that all these accessions belonged to the species *A. occidentalis* but not to *A. fatua* L. as previously decided. Examination in the field resulted in the identification of forms resistant to crown and stem rust as well as semi-dwarf forms (50–60 cm).

We continued field evaluations of wild species for diseases resistance. Results show that for diploid and tetraploid species disease resistance (crown and stem rust, mildew, *Helmintosporium, Septoria,* etc.) is the most important character from the practical point of view. Forms in which this trait is combined with a shorter vegetation period, short straw, good leafiness and quick growth habit, may be used as genetic sources for the improvement of *A. sativa* L. cultivars. Hexaploid forms demonstrated wide diversity of morphological and agricultural characters, such as semi-dwarfness, productive tillering, earliness, resistance to diseases and lodging, and other traits which can easily be transferred to *A. sativa* (Loskutov 1997, Loskutov and Merezhko 1997).

Field studies of wild species demonstrated a wide polymorphism of responses to photoperiodism and vernalization (Loskutov and Ivanova 1996). Obviously it is possible to find true winter forms among the species *A. clauda* Dur., *A. barbata* Pott ex Link and *A. sterilis* L., since several forms of these species, being late in the field, showed strong responses to the effect of vernalization in vegetation experiments. Such samples were collected either at high altitudes in mountains, or in the cultivation areas of winter type oat, with initial phases of plant development in winter months. Such species as *A. vaviloviana* Mordv. and *A. fatua* may be regarded as true spring species. The forms identified in the vegetation experiment showed weak responses to vernalization. Such insensibility probably pertained to the fact that these species are regarded as weeds in spring plantings. Worth mentioning as chiefly spring by type are species such as *A. wiestii* Steud., *A. canariensis* Baum Raj. et Samp. and *A. magna* Murphyi et Terrell. From the vast diversity of the two latter species it was possible to identify only 2–3 late samples showing medium response to vernalization. Generally these species always headed in the field and yielded full-scale grain harvests. It was found that the forms neutral to photoperiod may be identified among spp. *A. hirtula* Lag., *A. vaviloviana* and *A. fatua.* Late-ripening samples with strong response to the duration of day light were chosen, the diploid *A. clauda*, the tetraploid *A. murphyi* Lad. and the hexaploid *A. sterilis* L.

We started evaluation of oil content and its composition using anatomical methods. The results of this study showed that although links between the anatomical structure of the caryopsis' aleurone layer and its oil content existed, these links were not plainly explicit. It was also discovered that caryopses of different years of reproductions had different structure of the fat drops that filled the aleurone layer, i.e. caryopses of earlier reproductions formed smaller, but more numerous drops, compared with those of fresher reproductions. This phenomenon was probably determined by certain biochemical processes that took place in oat caryopses during storage. In the accessions stored from 1971 concentration of saturated (palmitate, stearate) and monounsaturated (oleate) acids increased, but concentration of polyunsaturated (linoleate and linolenate) decreased compared with analysis of the same accessions of 1990–1992 year reproductions (Loskutov and Moskaleva 1998). During our evaluation we found out that accessions of *A. maroccana* have 19–22.5% protein content and over 8–9% oil content.

All these studies should accelerate the production of progenitors carrying characters of primary and secondary genepools of *Avena* and hence make this source of variation available for oat improvement.

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The Spanish oat collection

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The Spanish Germplasm Bank has a collection of cultivated oats made up of 1275 accessions; the majority, 1251, were collected in Spain, 10 are from other European countries and the origin of 24 is unknown (Table 1). The distribution among species is as follows: 1175 *A. sativa* L., 95 *A. byzantina* C. Koch, and 15 *A. strigosa* Schreb. The majority of the accessions were collected in the 1940s, 1944 in particular, after the end of the Spanish Civil War and prior to modern agricultural practices and new varieties being widely adopted by Spanish farmers. Thus, most of the materials are true local varieties or landraces. A total of 289 accessions have been characterized according to the descriptors listed in Table 2, although there are only partial data for some of them.

Table 1. Oat collection at the Spanish Germplasm Bank

Accessions of Avena sativa

Spain	1142
Portugal	5
France	3
Hungary	1
?	24
Total	**1175**

Spanish accessions

Local varieties (landraces)	1140
Commercial varieties	2 ('Esperanza' and 'Teresa')

Regional distribution

Andalusia	24	Extremadura	170
Aragón	105	Basque Country	5
Asturias	1	Galicia	13
Balearics	2	La Rioja	17
Canaries	0	Madrid	38
Cantabria	2	Murcia	6
Castile-La Mancha	225	Navarre	27
Castile-León	309	Valencia	41
Catalonia	46		

Table 1 (cont.)

Collection years

1929	2	1935	2	1939	5
1940	4	1941	11	1942	9
1944	958	1952	1	1955	1
1970	58	1971	7	1977	3
1979	4	1980	1	1981	4
1983	1	1986	9	1987	21
1989	8	1991	2	1994	2
1995	1	1996	14	1997	5
?	8				

Accessions of *Avena byzantina*

Spain	94	Local varieties (landraces)
Portugal	1	
Total	95	

Regional distribution

Andalusia	34	Extremadura	4
Aragón	0	Basque Country	4
Asturias	0	Galicia	14
Balearics	4	La Rioja	0
Canaries	0	Madrid	0
Cantabria	0	Murcia	11
Castile-La Mancha	4	Navarre	5
Castile-León	1	Valencia	7
Catalonia	6		

Collection years

1940	1	1944	62	1950	1
1951	1	1977	1	1981	10
1982	1	1986	3	1987	9
1996	2	1997	1	?	1

Accessions of *Avena strigosa*

Spain	15	Local varieties (landraces)

Regional distribution

Canaries	3
Castile-León	2
Galicia	10

Collection years

1944	2	1980	1	1981	7
1994	2	1995	3		

Collecting activities

Collecting wild germplasm in Spain

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Several biological and taxonomic species of *Avena*, representing the three ploidy levels, have been described in Spain (Baum 1977, Romero Zarco 1990, 1994, Leggett *et al.* 1992). Southern Spain seems to be an area particularly rich in wild oat species. The Spanish Center for Plant Genetic resources has a large collection of cultivated oats, but wild oats were poorly represented, or not represented at all. Therefore, it seemed obvious to form and preserve a representative collection of these materials. The collection of wild oats was started in the 80s as the initial step for the PhD work of P. García on the genetic structure of Spanish *Avena barbata* Pott ex Link. (slender wild oat) populations and their comparison to those described in Californian populations by Professor Allard and co-workers. This work was continued by L. Sáenz de Miera and others, and the collection of *A. barbata* and its diploid ancestor *A. hirtula* Lag. was increasing after successive collections throughout the Spanish mainland and Majorca Island. The collection of other wild species was recently carried out thanks to a project grant from the Spanish Germplasm Conservation and Collection Programme (INIA. RF94-027). An active collection is maintained at the Universidad de León, and a duplicate has been sent to the Spanish Germplasm Bank. Data in the tables refer to the collection conserved in this Germplasm Bank.

The principal characteristic of our collection is that samples were collected and preserved to maintain the genetic structure of the populations:

- except in some instances, a single panicle was sampled from approximately 100 randomly chosen individual plants from much larger populations;
- seeds from each panicle were stored separately. When multiplication was required one seed per each original plant was sown and next-generation seeds were again stored separately.

This sample size is enough to collect most of the genetic variability, and by keeping the seeds separate from different plants we are able to maintain the structure and effective size of the original sample. Due to their predominantly self-pollinating mating system, heterozygous individuals are infrequent in the *Avena* species populations; thus, in general the genotypes of seeds collected from a single plant are identical and coincide with the genotype of the mother plant.

Oat populations were collected in a total of 291 localities, and some localities were sampled in two or more years. In these cases, only half the seeds collected in the last year were sent to the Spanish Germplasm Bank. Diploid, tetraploid and hexaploid wild *Avena* species were gathered (Table 1, Fig. 1). Most of the samples have been taxonomically classified; but some were not and are described as *Avena* spp. Many of them are likely to be formed only by *A. barbata* individuals, but since *A. hirtula* and *A. barbata* grow in mixed populations in some localities and sometimes it is difficult to distinguish between the two species on the basis of morphological criteria when collecting, the definitive assignment to the species will be made after further analyses. Likewise, some of them from the southeastern part of Spain may include *A. prostrata* individuals.

Fig. 1. Distribution of *Avena* species. Numbers refer to the accession number of the collection conserved at the Universidad de León. The populations under the name of '*barbata* group' correspond to those indicated as *Avena* spp. in Table 1.

With the exception of *A. murphyi* Ladizinsky, tetraploid and hexaploid oat species are widely distributed throughout mainland Spain (Fig. 1). The status of *A. murphyi* is completely different; it is probably a threatened or endangered species in Spain at this moment. In a two-year field study we found a single population of this species in the province of Cádiz, and a few additional isolated plants. We do not know if this was caused by habitat destruction, by population bottleneck due to several consecutive years of drought in the early 90s, or to incomplete field work in this area. Much more thorough field work in this area of southern Spain will be needed to ascertain the current status of this species in the wild. The isozymes variation of this population and of the isolated plants was analyzed by electrophoresis. The population was completely monomorphic, although the isolated plants showed different isozymatic patterns. Either way, the genetic variability is very low, in particular taking into account that *A. barbata,* also a tetraploid, is very polymorphic in this area of Spain. This low genetic variability of *A. murphyi* represents an additional threat to the survival of this species in Spain.

A noticeable result was observed in relation to the hexaploid species. Populations of *A. fatua* L. were widely distributed only in the northern half of Spain (Fig. 1) and mainly as weeds in cultivated fields. In the other half only sporadic small groups of this plant species were observed. *Avena sterilis* L. is distributed throughout Spain, although two slightly different morphological types can be distinguished considering the northern and southern halves of Spain.

Table 1. Populations of the taxonomically different[1] *Avena* species collected in Spain

Species	2n	Number of populations
A. hirtula	14	12
A. longiglumis	14	4
A. barbata	28	89
A. murphyi	28	1
A. fatua	42	26
A. sterilis	42	112
Avena spp.		47

[1] According to Ladizinsky 1989.

The distribution of *A. longiglumis* Dur. seems to be limited to the sandy areas of western Andalusia: Huelva and probably Seville (Fig. 1). This species is an example of small populations in some of which it was not possible to collect 100 individuals plants. This species was also analyzed by electrophoresis and, in general, its isozyme patterns were relatively similar to those of *A. hirtula*. The population from El Rocio showed an unusual characteristic: the frequency of heterozygous individuals was surprisingly high in comparison to other *A. hirtula* populations and *Avena* species.

Our particular interest in *A. barbata* and *A. hirtula* has produced a much more extensive collection of these two related species. The genetic structure of approximately 100 populations of these two species have been analyzed to date by isozyme electrophoretic analyses. These two sibling species are widely distributed in Spain but *A. hirtula*, the diploid ancestor of *A. barbata*, shows a more limited area of distribution: it is limited to the southern half of mainland Spain. With the exception of population number 4, to date we have not found any population of *A. hirtula* north of the Madrid parallel. Population number 4 is most probably a recent colonization of a sandy lot located between an abandoned grain mill, a local grain elevator and the recently closed railroad yard and line connecting Extremadura, where *A. hirtula* is relatively abundant, to northern Spain. Some of the populations were formed by a mixture of individuals of these two species (Table 2).

Table 2. Regional distribution of the accessions

Andalusia	96	Extremadura	12
Aragón	17	Basque Country	0
Asturias	2	Galicia	5
Balearics	3	La Rioja	4
Canaries	0	Madrid	3
Cantabria	2	Murcia	9
Castile-LaMancha	20	Navarre	2
Castile-León	69	Valencia	20
Catalonia	27		

Studies of the ecogenetics of *A. barbata* in Spain have established that the species is differentiated into many ecotypes marked by multilocus combinations of 14 Mendelian loci coding for discretely recognizable morphological and allozyme variants and that these ecotypes are distributed in patterns that overlay environmental heterogeneity, especially heterogeneity for available moisture and temperature (García *et al.* 1989, Pérez de la Vega *et al.* 1991). Overall, the evidence is compelling that particular alleles of single loci, and more particularly specific multilocus genotypes, are under very strong selection (García *et al.* 1991) and that selection is capable of rapidly reorganizing the multilocus structure of local populations to meet stresses imposed by short-term environmental changes. Multivariate analyses have established that genepools are structured on a multilocus basis and that both rainfall and temperature have statistically significant effects on multilocus genetic structure in Spain (Pérez de la Vega *et al.* 1991), as in Californian populations. Analysis of the ecogeographical distribution of these multilocus genotypes in Spain has led us to conclude that, as in California, natural selection was also the predominant integrating force in shaping the specific genetic structure of different Spanish local populations (Allard *et al.* 1993). These conclusions can be extended to the cultivated hexaploid *A. sativa*, at least in Spain. Ecogeographical variables have statistically significant effects on the distribution of allozyme multilocus genotypes in Spanish landraces of hexaploid oats (Pérez de la Vega *et al.* 1994). The electrophoretic studies indicate that genetic variability in *A. barbata* is higher in the southern populations (Andalusia) (Allard *et al.* 1993), with an average number of multilocus genotypes per population of 13.2, than in the centre of northern populations (averages of 11.4 and 6.8 respectively).

So far no samples have been collected in some Spanish regions (Table 2). In Euskadi (the Basque Country) we have observed the presence of *A. barbata*, *A. fatua* and *A. sterilis*. We plan to collect wild oats in the Canary Islands soon, due to the particular importance of *Avena* species in these islands.

Although the species *A. clauda* Dur. is not described in Spain, in reviews on the distribution of *Avena* species (Baum 1997, Leggett 1992) there are some notes describing its presence in Málaga, Madrid and Toledo. This represents a relatively wide area of distribution. However, we have not found this species in our field works.

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Table 2. Passport and characterization data

PASSPORT

1. ACCESSION DATA
GENEBANK DESIGNATION
1.1 ACCESSION NUMBER
1.2 DONOR NAME
1.3 DONOR IDENTIFICATION NUMBER
1.4 OTHER NUMBERS ASSOCIATED WITH THE ACCESSION
NAME OF INSTITUTION 1
1.4.1 NUMBER ASSOCIATED 1
NAME OF INSTITUTION 2
1.4.2 NUMBER ASSOCIATED 2
NAME OF INSTITUTION 3
1.4.3 NUMBER ASSOCIATED 3
1.5 SCIENTIFIC NAME
1.5.1 GENUS
1.5.2 SPECIES
1.5.3 SUBSPECIES
1.6 CULTIVAR NAME

2. COLLECTION DATA
2.1 COLLECTOR'S NUMBER
2.2 COLLECTING INSTITUTE
2.3 DATE OF COLLECTION OF ORIGINAL SAMPLE
2.4 COUNTRY OF COLLECTION OR WHERE CULTIVAR/VARIETY BRED REGION
2.5 PROVINCE
2.6 LOCATION OF COLLECTION SITE
2.7 LATITUDE OF COLLECTION SITE
2.8 LONGITUDE OF COLLECTION SITE
2.9 ALTITUDE OF COLLECTION SITE
UTM LATITUDE
UTM LONGITUDE
2.10 STATUS OF SAMPLE
2.12 LOCAL/VERNACULAR NAME

MANAGEMENT

1.7 ACQUISITION DATE
1.8 DATE OF LAST REGENERATION OR MULTIPLICATION
1.9 ACCESSION SIZE
VIABILITY

CHARACTERIZATION

3. SITE DATA
3.1 COUNTRY OF CHARACTERIZATION
3.2 SITE (RESEARCH INSTITUTE)
3.3 NAME OF PERSON IN CHARGE OF CHARACTERIZATION
3.4 SOWING DATE
3.5 HARVEST DATE
3.6 CULTIVATION METHOD

4. PLANT DATA

4.1 VEGETATIVE

- 4.1.4 GROWTH HABIT
- 4.1.5 PLANT HEIGHT
- 4.1.6 STEM THICKNESS
- 4.1.7 NODES HAIRINESS
- 4.1.8 ANGLE OF FLAG LEAF TO CULM
- 4.1.11 RIGIDITY OF LEAVES
- 4.1.12 HAIRINESS OF LEAF SHEATH

4.2 INFLORESCENCE AND FRUIT

- 4.2.1 SHAPE OF PANICLE
- 4.2.2 ERECTNESS OF PANICLE
- 4.2.4 ERECTNESS OF SPIKELETS

4.3 SEED

- 4.3.1 LEMMA COLOUR
- 4.3.3 KERNEL COVERING
- 4.3.4 AWNEDNESS
- 4.3.5 AWN TYPE
- 4.3.8 HAIRINESS AT BASAL PART OF THE PRIMARY GRAIN
- 4.3.9 SEED LENGTH
- 4.3.10 SEED WIDTH
- 4.3.11 SEED LENGTH/SEED WIDTH

FURTHER CHARACTERIZATION AND EVALUATION

5. SITE DATA

5.1 COUNTRY OF CHARACTERIZATION

5.2 SITE (RESEARCH INSTITUTE)

5.3 NAME OF PERSON IN CHARGE OF CHARACTERIZATION

5.4 SOWING DATE

5.5 HARVEST DATE

5.6 CULTIVATION METHOD

6. PLANT DATA

6.1 VEGETATIVE

- 6.1.3 NUMBER OF TILLERS
- 6.1.5 LODGING AT IMMATURE STAGE

6.2 INFLORESCENCE AND FRUIT

- 6.2.1 DAYS TO HEADING
- 6.2.2 DAYS TO HARVEST
- 6.2.4 NUMBER OF SEEDS IN PANICLE
- 6.2.5 NUMBER OF GRAINS IN SPIKELET

6.3 SEED

- 6.3.2 1000 GRAIN WEIGHT

7. STRESS SUSCEPTIBILITY

7.1 LOW TEMPERATURE DAMAGE

8. PEST AND DISEASE SUSCEPTIBILITY

8.2 FUNGI

- 8.2.1 *Erysiphe graminis avenae*

The status of the UK collection

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The status of the wild collection held at IGER has remained basically unchanged except that some further accessions from the original collections in 1985 have been multiplied, either at IGER or at the Vavilov Institute or both. Some minor evaluation has been carried out as described elsewhere in this report. It is of concern that there are still accessions from the 1985 collection which have not been multiplied, and without the injection of financial assistance, I do not foresee any improvement on this situation. There is also the problem that most of the collection is not held in duplicate elsewhere.

I have received the following update from Mike Ambrose at the John Innes Institute regarding the *Avena* collection held at that Institute.

The oat database has been exported out of dBase VI and into Microsoft Access. Flat files of passport data are being prepared (in alphabetical order) to go on our Internet server under BBSRC cereals collections.

Data have not been passed to the EADB in recent years, and perhaps this could be noted as a point for future action.

The collection has been updated to receive registered accessions from the British Society of Plant Breeders collection.

The institute is currently in the process of working with the Nordic Gene Bank project and the Irish Seed Saver Association to repatriate stocks to collections in their country of origin.

Avena insularis, a new tetraploid species from Sicily

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A new tetraploid wild oat species has been discovered in the Gela area of Sicily (Ladizinsky 1998). Morphologically it is closer to the hexaploid wild oat *Avena sterilis* L. more than any other wild tetraploid oat. In the field it can be distinguished from *A. sterilis* by: (1) nearly unilateral panicle shape, because spikelets are individually connected to the panicle axis; (2) linear (3 × 1 mm) disarticulation scar at the bottom of the dispersal unit; and (3) maturity, about 10 days earlier than *A. sterilis.*

Four populations of *A. insularis* Ladizinsky have been detected in a restricted area between Gela and Butera on uncultivated heavy clay soil, but not elsewhere in Sicily (Fig. 1). Cultivation seems to be the major reason for the limited distribution of *A. insularis* in the Gela area. In undisturbed niches *A. insularis* forms nearly pure but not massive stands, often with a few *A. sterilis* individuals at the edges or within *A. insularis* clumps.

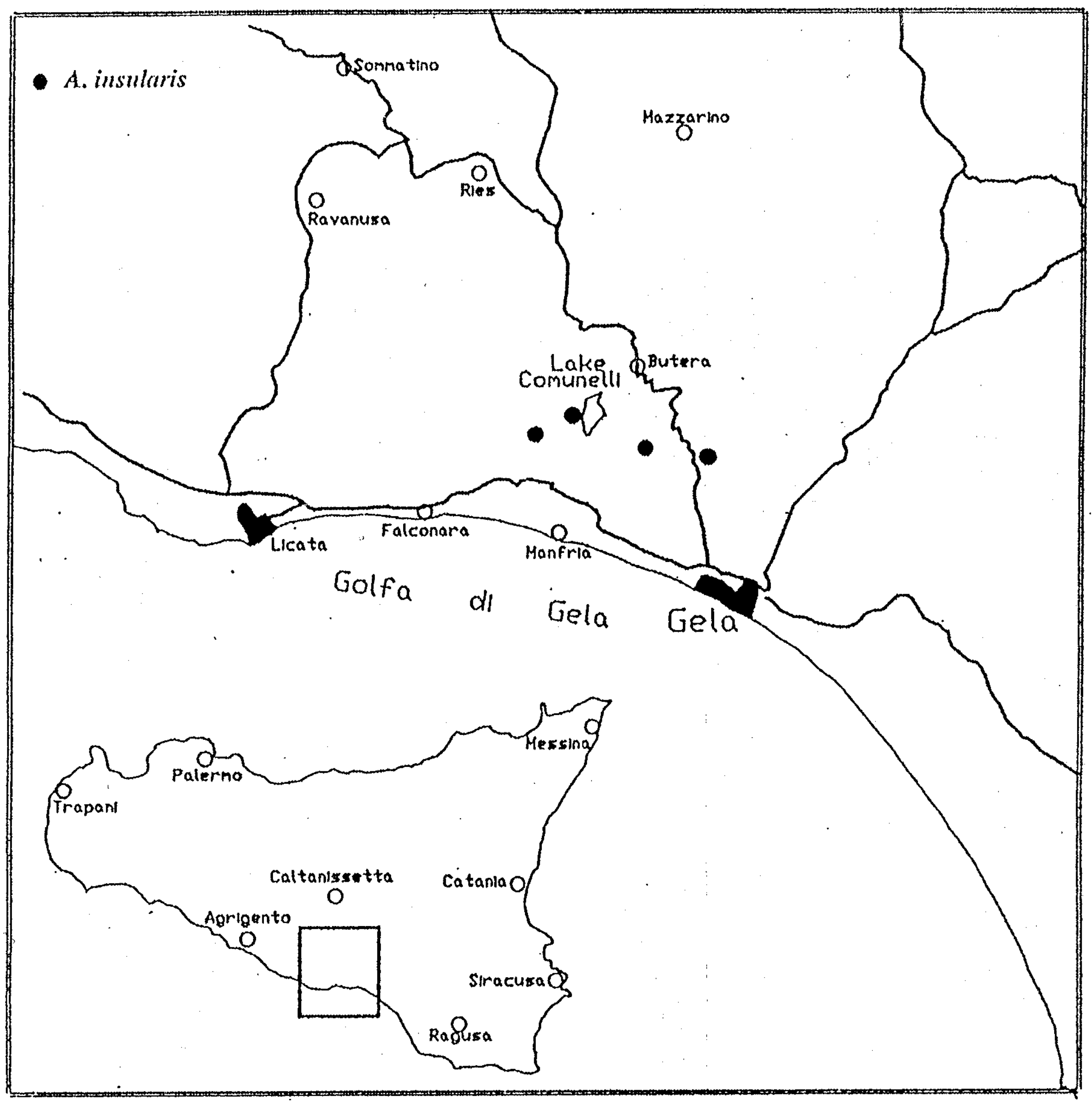

Fig. 1. Distribution of *A. insularis* in Sicily.

The chromosome number of *A. insularis* is 2n = 28. The karyotype is composed of two pairs of satellite chromosomes, four pairs of metacentrics, seven of sub-metacentrics and a single pair of sub-telocentric chromosomes. At meiosis, 14 bivalents are regularly formed.

Avena insularis was crossed with *A. sativa* L., as male parent. The hybrids developed normally and were partially fertile. Pollen stainability was about 30% and seed set up to 8%. Meiosis in these hybrids was characterized by a relatively small number of univalents (4.8–5.8), up to five multivalents, and a high number of chiasmata per cell. The number of chiasmata per cell in the hybrids was only 12% lower than the numbers observed in *A. insularis*. In a hybrid between an allohexaploid and its tetraploid progenitor the expected number of chiasmata per cell is similar to that of the tetraploid parent, and deviation from that number may result from chromosomal rearrangements which occurred after the formation of the hexaploid.

In the F_2 population chromosome numbers ranged from 2n = 28 to 2n = 34, and segregation for several morphological characters. Spikelet retention was segregating in a ratio of 3:1 (domesticated:wild).

Avena insularis was successfully crossed with the tetraploids *A. magna* Murphyi et Terr. and *A. murphyi* Ladizinsky. The hybrids developed normally but were totally sterile. Cytogenetically, *A. insularis* differs from *A. magna* by four chromosomal rearrangements, and from *A. murphyi* by three. Of the diploid oats, *A. insularis* was hybridized with *A. strigosa* Schreb., var. ‘Saia’. The hybrids developed normally and at meiosis most of the chromosomes (13.42 on average) were left as univalents, and the mean number of chiasmata per cell was only 4.36.

The tight morphological similarity between *A. insularis* and *A. sterilis*, the close cytogenetic affinity of the former with the hexaploid oats and the partial fertility of their hybrids, indicate that *A. insularis* is apparently the missing tetraploid progenitor of the hexaploid oats.

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Research activities and other ongoing activities

Research on wild and cultivated oats in Spain

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In Spain, oats are a minor cereal crop compared with other cereals such as wheat, barley and maize. That means that the interest and effort in breeding new varieties of oats over the last few decades has been, and still is, scarce or null. The main breeding effort has been carried out by Dr Martín-Lobo at the Instituto Madrileño de Investigación Agaria at El Encin; other researches are mainly basic genetic and evolutionary researches.

At the Universidad de León, and within a greater project to evaluate and characterize winter cereals supported by the Spanish I.N.I.A. (project 7689 led by Dr Soler), the nine-locus isozyme genotypes of 267 landrace accessions of *A. sativa* L. from 31 provinces representing all climatic areas within mainland Spain were determined. The results established that the level of genetic variability is usually high both within and among accessions (Gómez *et al.* 1991) of this heavily self-fertilizing hexaploid species and that multilocus genetic structure differs in various ecogeographical regions of Spain. The frequencies of different multilocus associations varied widely in different ecogeographical regions and correlated with environmental conditions, i.e., while a particular multilocus association was present at the highest frequency in the warmer climates of southern Spain, a complementary association was most frequent in the colder areas. On the other hand, the distribution pattern of multilocus associations did not fit into possible historical or commercial patterns. Multivariate analysis proved a very strong association in particular between four isozyme loci and the mean temperature of the area in which accessions were collected. The results of this study support the notion that information concerning the adaptive properties of specific alleles, specific within-locus (intralocus) associations (possible in an hexaploid species among homoelogous loci) and specific interlocus (epistatic) multilocus allelic combinations could be useful in developing strategies for selecting, evaluating, managing and utilizing genetic resources variability (Pérez de la Vega *et al.* 1994).

Other data obtained from these accessions were the patterns of endosperm storage proteins (by the group of Dr Carrillo at the Universidad Politécnica de Madrid) and morphological and agronomic characteristics listed in Table 2 in “The Spanish oat collection”, this volume.

As far as we know, there are three research projects on oats in Spain, two centred on basic research and one on breeding.

The group led by Dr Fominaya at the Universidad de Alcalá de Henares is obtaining, from wild species, DNA probes to identify chromosomes belonging to different oat genomes and also specific probes to distinguish individual chromosomes within them. The use of these markers would allow us to understand the evolutionary origin of the genomes of cultivated forms. The comparison of the distribution of repetitive DNA sequences, either specific to a genome or shared by different genomes, in diploid and polyploid species provides a more comprehensive image of the genome relationships. This study includes the use of two types of repetitive DNA sequences: (i) those found in a single genome, and (ii) sequences of DNA highly conserved in plants (e.g. ribosomal sequences). Of the probes obtained two are particularly relevant: Am1 and pAs120 and the related pAs120a. Am1 was isolated from *A. murphyi* Ladiz. (AACC); this sequence was present in species with the C genome and absent in diploid and tetraploid species without it; this sequence was a satellite DNA specific to the C-genome heterochromatin. Other conclusions obtained were: the D genome is not related to the C genome of diploid species; and there are A/D-C intergenomic translocations in polyploid oats. pAs102 was obtained from *A. strigosa* Schreb. (As genome) and *in situ* hybrization showed that complementary sequences to pAs102 were dispersed throughout the genomes of diploid (A and C genomes), tetraploid (AC genomes) and hexaploid (ACD genomes) *Avena* species. On the other hand, sequences homologous to pAs102a were found in *A. strigosa*, *A. longiglumis* Dur. and *A. sativa*, but the probe sequence was not very amplified in the tetraploid *A. murphyi* and it was absent in the remaining A- and C-genome diploid species (Fominaya *et al.* 1995; Linares *et al.* 1996; Linares *et al.* 1998).

At the Universidad de León the analysis of the genetic structure of population of *A. barbata* Pott ex Link and related species continues, thanks to financial aid from the Spanish Agency for International Cooperation (AECI). We are currently comparing the structure of ancestral Spanish populations and the structure of colonial populations in Argentina in collaboration with the Universidad de Mar del Plata.

At the Instituto Madrileño de Investigación Agraria, Dr Martín Lobo is breeding *A. sativa* for disease resistance and other agronomic traits. In particular they are analyzing the virulence races of *Puccinia graminis* and *P. coronata*, and breeding to introduce resistance to these races and to *Erysiphe graminis*. Other characteristics evaluated in these breeding lines are: yield, protein content, fibre content, and resistance to the relatively arid conditions of Spanish Meseta. The acquisition of new crosses was stopped in 1993 and currently many advanced breeding lines (one to four backcrosses and then 6 to 12 selfings) are maintained and are being evaluated. Five cultivars have been registered as *A. sativa* L., 'Cobeña', 'Canencia', 'Acebeda', 'Patones', 'Araceli', and one of *A. sativa* L. f. sp. *nuda*, 'Achuela'.

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Desirable agronomic traits identified in wild oat accessions

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Preliminary screening for resistance to mildew (*Erysiphe graminis* f. sp. A*vena*) amongst wild hexaploid germplasm lines of *A. fatua* L. and *A. sterilis* L. (a total of 230 unique accessions) collected in the Canary Islands has been completed. The seedlings were challenged with a race 5 isolate of the pathogen.

In all, 28 resistors/partial resistors to the disease were identified. As with other resistant/ partially resistant lines of these wild hexaploid species, the infection type is indistinct, frequently changing with the growth stage of the plant. For this reason, the selected lines require re-testing to confirm the resistance.

One accession, Cs6/67 of the wild tetraploid *A. barbata* Pott ex Link appears to be immune. This source of resistance will be compared to another accession of *A. barbata* (Cc4897) originally collected in Algeria, the resistance of which has already been incorporated into the cultivated hexaploid oat.

Hybrids between the wild diploids *A. atlantica* Baum et Fedak and *A. strigosa* Schreb. also appeared to contain a degree of resistance to mildew and similarly require re-testing to confirm the resistance.

A number of accessions of wild oats have been screened for protein, oil and β-glucan content (Welch, R.W., Brown, J.C. and Leggett, J. M., *in preparation*). As expected, considerable variation for these traits was observed. Some accessions contained higher levels of these components than cultivated forms. A programme to introgress high β-glucan into the cultivated oat has been initiated at IGER.

Appendix I. *Avena* Passport Descriptors

Based on the FAO / IPGRI Multicrop Passport Descriptors:

***Avena* PASSPORT DESCRIPTORS**
1. Institute code (INSTCODE) Code of the institute where the accession is maintained. The codes consist of the 3-letter ISO 3166 country code of the country where the institute is located plus a number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a 3-letter ISO 3166 country code and an acronym.
2. Accession number (ACCENUMB) This number serves as a unique identifier for accessions and is assigned when an accession is entered into the collection. Once assigned, this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number should never be reused. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system).
3. Collecting number (COLLNUMB) Original number assigned by the collector(s) of the sample, normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates held in different collections. It should be unique and always accompany subsamples wherever they are sent.
4. Genus (GENUS) Genus name for taxon. Initial uppercase letter required.
5. Species (SPECIES) Specific epithet portion of the scientific name in lowercase letters plus authority[1]. Following abbreviation is allowed: ‘sp’.
6. Subtaxa (SUBTAXA) Subtaxa can be used to store any additional taxonomic identifier plus authority.[1] Following abbreviations are allowed: ‘ssp.’ (for subspecies); ‘var.’ (for variety); ‘convar.’ (for convariety); ‘f.’ (for form).
7. Accession name (ACCNAME) Either a registered or other formal designation given to the accession. First letter uppercase. Multiple names separated with semicolon.
8. Country of origin (ORIGCTY) Name of the country in which the sample was originally collected or derived. Use the ISO 3166 extended codes, (i.e. current and old three letter ISO 3166 country codes).
9. Location of collecting site (COLLSITE) Location information below the country level that describes where the accession was collected starting with the most detailed information. Might include the distance in kilometres and direction from the nearest town, village or map grid reference point, (e.g. CURITIBA 7S, PARANA means 7 km south of Curitiba in the state of Parana).
10. Latitude of collecting site (LATITUDE) Degrees and minutes followed by N (North) or S (South) (e.g. 1030S). Missing data (minutes) should be indicated with hyphen (e.g. 10—S).
11. Longitude of collecting site (LONGITUDE) Degrees and minutes followed by E (East) or W (West) (e.g. 07625W). Missing data (minutes) should be indicated with hyphen (e.g. 076—W).
12. Elevation of collecting site [m asl] (ELEVATION) Elevation of collecting site expressed in meters above sea level. Negative values allowed.

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

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

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

14. Status of sample (SAMPSTAT)

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

15. Collecting source (COLLSRC)

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

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

16. Donor institute code (DONORCODE)

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

17. Donor number (DONORNUMB)

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

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

Any other identification number known to exist in other collections for this accession. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession that comes from the genebank at Bari, Italy; CGN indicates an accession from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system). Multiple numbers can be added and should be separated with a semicolon.

19. Remarks (REMARKS)

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

FAO WIEWS DESCRIPTORS

1. Location of safety duplicates (DUPLSITE)

Code of the institute where a safety duplicate of the accession is maintained. The codes consist of 3-letter ISO 3166 country code of the country where the institute is located plus number or an acronym as specified in the Institute database that will be made available by FAO. Preliminary codes (i.e. codes not yet incorporated in the FAO Institute database) start with an asterisk followed by a three-letter ISO 3166 country code and an acronym. Multiple numbers can be added and should be separated with a semicolon.

2. Availability of passport data (PASSAVAIL)

(i.e. in addition to what has been provided)

0 Not available
1 Available

3. Availability of characterization data (CHARAVAIL)

0 Not available
1 Available

4. Availability of evaluation data (EVALAVAIL)

0 Not available
1 Available

5. Acquisition type of the accession (ACQTYPE)

1 Collected / bred originally by the institute
2 Collected / bred originally by joint mission / institution
3 Received as a secondary repository

6. Type of storage (STORTYPE)

Maintenance type of germplasm. If germplasm is maintained under different types of storage, multiple choices are allowed, separated by a semicolon (e.g. 2;3). (Refer to FAO / IPGRI Genebank Standards 1994 for details on storage type).

1 Short-term
2 Medium-term
3 Long-term
4 *In vitro* collection
5 Field genebank collection
6 Cryopreserved
99 Other (elaborate in REMARKS field)

Appendix II. Abbreviations and Acronyms

ASSINSEL	Association internationale des sélectionneurs, Switzerland
BAZ	Bundesanstalt für Züchtungsforchung an Kulturpflanzen (Federal Centre for Breeding Research on Cultivated Plants), Germany
BBSRC	Biotechnology and Biological Sciences Research Council, UK
BGRC	Braunschweig Genetic Resources Collection
BYDV	Barley yellow dwarf luteovirus
CCDB	Central Crop Database
CGIAR	Consultative Group on International Agricultural Research
CGN	Centre for Genetic Resources, Wageningen, the Netherlands
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
EU	European Union
FAL	Federal Agricultural Research Centre Braunschweig-Völkenrode, Germany
FAO	Food and Agriculture Organization of the United Nations
GEVES	Groupe d'étude et de contrôle des variétés et des semences, France
IGER	Institute for Grassland and Environmental Research, Aberystwyth, UK
INIA	Instituto Nacional de Investigaciones Agrarias, Badajoz, Spain
INRA	Institut National de la Recherche Agronomique, France
INRA	Institut National de la Recherche Agronomique, Morocco
IPK	Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany
NGB	Nordic Gene Bank, Alnarp, Sweden
NSGC	National Small Grains Collection, USA
PGR	Plant genetic resources
VIR	N.I. Vavilov Research Institute of Plant Industry, Russia
ZADI/IGR	Zentralsstelle für Agrardokumentation und –information/ Informationszenttrum für Genetische Ressourcen, Bonn, Germany (Centre for Agricultural Documentation and Information/Information Centre for Genetic Resources)

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