EUROPEAN COOPERATIVE PROGRAMME FOR THE CONSERVATION AND EXCHANGE OF CROP GENETIC RESOURCES

IBPGR

REPORT OF A WORKING GROUP ON *AVENA*

(third meeting) held at the Plant Breeding and Acclimatization Institute Radzikow, Poland 7-9 March 1989

INTERNATIONAL BOARD FOR PLANT GENETIC RESOURCES

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EUROPEAN COOPERATIVE PROGRAMME
FOR THE CONSERVATION AND EXCHANGE OF CROP GENETIC RESOURCES
(ECP/GR)

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ECP/GR/IBPGR
Rome, 1989

The International Board for Plant Genetic Resources (IBPGR) is an autonomous international scientific organization under the aegis of the Consultative Group on International Agricultural Research (CGIAR). IBPGR was established by CGIAR in 1974. The basic function of IBPGR is to promote and coordinate an international network of genetic resources centres to further the collection, conservation, documentation, evaluation and use of plant germplasm and thereby contribute to raising the standard of living and welfare of people throughout the world. Financial support for the core programme is provided by the governments of Australia, Austria, Belgium, Canada, China, Denmark, France, FRG, India, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the UK and the USA as well as the United Nations Environment Programme and the World Bank

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INTRODUCTION

The third meeting of the ECP/GR Avena Working Group was convened at the Plant Breeding and Acclimatization Institute (IHAR), Radzikow, 7-9 March 1989, at the kind invitation of its Director, Prof. Czembor. Dr Aniol, Vice-Director of IHAR, welcomed the participants. Dr Funke, von Lochow Petkus, FRG and Dr J. Krolikowski, leader of the Polish Avena programme in the Wielopole Plant Breeding Station, were unable to attend and sent their apologies. Dr Seidewitz was also invited but was unable to attend and Dr Ch. Otto represented the European Avena Data Base (EADB).

The list of participants is provided in Appendix I. The meeting unanimously elected Dr G. Ladizinsky as Chairman and the Agenda, as approved, is provided in Appendix II.

REPORT

REVIEW OF ACTIVITIES SINCE SECOND MEETING

European Avena Data Base

1. Dr Otto introduced a paper compiled by Dr Seidewitz on the current status of the European Data Base of the ECP/GR on Avena, Institut für Pflanzenbau und Pflanzenzüchtung der FAL (BGRC), Braunschweig, FRG (Appendix III). He mentioned that the database now contained passport data on 17 000 accessions from 21 contributing countries, including USA and Canada. One of the main constraints faced by the EADB was the inability of some data managers to follow the format for exchange of information established in 1984 by an ECP/GR Workshop. The Israel Genebank has been computerizing data on its Avena collection and this will be sent to the EADB.

2. Comments were made on the problems of the taxonomy of the genus in relation to the database. The meeting was reminded that the biological species concept is a prerequisite for full understanding of species relationships and is most useful for presenting the diversity to users. The previous meetings of the Working Group had agreed that the EADB should structure its files on the basis of biological species. However, the Group was also reminded that any taxonomic information sent by curators should be kept by the EADB, as it may include some hidden information. Dr G. Ladizinsky gave a paper entitled "Biological species and wild genetic resources in Avena" which was highly appreciated by members of the Group (Appendix IV). A lengthy discussion followed on different taxonomic treatment as well as on the introduction of a hierarchical system of different taxa within the database files. It was agreed that each national programme would be responsible for following current practice in its own country and that taxonomic species not fitting with biological species should be recorded as subspecies. Finally all members agreed that priority should be given to the concept of biological species; this would in no case impede any users from requesting information based on traditional taxonomy. In view of the constraints faced by the documentation officer of the EADB regarding taxonomic information, the meeting recommended that Dr Ladizinsky act as an advisor to the database.

3. Following the recommendation of the second meeting, lists of potential duplicates identified by name and number and ordered by originating countries were sent to all interested parties. It was noted that unfortunately not all receivers had checked these lists and returned their comments. However the identification of duplicates is progressing well and it appears that about 48% (6585 accessions) of the named accessions are duplicates.

Progress with evaluation and characterization

4. IHAR had sent a comprehensive set of characterization and evaluation data on 1000 accessions to the EADB. The Institute of Plant Science Research (IPSR), UK had also sent data for two evaluation descriptors, whereas the BGRC had provided the EADB with recommended characterization and evaluation data for 1323 accessions.

   Other institutes had not yet been able to send characterization and evaluation data. However members were informed that INRA France has numerous records in manual files of characterization and evaluation data which will be sent in computerized form to the EADB before the end of 1989. Similarly data from the Nordic Gene Bank (NGB) should be sent very soon. Data on 45 descriptors for 900 accessions are available in the Research Institute for Agrobotany (RCA), Hungary and these will be sent as soon as specific software and hardware constraints in RCA are solved. At the Cereal Research and Breeding Institute, Czechoslovakia, many data have been accumulated in manual files over the last 15 years and these will be gradually computerized and sent to the EADB.

5. A systematic programme for evaluation of Avena had been initiated by the Landwirtschaftlich-chemische Bundesanstalt, Linz, Austria, in 1987. Similarly INIA, Spain had started a four-year evaluation project for Avena genetic resources in 1988. At IHAR 64 Polish old varieties were currently under evaluation and, in continuation of this project, landraces would be evaluated in 1990. Only Belgium, the GDR and the Netherlands had informed the ECP/GR Secretariat that they were unable to undertake evaluation of their original material in the near future due to diverse constraints.

Progress in collecting

6. In 1988, following the recommendation of the second meeting, IBPGR had initiated a three-year collecting programme in Morocco. Sixty-four populations representing ten of the 12 possible biological species had already been collected. WPBS, UK is giving this programme technical assistance. Also, 24 populations of A. macrostachya had been sampled in northern Algeria in 1988 by an IBPGR collector. Vegetative material collected on this mission was being grown at a site in Algeria with the eventual aim of producing quantities of viable seeds. Seeds from the original collection, where sufficient, would be distributed to WPBS, IHAR and the IBPGR base collections.

In the southern and southeastern regions of Poland, IHAR had collected around 40 accessions of landraces and old varieties of A. sativa, A. strigosa and samples of A. fatua. Furthermore IHAR had received 50 accessions from Mongolia of which 25 were landraces of A. nuda. Spain had collected populations of A. barbata and other species in 1987 in the southern part of the country.

Dr Soldatov summarized the position on resources collecting in USSR. Five Avena collections had been made, principally from the Caucasus region and 234 wild accessions originating from USSR were at present available.

Multiplication and preliminary evaluation of the wild collected material

7. Dr H. Thomas reported on progress with multiplication and characterization of the 105 populations collected in 1985 in southern Spain, the Canary Islands and Morocco. At present, 35 populations have been multiplied and are available for distribution. More comprehensive information on the latest achievements is provided in Appendix V.

Current extent of safety duplication in base collections

8. The meeting was reminded that NGB was acting as a global Avena base collection together with the Central Office for Plant Genetic Resources of Canada (PGR), Ottawa, Canada. According to the information provided by Dr Gullord the number of safety duplicates held in NGB was considered to be rather low.

Review of progress on other recommendations of the second meeting

9. The second meeting had recommended that a training course on characterization and evaluation on Avena be organized. Consequently this was held in Institut für Pflanzenbau und Pflanzenzüchtung, FAL, FRG, in July 1987. Thirteen participants from Europe and north Africa attended and Drs G. Ladizinsky and H. Thomas were guest lecturers. The training course was considered a success. As recommended in the report of the second meeting, FAL is maintaining contacts with Canada and USDA.

WORKPLAN

Commitments from national genebanks for maintenance of their original material

10. The members who had not yet checked the list of potential duplicates originating from their countries agreed to do it as soon as possible in order that the EADB may publish a final list of original accessions to be maintained by each collection. Additionally a new list of duplicates would be distributed for checking (USA and Canada). Thereafter it was agreed that each curator would take the responsibility of treating his original material as an active collection. In accordance with the accepted definitions of active collections they should:

(i) provide duplicate samples to the designated base collections,
(ii) regenerate and multiply the material,
(iii) distribute material on request, and
(iv) document data as listed in Appendix VI.

11. It was recommended that unique material held in active collections be repatriated to the collections of the country of origin. Dr Soldatov expressed the willingness of VIR to participate fully in the European Avena network, starting by sending available passport data in printed or computerized form to the EADB. This offer of participation was highly appreciated by the Working Group.

Minimum characterization and evaluation

12. The meeting, reviewing the progress in the registration of characterization and evaluation data by the EADB, emphasized that the number of accessions for which such data had been received was low (no more than 20% of unique accessions). However, the information provided on current evaluation activities in different countries as well as that on the completion of computerization of available data (see para. 4) was encouraging and showed that the EADB would soon be in a position to start offering a service to end users.

13. The Working Group recommended that evaluation activities in each country and the subsequent sending of data to the EADB be accelerated. Members restated that the list of 12 minimum recommended evaluation descriptors was considered to be the most realistic and useful (see Appendix VI). These 12 descriptors only applied to unique accessions. It was stressed that even incomplete data should be sent.

14. For meaningful comparison between data the meeting agreed that for descriptor 4.1.5, Plant Height, the value should be given in absolute numbers (cm) and not on a 1 to 9 scale. Some members informed the Group that they were at present unable to provide detailed analyses of protein and oil content owing to a lack of adequate equipment. Braunschweig offered help and support in analyzing up to 250 accessions per year, if publication of these data is possible.

15. The meeting emphasized that the use of reference varieties in each trial was advisable in order to provide meaningful comparison for both morphological and agronomical characters. A lengthy discussion followed on the possibilities of using a common reference variety within the same ecoclimatic region. For example, the possibility of using three common reference varieties for Germany, Czechoslovakia and Poland was suggested. Finally, it was agreed that each curator must include in each trial a reference variety of his own choice.

EADB services to end users

16. The Working Group stressed again that all the contents of the database were freely available to any end user. It was agreed that the distribution of a printed catalogue was beyond the financial means of the Group and did not facilitate the easy retrieval of information; it was therefore recommended that this catalogue be produced in computerized form. A reminder was given that centres unable to read diskettes provided by the EADB could benefit from the services of the file transfer centres (IHAR, NGB and IBPGR), which will transform the diskettes into readable form. It was also emphasized that the EADB would be prepared to meet any specific requests for searches of the database.

17. In view of the progress achieved, the Working Group recommended that the EADB publish summary tables including tables of the available agronomic and morphological variation before the end of 1989 in order to promote the potential of the database.

Enhancement of safety duplication

18. Members agreed that each original accession should be duplicated and monitored in long-term storage for safety. Considering that follow-up of safety duplication could only be efficiently managed through the services of the EADB, the Group recommended that the Institut für Pflanzenbau und Pflanzenzuchtung, FAL, FRG, act as Avena global base collection. IBPGR was requested to contact this institute for its official agreement. A sample of seeds produced from each regeneration should, as a matter of course, be sent to BGRC for long-term safety. Discussion centred around the size of the required sample for safety duplication and the meeting agreed in the absence of data to accept the IBPGR general recommendations[1/].

Members requested the future Avena global base collection to clarify the preferred procedures for sending samples.

1/ The size of each accession in base collections should, if possible, not be less than about 4000 seeds for genetically uniform material and 12 000 seeds for heterogeneous material.

19. There was then an exchange of technical information on the methodologies used for the respective regeneration systems. The number of plants used for regeneration should be large enough to avoid genetic erosion, but in the absence of sufficient data, this was left to the assessment of each curator.

Further characterization, evaluation and exploration of variation within wild species

20. Reviewing progress of characterization and evaluation of wild material collected since 1985 it was apparent that progress was hampered by the fact that procedures were labour intensive. After prolonged discussions of this 'bottleneck' it was recommended that a 'germplasm enhancement network' be established. It was envisaged that this would initially involve the collaboration of four laboratories, i.e. Hebrew University, Israel, WPBS, UK, Svalof, Sweden, and IHAR, Poland, with the option for any other interested laboratories to participate. Pooling the expertise of these various laboratories should speed up the process of producing improved germplasm that contains attributes from wild species of Avena, and hence make this untapped source of variation available for oat improvement for both human consumption and forage purposes. This would also provide an opportunity to assess the potential of this diversity under different ecological conditions. Although some of this work is already on-going in some of the institutes, any expansion of new programmes will require financial support from international agencies. The four centres mentioned above agreed to produce a draft project for collaborative enhancement of the wild germplasm, which will be submitted to the TCC of the ECP/GR.

Further collecting

21. The IBPGR germplasm acquisition officer informed the meeting that it was planned to collect A. damascena in Syria by the end of 1990. Further, a three-year collecting programme in Morocco had been approved (see para. 6) and two further missions were to be completed. When the situation regarding the 1988 collection of A. macrostachya in Algeria is clarified, there may be a need for further collecting of this species owing to the scarcity of collected material.

The meeting was informed that populations of A. murphyi were possibly located in western Sicily and may require collecting in the future. The meeting further suggested that some attention be paid to western China, where A. nuda was an important cultivated species. IBPGR agreed to investigate the possibility of collecting in this region. Members considered that the participation of an oat worker would be desirable in any future collecting mission. INIA, Spain, plans to collect landraces on both sides of the Pyrenees, with the possible collaboration of France, in 1990.

22. The meeting agreed that the production of a field guide for the genus Avena would be a most valuable tool to aid in the collection and evaluation of the taxa. It recommended that IBPGR include this genus in its planned field guide production programme.

Collaboration of the European network with other regions of the world

23. The Working Group confirmed its willingness to cooperate fully with USA, Canada and the developed countries of the Southern Hemisphere. It also stressed the need to collaborate with China and asked IBPGR to use its staff to investigate the possibilities. Similarly the meeting felt that insufficient information was available on the oat improvement programme in Latin America and requested IBPGR to identify potential collaboration.

Recommendations on coordination of the European Avena network after the end of Phase III

24. There was general consensus that the activities of the network would terminate if future meetings were not arranged and, depending upon progress, it was suggested that one be held within two/three years. Considering that only a small proportion of the workplan had been implemented, the provision of a coordinator for the next three years was an absolute necessity. Members thought that the BGRC, as EADB, would be ideal for such coordination. Realizing that this coordination needs effort and time, the Working Group recommended that FAL send an estimate of additional input in staff and money required for the next three years to the ECP/GR Secretariat. Such requirements for proper coordination will be formally submitted by the ECP/GR Secretariat to the Government of FRG at the occasion of the TCC.

The needs and methodology for the coordination of the network for enhancement of wild germplasm were left pending until a firm proposal is forthcoming.

Members highly appreciated the excellent organization and the hospitality extended to them by all members of IHAR, in particular the conference organizer, Mr W. Podyma.

APPENDIX I

LIST OF PARTICIPANTS

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APPENDIX II

AGENDA

1. Opening Addresses
2. Election of Chairman
3. Adoption of Agenda
4. Review of activities since second meeting
   - 4.1 European Avena Data Base (EADB)
     - 4.1.1 Presentation of the EADB (Dr L. Seidewitz)
     - 4.1.2 Discussion on current strategies for inventory/updating of passport data
     - 4.1.3 Review of progress for identification of duplicates
   - 4.2 Progress with characterization and evaluation of the material
   - 4.3 Review of progress in collecting in relation to the recommendations of the second meeting
   - 4.4 Reports on progress with multiplication and preliminary evaluation of wild collected germplasm
   - 4.5 Current extent of safety duplication in base collections
   - 4.6 Review of progress on other recommendations of the second meeting
5. Formulation of a workplan
   - 5.1 Minimum characterization and evaluation as recommended by the Working Group (second meeting)
   - 5.2 Services of the European Avena Data Base to breeders/researchers
   - 5.3 Enhancement of safety duplication
   - 5.4 Commitments from national genebanks for maintenance of their original material (rationalization of collections)
   - 5.5 Enhancement of wild Avena spp.: implementation of a collaborative project
   - 5.6 Recommendations for further collecting
   - 5.7 Collaboration of the European network with other regions of the world
6. Recommendations on coordination of the European Avena network after end of Phase III (see introduction paper)
7. Other matters
8. Writing of report
9. Consideration of report and approval by Working Group

APPENDIX III

CURRENT STATUS OF THE EUROPEAN CATALOGUE OF THE ECP/GR ON AVENA

Dr L. Seidewitz, FAL, FRG

The present European Catalogue on Avena is being compiled from information from 21 informants. The catalogue was edited for the second time in February 1988. Then, the information came from 14 informants and concerned 9506 accessions. Now there is information from 21 contributors on 16 874 accessions, as summarized in Table 1. On behalf of the European Cooperative Programme for the Conservation and Exchange of Crop Genetic Resources (ECP/GR) a database has been established at the Institute of Crop Science and Plant Breeding, FAL, Braunschweig. Database work has started with so-called passport data. There is a strong wish to continue with the incorporation of evaluation data. Such evaluation data have been made available from Poland (IHAR), UK (IPSR, Cambridge; WPBS, Aberystwyth) and FRG. Very recently, evaluation data have been promised by the Nordic Gene Bank.

The scope of what was originally a strictly European Catalogue has been widened by taking up data from Canada and the USA. This has been done in the knowledge that many accessions of European origin are held in the USA and Canada.

A third edition of this catalogue will not be distributed unless evaluation data have been made available from all contributors. Computerized listings will, of course, be made available upon special request. There is another reason why a third edition is not yet being prepared: taxonomic terminology requires clearing.

TABLE 1. **Number of accessions reported**

Genebank	No. of accessions	Named accessions	Unnamed accessions
AUTBAUWIEN	74	74	0
AUTBVAL	170	82	88
BELCRAGXAP	624	468	156
BGRIIPR	356	337	19
CANPGRC	514	482	32
CSKKROME	1438	1416	22
DDRGAT	1073	736	337
DEUBGRC	1804	1569	337
ESPINIA	1030	99	931
FRAINRA	824	813	11
GBRPBI	2422	2372	50
GBRWPBS	231	161	70
GRCGGB	22	5	17
HUNRCA	1024	957	67
NLDCGN	542	361	181
POLIHAR	1530	1388	142
PRTENMP	41	41	0
SWENGB	777	637	140
TURARARI	530	0	530
USAUSDA	1682	1490	192
YUISG	166	165	1
Total	16,874	13,653	3221

The proportions of spring and winter types can be seen from Table 2:

TABLE 2. **Proportion of spring and winter forms of Avena**

Seasonality	Total	Named accessions	Unnamed accessions
Spring	9159	7574	1585
Winter	1709	1388	321
Alternate	12	1	11
Not specified	5994	4690	1304
Total	16,874	13,653	3221

The identification of duplicates is the most important objective of this catalogue. The easiest way of doing this is by comparing names in alphabetical sequence (identical names are duplicates). For this purpose, accessions to which a name or other identification has been applied have been separated from those to which no such identifying name or sequence of figures has been applied. The results of this analysis are presented in Table 3. Out of the named accessions 4963 are unique, according to the name or number under which they have been registered. Of the remaining named accessions 8262 are duplicated. The rest, 492 accessions, have been excluded owing to the kind of name assigned to them.

TABLE 3. **Distribution of frequencies in duplicated named accessions**

Size of group	Times found	Total no. of accessions
1	4963	(not duplicated)
2	911	1822
3	375	1125
4	236	984
5	170	850
6	131	786
7	76	532
8	70	560
9	39	351
10	34	340
11	24	264
12	16	192
13	9	117
14	9	126
17	5	85

In Table 4 a distinction has been made between spring and winter forms in each collection about which information is available.

TABLE 4. Seasonal types of Avena accessions as reported by genebank

Genebank	Not specified	Spring forms	Winter forms	Alternate forms
AUTBAUWIEN	74			
AUTBVAL		170		
BELCRAGXAP		624		
BGRIIPR	138	210	8	
CANPGRC	514			
CSKKROME	47	1358	33	
DDRGAT		1027	46	
DEUBGRC	197	1107	488	12
ESPINIA	1030			
FRAINRA	823	1		
GBRPBI	1	2128	293	
GBRWPBS		204	27	
GRCGGB		22		
HUNRCA		1024		
NLDCGN	2	518	22	
POLIHAR	1530			
PRTENMP	41			
SWENGB	695	80	2	
TURARARI		530		
USAUSDA	902		780	
YUISG		156	10	

In Table 5 the sample status of Avena accessions is given.

Table 5. Number of accessions and their status as reported by genebank

Genebank	Not spec.	Cvs	Landraces	Lines	Wild	Pop.	Other	Total
AUTBAUWIEN	42	32	-	-	-	-	-	74
AUTBVAL	6	80	67	17	-	-	-	170
BELCRAGXAP	458	94	4	56	-	-	12	624
BGRIIPR	152	200	1	3	-	-	-	356
CANPGRC	378	2	2	130	-	1	1	514
CSKKROME	662	136	23	617	-	-	-	1438
DDRGAT	999	68	5	1	-	-	-	1073
DEUBGRC	117	909	5	230	438	-	105	1804
ESPINIA	1	1008	-	21	-	-	-	1030
FRAINRA	760	62	2	-	-	-	-	824
GBRPBI	9	1284	420	487	213	9	-	2422
GBRWPBS	163	24	1	3	40	-	-	231
GRCGGB	16	-	6	-	-	-	-	22
HUNRCA	957	53	14	-	-	-	-	1024
NLDCGN	13	316	70	122	21	-	-	542
POLIHAR	599	721	104	70	18	-	18	1530
PRTENMP	1	40	-	-	-	-	-	41
SWENGB	115	596	16	34	16	-	-	777
TURARARI	530	-	-	-	-	-	-	530
USAUSDA	1627	54	-	1	-	-	-	1682
YUISG	59	60	10	37	-	-	-	166
Total								16,874

APPENDIX IV

BIOLOGICAL SPECIES AND WILD GENETIC RESOURCES IN AVENA

Dr G. Ladizinsky, Faculty of Agriculture, Rehovot, Israel

One of the aims of taxonomy is to provide a classification which expresses as much as possible the natural relationships among organisms (Davis and Heywood, 1973). The species is widely accepted as the basic unit of taxonomy. However, there is no universal definition of this term and the 'species problem' has been a subject of continuous debate and disagreement among scientists. In orthodox classification species delimitation is made according to morphological-geographical criteria. The main disadvantage of the morphological approach is that occasionally different species are fully interfertile with each other and the discontinuous variation between them is simply inherited. In addition, on morphological grounds alone it is extremely difficult to separate sibling species from each other. Geneticists, on the other hand, prefer breeding relationships as the main guide for species delimitation, and consider biological species as a genepool that is protected by reproductive barriers. Biological species is therefore a more dynamic and evolutionary category than morphological species.

Morphological and biological species are not necessarily mutually exclusive and may even overlap with each other in many cases, because morphology, like cytology, ecology and geographic distribution, is an attribute of the species genepool. For greater affinity between the two systems, it is useful to apply the nomenclature rules of classical taxonomy also for biological species. When several morphological species are included in the same biological species, they can be eliminated or retained as subspecies.

Introduction of the biological species concept to taxonomy involves breeding experiments and cytogenetic analysis of the hybrids. This is apparently why it is has been applied to a relatively small number of plant groups, most of them of economic value. In general with crop plants, the biological species concept allows better understanding of the history of the plant and the genetic resources potential among its wild relatives.

The genus Avena has been the subject of taxonomic and genetic studies, particularly in the last 20 years. The first most comprehensive taxonomic treatment of Avena was made by Malzew (1930), and a relatively recent monograph was published by Baum (1977). In both treatments the morphological species was adopted even though considerable information has become available on the genetic affinities between some of the morphological species.

The aim of this paper is to present a synthesis of the taxonomic and genetic information and to apply the biological species concept to Avena. It may provide a more natural classification of this economically important genus, and help curators of genebanks and breeders deal with wild genetic resources of cultivated oats. The paper also includes a key to the biological species, morphology and ecology of each of the species and discusses the relative importance of the various species as genetic resources. The biological species of Avena and each of the morphological types they include are shown in Table 1.

TABLE 1. **Biological and taxonomic species in Avena**

Biological species	2n	The taxonomic species include
A. ventricosa	14	A. ventricosa
A. clauda	14	A. clauda, A. eriantha
A. longiglumis	14	A. longiglumis
A. prostrata	14	A. prostrata
A. damascena	14	A. damascena
A. strigosa	14	A. strigosa, A. brevis, A. hirtula, A. wiestii
A. atlantica	14	A. atlantica
A. canariensis	14	A. canariensis
A. macrostachya	28	A. macrostachya
A. barbata	28	A. barbata, A. abyssinica, A. vaviloviana
A. agadiriana	28	A. agadiriana
A. magna	28	A. magna
A. murphyi	28	A. murphyi
A. sativa	42	A. sativa, A. sterilis, A. fatua

Key to the biological species and the main subspecies

The key is based on three main characters: the length of the lower glume relative to that of the upper glume, the lemma tip structure and the mode of floret disarticulation. The chromosome number of each species is also added, as occasionally it is essential for more accurate identification. Two groups of sibling species are known in Avena and it is difficult to identify the various species within a group on morphological grounds alone.

1a. Glumes unequal (2)

1b. Glumes are equal or nearly so (4)

2a. Perennial plants; 2n=28; A. macrostachya

2b. Annual plant (3)

3a. Lower glume 3/4 the length of the upper glume; disarticulation occurs at the lowermost floret only; callus sharp, 4-5 mm long, 2n=14. A. ventricosa

3b. Lower glume 1/3-1/2 the length of the upper glume; disarticulation occurs at the base of each floret, 2n=14. A. clauda ssp. clauda

3c. The same as 3b. but disarticulation occurs at the basal floret only. A. clauda ssp. eriantha

4a. Lemma tips biaristulate (5)

4b. Lemma tips bidentate (10)

5a. Panicle non-shattering; cultivated (6)

5b. Panicle shattering (7)

6a. Panicle condense; mainly in W. Europe, 2n=14. A. strigosa ssp. strigosa

6b. Panicle sparse; mainly in Ethiopia, 2n=28, A. barbata ssp. abyssinica

7a. Disarticulation occurs at the basal floret only; 2n=14. A. atlantica

7b. Disarticulation occurs at each floret (8)

8a. Callus of the diaspore awl shaped; 2-3 mm long; glumes 25-40 mm long. Panicle usually unilateral; 2n=14. A. longiglumis

8b. Callus shorter and round (9)

9a. Stem prostrate; glumes 14-17 mm long; lemma tips 3-5 mm long; 2n=14. A. prostrata

9b. Stems erect; glumes 15-30 mm long; lemma tips 3-7, occasionally 15 mm long, 2n=14. A. damascena

9c. Lemma tips 5-10 mm long; 2n=14. A. strigosa ssp. wiestii-hirtula

9d. Lemma tips 2-5 mm long; 2n=28. A. barbata

10a. Panicle non-shattering; cultivated; 2n=42. A. sativa ssp. sativa

10b. Panicle shattering (11)

11a. Disarticulation occurs at each floret, 2n=42. A. sativa ssp. fatua

11b. Disarticulation occurs at the basal floret only (12)

12a. Awn inserted at the lower 1/4 of the lemma; 2n=28; A. murphyi

12b. Awn inserted 1/3 to half-way up lemma (13)

13a. Spikelet V shaped; 2n=42. A. sativa ssp. sterilis

13b. Spikelet widest at the point of awn insertion (14)

14a. Spikelet 20-30 mm long; lemmas extremely hairy; 2n=28. A. magna

14b. Spikelet 12-16 mm long; in Canary Islands; 2n=14. A. canariensis

14c. Similar to A. canariensis; in Morocco 2n=28. A. agadiriana

Description, ecology and crossability relation of the biological species

A. macrostachya Bal. ex Coss. et Dur. (2n=28)

Perennial; culms erect and often geniculate; 40-100 cm long; Spikelet (without awns) 20-30 mm long; 3-6 florets, glumes unequal, the lower being about half the length of the upper, 10-25 mm long; all florets disarticulate at maturity; awn inserted at about the upper 1/3 of the lemma; lemmas glabrous with bisubulate tips.

A. macrostachya is found in restricted areas of Mount Djurdjura in Algeria, at altitudes of 1500-2000 m, where it is exposed to severe winter conditions. A. macrostachya has managed to survive the winter in Ottawa, Canada, without any apparent damage to the plants (Baum and Rajhathy, 1976). This species is a cross-pollinating one and set only few seeds upon bagging. Cytogenetically it behaves as an autotetraploid. When ordinary crossing procedures are used, it is cross-incompatible with the annual oats.

A. ventricosa Bal. ex Coss. (2n=14)

Annual; culms erect, 20-60 cm long; panicle flagged or nearly so; spikelets (without awns) 15-25 mm, each spikelet contains two florets; glumes unequal, the lower being about three-quarters the length of the upper one; lemma tips bisubulate; disarticulation occurs at the basal floret only; the callus at the base of the diaspore is sharp, 4-5 mm long.

This wild diploid oat grows in dry habitats on shallow soils which usually form a hard crust when dry, but it has also been found growing on calcareous and sandy soils. The habitat is also suitable for A. clauda and the two commonly form mixed populations. It has been reported from Morocco, Algeria, Libya, Saudi Arabia, Iraq and Azerbidjan.

A. ventricosa is only cross-compatible with A. clauda, but the F_1 hybrids are sterile because of irregular chromosome pairing at meiosis (Rajhathy and Thomas, 1974). Using embryo culture techniques A. ventricosa can be crossed with the common oat A. sativa, but the hybrids are sterile.

A. clauda Dur. (2n=14)

Annual; culms erect, 20-60 cm long; spikelets (without awns) 15-25 mm; glumes unequal in length, the lower being about one-half to one-third as long as the upper; lemma tips bisubulate-biaristulate. A. clauda contains two fruiting morphs or subspecies that are considered as separate species in classical taxonomy; in the first type, A. clauda, individual florets serve as dispersal, while in the second type, A. eriantha Dur., all the florets of the spikelet are shed as one unit. The two fruiting types are fully interfertile and the difference in the disarticulation pattern is controlled by a single gene. The two types of A. clauda commonly grow side by side throughout their distributional range. A. clauda is dispersed over a vast geographical area from the Iberian Peninsula and the Magreb countries of north Africa to Afghanistan. It usually forms small populations and occurs mainly on shallow soil in relatively dry habitats. Occasionally, however, the populations are large and may extend into more fertile habitats.

A. clauda is only cross-compatible with A. ventricosa. It can be crossed with the common oat only with the aid of embryo culture, but the hybrids are sterile.

A. longiglumis Dur. (2n=14)

Annual; culms 30-150 cm long; panicle equilateral or flagged; spikelet (without awns) 20-35 mm; glumes equal in length 25-40 mm long; 2-3 florets which disarticulate individually at maturity; lemma tips biaristulate 6-12 mm long; callus at the base of the diaspore awl-shaped 3-4 mm long.

This species is restricted to sandy and sandy loam soils, mainly along the coastal belt of the Mediterranean Sea and adjacent areas. Two interfertile ecological races are known; a mesic, robust type along the coastal belt and a smaller, more delicate type in the deserts bordering the Mediterranean zone.

A. longiglumis is cross-compatible with the diploid species A. prostrata and A. strigosa. The hybrids of the first cross combination are partially fertile but those of the second one are completely sterile. Using embryo culture, A. longiglumis can be hybridized with the common oat but the hybrids are sterile or partially fertile.

A. prostrata Ladizinsky (2n=14)

Annual; culms prostrate or erect, 10-40 cm long; panicle rather compact, spikelets consist of 2-3 florets, 12-15 mm long; glumes equal in length, lemma tips biaristulate, 3-5 mm long; florets disarticulate individually at maturity.

This species is found in dry habitats on metamorphic bedrock in southeastern Spain.

A. prostrata belongs to an aggregate of sibling species including A. damascena, A. strigosa and A. barbata, all of which are intercrossed with one another and form highly sterile hybrids. It is cross-compatible also with the diploid A. canariensis, the tetraploids A. magna and A. murphyi and the hexaploid oats, but the hybrids are sterile.

A. damascena Raj. et Baum. (2n=14)

Annual; culms erect, 30-90 cm long; spikelets (without awns) 20-26 mm long; glumes equal in length or nearly so, 22-28 mm long; lemma tips biaristulate, 4-6, occasionally 15 mm long; florets disarticulate individually at maturity.

This species was known until recently only from the Syrian desert but apparently grows also in Morocco.

A. damascena is cross-compatible with A. prostrata, A. strigosa and A. barbata but the hybrids are highly sterile.

A. strigosa Schreb. (2n=14)

Includes interfertile cultivated and wild forms that are considered independent species in the taxonomic literature, but subspecies rank for the cultivated and the wild forms seem more appropriate.

Annual; culms erect, 50-120 cm long; panicle equilateral or flagged; spikelets consist of 1-3 florets; glumes equal in length or nearly so; lemma tips biaristulate, 5-12 mm long. The panicle is non-shattering in the cultivated forms but the florets disarticulate individually at maturity in the wild types.

Cultivated A. strigosa ssp. strigosa is grown mainly in west-central Europe and also includes the taxonomic species A. brevis Rogh, A. nuda L. and A. hispanica Ard., all of which are interfertile. Among the wild forms of A. strigosa, two main races can be distinguished: a mesic robust type, taxonomically known as A. hirtula Lag., and a more delicate, desert type, A. wiestii Steud., which are fully interfertile. The two taxonomic species considered by Baum (1977), A. lusitanica (Tab. et Mor.) Baum and A. matritensis Baum, apparently belong to the A. strigosa complex as well. The wild members of A. strigosa are dispersed over a vast geographical area from the Iberian Peninsula to Afghanistan, and occupy diverse ecological niches and soil types in primary habitats.

A. strigosa can be crossed with most of the Avena species except those having unequal glumes: A. macrostachya, A. ventricosa and A. clauda. It produces partially fertile hybrids only with A. barbata.

A. atlantica Baum et Fedak (2n=14)

Annual; culms erect, 4-70 cm long; panicle equilateral; glumes equal in length or nearly so, 20-25 mm long; spikelet consists of 2, rarely 3, florets which fall jointly at maturity; lemma tips biaristulate, 3-5 mm long.

A. atlantica is a recently described taxon (Baum and Fedak, 1985a). Breeding experiments and cytogenetic analysis of hybrids (Leggett, 1987) indicate that this taxon resembles A. strigosa by its crossability relations with other Avena species. Even more significant is the complete chromosome pairing at meiosis in the A. atlantica x A. strigosa hybrids, which may suggest that A. atlantica is another fruiting morph of wild A. strigosa (Leggett, 1987). The final decision regarding the status of A. atlantica as a biological species has to wait until more information becomes available on the fertility of the A. atlantica x A. strigosa hybrids and the genetics of floret separation.

A. barbata Pott ex Link (2n=28)

This comprises another complex of wild, weedy and cultivated forms that are mutually interfertile. In taxonomic literature they are considered independent species but subspecies rank to the cultivated and the wild forms is more appropriate.

Annual; culms erect, 60-150 cm long; panicle equilateral; spikelets (without awns) 20-30 mm long; glumes equal in length or nearly so, 20-30 mm; florets remain intact in the cultivated forms and disarticulate individually at maturity in the wild types; lemma tips biaristulate, 2-5 mm long.

The wild form, ssp. barbata, is dispersed over a vast geographic area, mainly in the Mediterranean basin, and as a weed in other territories where Mediterranean crops are grown. Another wild form, ssp. vaviloviana (Malz.) Mordv., from Ethiopia, is characterized by retaining the lower florets on the panicle for a relatively long time after maturity, but this behaviour was not observed when the plants were grown elsewhere (Ladizinsky, 1975). A semi-cultivated non-shattering type in this complex is ssp. abyssinica Hochst. Seed non-shattering in this case is controlled by two genes (Ladizinsky, 1975). This oat is restricted to the Ethiopian and Yemeni highlands where it is found exclusively in cereal, mainly barley, fields. The farmers in these regions usually weed out the ssp. abyssinica plants, but may harvest them when the main cereal crop is poor. By the winnowing technique used in Ethiopia, seeds of ssp. abyssinica cannot be separated from barley seeds, so they are occasionally sown and consumed as a mixture.

A. barbata is cross-compatible with all the Avena species except those with unequal glumes.

A. canariensis Baum Raj. et Samp. (2n=14)

Annual; culms erect, 20-70 cm long; panicle equilateral; spikelets (without awns) 12-16 mm long; glumes equal in length, or nearly so, 14-17 mm; 2 florets per spikelet, disarticulation occurs at the basal floret only; lemma tips bidentate.

This species is endemic to the Canary Islands of Lanzarote and Fuerteventura, and although rare it is also found in Tenerife. The lemma structure of A. canariensis is similar to that of the hexaploid oats and the tetraploids A. magna, A. murphyi and A. agadiriana with which it is also cross-compatible. A. canariensis is also cross-compatible with the diploids A. strigosa and A. prostrata.

A. agadiriana Baum et Fedak (2n=28)

Morphologically this taxon is indistinguishable from A. canariensis but is a tetraploid. It was discovered recently in Morocco (Baum and Fedak, 1985b) and independently collected in spring 1985 by an oat collecting group supported by the International Board for Plant Genetic Resources.

A. magna Murphy et Terrell (2n=28)

Annual; culms usually erect, 50-100 cm long; panicle equilateral; spikelets (without awns) 20-30 mm, widest at the point of awn insertion; 2-4 florets per spikelet that are shed as one unit at maturity; glumes equal in length or nearly so, 30-40 mm; lemmas extremely hairy, lemma tips bidentate.

A. magna has been found only in Morocco, and on heavy alluvial soil. The natural habitat of this species is rapidly being converted into farmland and as a result it is under threat of extinction.

Baum (1977) treated this taxon as A. maroccana Gdgr., referring to the type specimen in the herbarium of the Faculty of Science in Lyon, France. Subsequent inquiries about this material revealed that it is not deposited there and in fact cannot be traced. Close inspection of the photograph of the type specimen in Baum's book suggests that it is closer to the hexaploid A. sterilis than to A. magna. Further enquiries about the origin of A. maroccana have shown that it was collected by a French botanist, Gandoger, who visited Morocco twice. On his first trip (Gandoger, 1907) he collected three Avena species near Ceuta: A. fatua, A. sterilis and A. longiglumis. On his second trip he visited the Saferinas Islands near Melilla, where he discovered A. maroccana (Gandoger, 1908), but referred to the Ceuta area as the type-locality. In the 1985 survey of the ecological preferences and habitats of A. magna supported by the International Board for Plant Genetic Resources, 12 populations of A. magna were found in the Rommani area, about 80 km southeast of Rabat. All were found on heavy alluvial soil. In the Ceuta area, on the other hand, no alluvial but sandy and sandy loam soils were found, and no plants of A. magna were found. Thus, on morphological and ecological grounds it seems reasonable to reject A. maroccana as the valid name and to retain the name A. magna.

A. magna is exceptionally rich in protein and resistant to rust, and is cross-compatible with most of the Avena species. The meiotic behaviour of A. sativa x A. magna hybrids indicates close affinities between the two but cannot support A. magna as the tetraploid ancestor of the hexaploid oats.

A. murphyi Ladizinsky (2n=28)

Annual; culms 50-100 cm long; panicle equilateral; spikelets (without awns) 20-30 mm; 2-4 florets that fall as one unit at maturity; glumes equal in length or nearly so, 30-40 mm; lemma tips bidentate; awn inserted in the lower quarter of the lemma.

This species is found in a restricted area near Tarifa, southern Spain and near Tanger, Morocco. It grows on heavy soil, but the habitat is rapidly coming under cultivation and there is a real threat of extinction of this species.

A. murphyi is cross-compatible with most of the Avena species. Cytogenetically it is more distantly related to the hexaploid oats than is A. magna.

A. sativa L. (2n=42)

This is perhaps the most variable species in the genus Avena, but all types have bidentate lemma tips, share the same chromosome number and are mutually interfertile. It is a complex of wild and weedy form and cultivated derivatives that have been treated as different species in the taxonomic literature. Under the biological species concept they may be treated as subspecies.

The cultivated form ssp. sativa is characterized by non-shattering panicles, essentially glabrous lemmas and awns that are rudimentary or absent. The caryopsis is hulled in most of the ssp. sativa cultivars but naked types are known and are characterized by membranous lemmas, relatively long rachillas and 3-4 florets per spikelet.

Among the wild forms of A. sativa two main types can be distinguished: ssp. sterilis, in which all the florets shed as one unit at maturity, and ssp. fatua in which the florets disarticulate individually at maturity. The sterilis taxon is a major component of the annual vegetation in the Mediterranean region and other areas having a Mediterranean-like climate. In these regions it is also an aggressive weed in fields and man-made habitats. The fatua taxon is confined mainly to man-made habitats and cultivated fields, in particular in western and central Europe and North America. As a native plant it has been found in a few locations in the Canary Islands.

Wild genetic resources of oats

The rearrangements of the genus Avena in biological species reflects also the potential wild genetic resources of the cultivated oats. Obviously, the wild forms of A. sativa ssp. sterilis and ssp. fatua are the most accessible wild material for the breeder since they share the same chromosome number, are fully interfertile with the common oat, ssp. sativa, and are members of its primary genepool. The contribution of these two taxa to the common oat has been discussed at length by Frey (1986). The fatua taxon contributed genes for dormancy, earliness, resistance to seed shattering, and large seed, while ssp. sterilis contributed resistance against crown and stem rust, powdery mildew and barley yellow dwarf virus, higher content of oil and protein in the groat, and higher biomass and grain yield. Frey's conclusion that ssp. sterilis is a more valuable source of genetic diversity to the common oat than ssp. fatua is compatible with the greater ecogeographic diversity of ssp. sterilis and the effective geographic isolation between this taxon and the common oats that were developed in Europe.

The diploid and the tetraploid wild oats can be hybridized with common oats directly, or by the aid of embryo culture, but the resultant hybrids are highly or totally sterile. Collectively they can be regarded as the secondary genepool of the common oat, but gene transfer from them requires special techniques and experimental manipulations which are time consuming.

Irregular chromosome pairing is the main reason for the high sterility of the interspecific hybrids involving the common oats and species of the secondary genepool. Pentaploid hybrids between the tetraploid species A. magna and A. murphyi and the common oat can be obtained by common crossing procedure but are self sterile. They may, however, produce a few seeds upon back-crossing with A. sativa pollen

(Ladizinsky and Feinstein, 1977; Thomas et al. 1980a). When climatic conditions are favourable, natural back-crossing may occur, and consequently better seed set, by planting these F_1 hybrids among plants of A. sativa. This practice may also prove useful in back-crossing pentaploid hybrids involving A. barbata and A. macrostachya. Doubling of the chromosome number of hybrids between diploid oat species and A. sativa is a common procedure to overcome their sterility, and repeated back-crosses with pollen of the common oat may result in the desirable recombinants.

Occasionally the barrier to geneflow from species of the secondary genepool is a result of inadequate chromosome pairing in the interspecific hybrid. Sharma and Forsberg (1977) induced translocation between A. sativa and A. abyssinica chromosomes by irradiation with thermal neutrons, which lead to incorporation of genes for crown rust resistance of A. abyssinica in A. sativa. A similar approach was used by Aung et al. (1977) to transfer mildew resistance from A. barbata to A. sativa. A more sophisticated method to overcome poor pairing has been employed by Thomas et al. (1980b). Using the cw 57 A. longiglumis genotype, which promotes pairing between homoeologous chromosomes, they transferred a gene for mildew resistance from A. barbata to A. sativa.

Although gene transfer from species of the secondary genepool is more difficult and time consuming, the merit of this genepool is diversity which may not exist in the primary genepool. Some of the examples are most indicative: the highest protein content in the groat is about 20% in the primary genepool of A. sativa, but 30% and 27% in A. magna and A. murphyi respectively. Winter hardiness has been recorded in the primary genepool of A. sativa, but A. macrostachya is apparently unique in this regard since it can stand the winter of Ottawa without obvious damage to the plants.

The present view on genetic resources in oats and other crop plants is derived from crossability relations and availability of methods for gene transfer. Broadening of the genetic resources and shortening the time for gene transfer in oats may be obtained by genetic engineering. The prospects and difficulties with this new technology are obvious. Time will tell us if and how this new technology may offer new diversity and new tools to the breeder.

References

Aung, T., Thomas, H. and Jones, I.T. 1977. The transfer of gene for mildew resistance from A. barbata (4x) into cultivated oat A. sativa by induced translocation. Euphytica 26: 623-632

Baum, B.R. 1977. Oats: wild and cultivated. Can. Dept. Agric. Ottawa

Baum, B.R. and Fedak, G. 1985a. A. atlantica, a new diploid species of the oat genus from Morocco. Can. J. Bot. 63:1057-1060

Baum, B.R. and Fedak, G. 1985b. A new tetraploid species of Avena discovered in Morocco. Can. J. Bot. 63:1379-1385

Baum, B.R. and Rajhathy, T. 1976. A study of Avena macrostachya. Can. J. Bot. 21:2434-2439

Davis, P.H. and Heywood, V.H. 1973. Principles of Angiosperm Taxonomy. Robert E. Krieger, N.Y.

Frey, K.J. 1986. Genetic resources and their use in oat breeding. In: Lawes, D.A. and Thomas, H., eds. Proc. Sec. Int. Oat Conf. Martinus Nijhoff, Lancaster

Gandoger, M.M. 1907. Flore du Ceuta (Espagne). Bull. Soc. Bot. France 54:77-81

Gandoger, M.M. 1908. Flore du litoral Mediterraneen du Maroc. Bull. Soc. Bot. France 56:656-659

Ladizinsky, G. 1975. Oats in Ethiopia. Econ. Bot. 29:238-241

Ladizinsky, G. and Feinstein, R. 1977. Introgression between the cultivated hexaploid oat A. sativa and the tetraploid wild A. magna and A. murphyi. Can. J. Genet. Cytol. 19:59-66

Leggett, J.M. 1987. Interspecific hybrids involving the recently described diploid taxon A. atlantica. Genome 29:361-364

Malzew, A.I. 1930. Wild and cultivated oats, section Euavena Grisb. Bull. Appl. Bot. Gent. Plant Breeding. 38th Suppl.

Rajhathy, T. and Thomas, H. 1974. Cytogenetics of oats (Avena L.) Genet. Soc. Can. Misc. Publ. 2. Ottawa

Sharma, D.C. and Forsberg, R.A. 1977. Spontaneous and induced interspecific gene transfer for crown rust resistance in Avena. Crop Sci. 17:855-860.

Thomas, H., Haki, J.M. and Arangzeb, S. 1980a. The introgression of characters of the wild oat A. magna (2n=2x=28) into cultivated oat A. sativa (2n=6x=42). Euphytica 29:391-399

Thomas, H., Powell, W. and Aung, T. 1980b. Interfering with regular meiotic behaviours in A. sativa as a method of incorporating the gene for mildew resistance from A. barbata. Euphytica 29:635-640

APPENDIX V

SUMMARY OF PROGRESS WITH MULTIPLICATION/CHARACTERIZATION OF THE WILD OAT ACCESSIONS COLLECTED DURING THE 1985 COLLECTING EXPEDITION

WPBS pop. acc. no.	Original collection	Species	Country of origin	Individual accessions in population
Cc7178	Cs40	A. murphyi	Spain	77
Cc7179	Cs41	A. murphyi	Spain	50
Cc7180	Cs42	A. murphyi	Spain	103
Cc7181	Cs43	A. murphyi	Spain	73
Cc7182	Cs44	A. murphyi	Spain	76
Cc7183	Cs45	A. murphyi	Spain	95
Cc7184	Cs46	A. murphyi	Spain	33
Cc7185	Cs47	A. murphyi	Spain	43
Cc7186	Cs48	A. murphyi	Spain	84
Cc7188	M28	A. murphyi	Morocco	15
Cc7189	M30	A. murphyi	Morocco	42
Cc7190	M32	A. murphyi	Morocco	20
Cc7191	Cs30	A. prostrata	Spain	6
Cc7192	Cs33	A. prostrata	Spain	110
Cc7193	Cs34	A. prostrata	Spain	72
Cc7194	Cs35	A. prostrata	Spain	32
Cc7195	Cs36	A. prostrata	Spain	30
Cc7196	Cs37	A. prostrata	Spain	6
Cc7197	Cs39	A. prostrata	Spain	19
Cc7231	M41	A. hirtula?	Morocco	11
Cc7237	M1	A. maroccana	Morocco	47
Cc7238	M2	A. maroccana	Morocco	17
Cc7239	M3	A. maroccana	Morocco	38
Cc7240	M4	A. maroccana	Morocco	44
Cc7241	M5	A. maroccana	Morocco	46
Cc7243	M7	A. maroccana	Morocco	23
Cc7244	M8	A. maroccana	Morocco	22
Cc7245	M9	A. maroccana	Morocco	63
Cc7246	M22	A. maroccana	Morocco	42
Cc7247	M23	A. maroccana	Morocco	47
Cc7248	M26	A. maroccana	Morocco	58
Cc7255	M40	Unclassified	Morocco	13
Cc7256	M45	A. damascena	Morocco	15
Cc7263	M55	A. agadiriana	Morocco	25
Cc7264	M59	A. agadiriana	Morocco	25
Cc7265	M60	A. agadiriana	Morocco	25
Cc7266	M71	A. agadiriana	Morocco	25
Cc7278	M42	A. eriantha	Morocco	23
Cc7279	M43	A. clauda	Morocco	11
Cc7280	M39	A. prostrata	Morocco	3

The above accessions have been multiplied and characterized. Limited seed samples are available.

Subsamples from the following accessions have been used in hybridization experiments, and small seed samples are available for distribution.

WPBS pop. acc. no.	Original collection	Species	Country of origin
Cc7268	M57	A. atlantica	Morocco
Cc7269	M58	A. atlantica	Morocco
Cc7270	M62	A. atlantica	Morocco
Cc7272	M66	A. atlantica	Morocco
Cc7274	M68	A. atlantica	Morocco
Cc7275	M70	A. atlantica	Morocco
Cc7276	M72	A. atlantica	Morocco
Cc7277	M73	A. atlantica	Morocco
Cc7257	M47	Unclassified	Morocco
Cc7258	M48	Unclassified	Morocco
Cc7259	M49	Unclassified	Morocco
Cc7269	M51	Unclassified	Morocco
Cc7261	M52	Unclassified	Morocco
Cc7234	M54	A. hirtula?	Morocco

A number of interspecific and intraspecific hybrids have been produced from a number of the accessions, and have been published in the scientific literature. Two diploid species, Avena prostrata (Cc7280) and A. damascena (Cc7256) have been identified among the collections made in Morocco.

The following accessions are being multiplied in Japan by Dr Toshi Morikawa, University of Osaka, Japan.

WPBS pop. acc. no.	Original collection	Species	Country of origin
Cc7249	M10	A. longiglumis	Morocco
Cc7250	M11	A. longiglumis	Morocco
Cc7251	M13	A. longiglumis	Morocco
Cc7252	M14	A. longiglumis	Morocco
Cc7253	M27	A. longiglumis	Morocco
Cc7254	M61	A. longiglumis	Morocco

APPENDIX VI

REGISTRATION OF EVALUATION DATA IN EUROPEAN DATA BASE

4.1.5*	Plant height
6.1.6	Lodging at mature stage
6.2.2	Days to harvest
6.3.2	1000 grain weight (g)
6.3.4	Percentage of husk (%)
6.3.5**	Percentage protein content of caryopsis (%)
6.3.6**	Percentage oil content of caryopsis (%)
7.1	LOW TEMPERATURE DAMAGE
7.5	WINTER KILL
8.2.1	Erysiphe graminis avenae
8.2.3	Puccinia coronata avenae
8.4.1	Barley yellow dwarf virus (BYDV)

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* The numbering follows the IBPGR descriptor list for Avena, which provides detailed information.

** The percentage protein and oil may be measured on the kernel; it should be clearly specified if such analyses have been performed on the kernel or on the caryopsis.