European Cooperative Programme for Crop Genetic Resources Networks

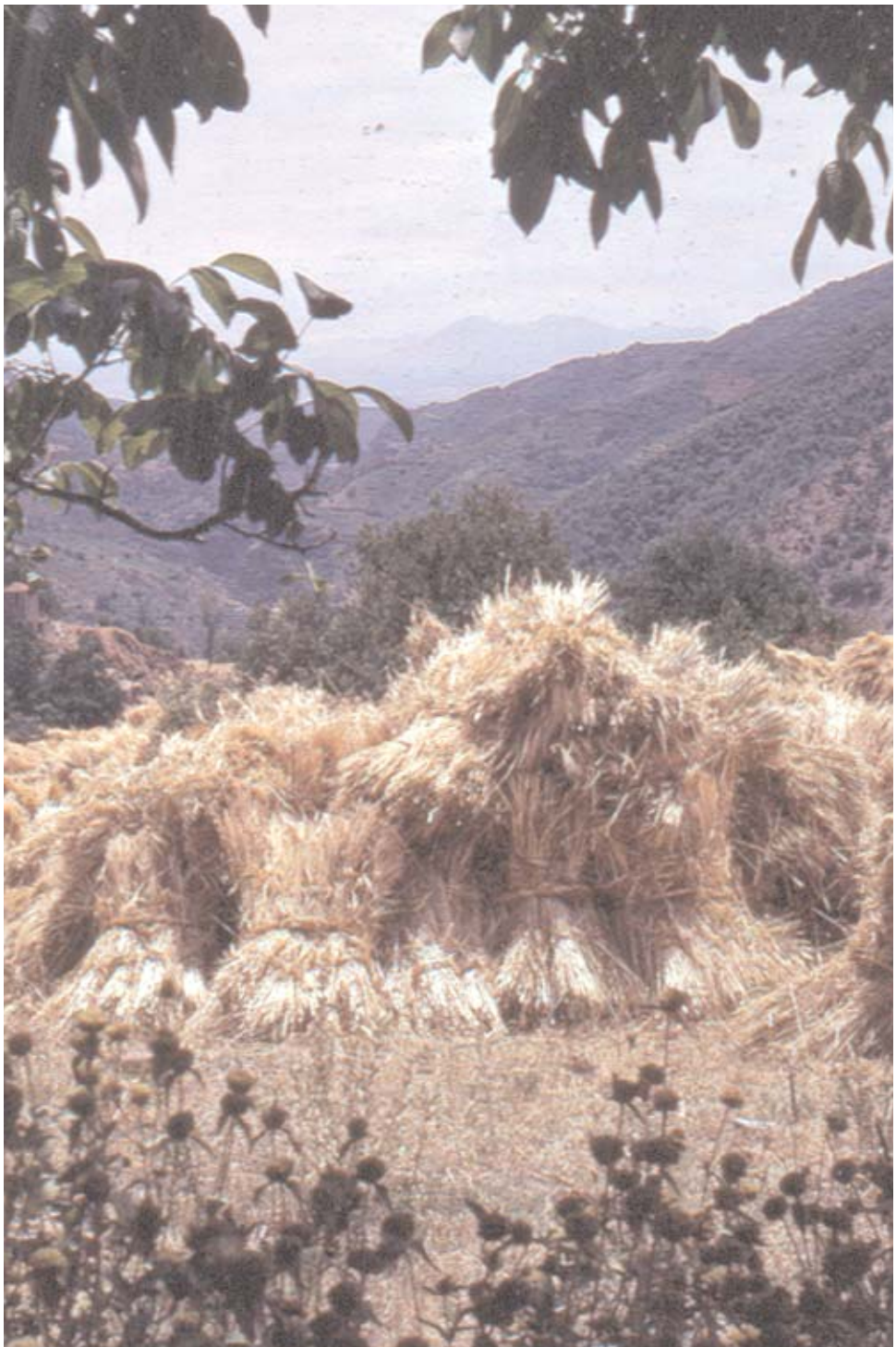
ECP/GR

Report of a Working Group on Wheat

IPGRI

First meeting, 8–10 November 2001, Prague-Ruzyne, Czech Republic

L. Maggioni, I. Faberová, A. Le Blanc and E. Lipman, *compilers*



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The International Plant Genetic Resources Institute (IPGRI) is an autonomous international scientific organization, supported by the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to advance the conservation and use of genetic diversity for the well-being of present and future generations. IPGRI has its headquarters in Maccarese, near Rome, Italy, with offices in more than 20 other countries worldwide. The Institute operates through three programmes: (1) the Plant Genetic Resources Programme, (2) the CGIAR Genetic Resources Support Programme and (3) the International Network for the Improvement of Banana and Plantain (INIBAP).

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

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PART I. DISCUSSION AND RECOMMENDATIONS

Introduction

Opening of the meeting

Iva Faberová, Genebank Documentation Officer at the Research Institute for Crop Production Prague-Ruzyne (RICP), hosting institute of the first meeting of the Working Group on Wheat, welcomed all participants and underlined the historical importance of this meeting. Vaclav Šíp, Vice-Director of the Division of Genetics and Plant Breeding of RICP, opened the meeting on behalf of Ladislav Dotlačil, Director of the Division, with a welcome address to all the participants. He explained that wheat is one of the most important crops in the Czech Republic, with a cultivated area of over 800 000 hectares, i.e. one-third of the arable land in the country. The Institute, which is celebrating its 50th anniversary, is composed of four Divisions. The Division of Genetics and Plant Breeding focuses mainly on wheat, but also deals with winter rape, barley and potatoes. Its main activities are the study and conservation of plant genetic resources, genetic studies and breeding resistance to fungal and viral diseases, e.g. resistance to powdery mildew, tolerance of abiotic stresses, increased use of genetic diversity, improvement of selection efficiency and breeding of new varieties. RICP is responsible for the coordination of plant genetic resources activities in the Czech Republic, and for collections of wheat, *Triticale*, winter barley, sunflower, beet, maize and pseudo-cereals. Finally, V. Šíp wished everybody a successful meeting, with a good exchange of ideas in a spirit of fruitful collaboration, as well a pleasant stay in Prague.

Iva Faberová and Annick Le Blanc, co-Chairs of the Working Group, opened the technical session of the meeting. The agenda was subsequently adopted with some modifications.

ECP/GR briefing and outcome of the Mid-term Steering Committee meeting

Lorenzo Maggioni, ECP/GR Coordinator, welcomed the participants to the first meeting of the Working Group on Wheat, including Group members, observers from non-ECP/GR countries (Latvia, Russia and the Ukraine) and other guests. He explained that ASSINSEL and FAO were invited to attend, but were unable to send representatives.

He then reminded the Group that collaborative work on wheat within ECP/GR dated back to 1996, when an *ad hoc* meeting was held in Paris, France. At that time, agreements were made for the establishment of a European Wheat Database and the objectives of an ECP/GR Working Group on Wheat were defined.[1] The Working Group on Wheat was then officially established by the ECP/GR Steering Committee in 1998, during its seventh meeting in Braunschweig, Germany.

For the benefit of several members participating in an ECP/GR meeting for the first time, the Coordinator briefly explained the history, objectives and mode of operation of ECP/GR and mentioned the Cereals Network's activities carried out and planned within Phase VI of ECP/GR (1999-2003). In particular, he summarized the recommendations made by the Cereals Network Coordinating Group during its meeting in Radzików, Poland.[2] *Inter alia*, the Working Groups were invited to further develop documentation work (completion of passport data and addition of characterization/evaluation data to the central databases), to

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1 Gass, T., M. Ambrose, I. Faberová, A. Le Blanc and J. Weibull, compilers. 1997. Report of a Workshop on Wheat Genetic Resources, 21-23 March 1996, Paris, France. International Plant Genetic Resources Institute, Rome, Italy.

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

promote collecting activities to fill gaps in the collections, to identify regeneration needs, especially of wild species, to establish a system for safety-duplication of all accessions, and to identify strategies for the conservation of the most endangered wild relatives. The Working Groups were also encouraged to implement a system for sharing responsibilities and the genebanks were encouraged to develop their own quality guidelines and to publish them.

He then pointed out that the only Cereals meeting planned in the remaining two years of Phase VI would be the Cereals Network meeting, planned for 2003 with the aim of reviewing progress made by the Network and planning its future. All attending members of the *Avena*, Barley and Wheat Working Groups would be invited to participate.

L. Maggioni gave a brief account of the outcomes of the Mid-term meeting of the ECP/GR Steering Committee, held in St. Petersburg, Russian Federation, on 14-17 October 2001. Several policy issues were addressed; however no specific Material Transfer Agreement model was endorsed. It was considered preferable to wait for the adoption of the revised International Undertaking (IU), which was thought to be imminent.[3] A statement was made on the IU negotiations, recommending the extension of the list of crops to be included in a Multilateral System. Regarding the Cereals Network, the Steering Committee expressed its appreciation of the work done so far and encouraged the initiation of activities on *Secale* and *Triticale.* The Committee also expressed support for the initiatives of the Working Groups to find mechanisms for sharing responsibilities and considered it very important that the issue of quality standards be addressed. The Committee was also pleased to see progress made on all of the ECP/GR objectives, but recommended increased attention to facilitating the utilization of plant genetic resources (PGR) in Europe and to increasing awareness of the importance of PGR conservation and use. In order to develop a strategy for the next phase of ECP/GR (Phase VII), two Task Forces, composed of a few Steering Committee members, were established to discuss (1) the impact on PGR of recent developments in science, technology and international policy; and (2) how genebanks should implement relevant international agreements and their effect on the operation of genebanks.

Loek van Soest asked for news of a possible collaboration with a revised European Council regulation EC 1467/94. The ECP/GR Coordinator replied that, as far as is known, a new programme was expected to commence in 2002, particularly focused on *in situ* conservation, including forestry and animal genetic resources, but with some funding for *ex situ* plant genetic resources. Delegation of the management of the funds to the individual countries is expected.

Networking activity on wheat and the European Wheat Database

Iva Faberová presented the progress of the Working Group on Wheat, as recently reported to the Steering Committee (see Appendix I). She mentioned that after the first *ad hoc* meeting in March 1996 in Paris, the database structure was prepared by both database co-managers and was completed in September 1996. In line with the standard IPGRI/FAO *Multi-crop Passport Descriptors* (MCPDs), the database was subsequently approved in October 1996.

Despite the fact that the Wheat Group had not met officially until now, the European Wheat Database (EWDB) development had made continuous progress and the provisional on-line EWDB Internet application was tested in February 1998 with an initial set of 28 000 passport records. The database was first made publicly available in June 1998, based on the IDC/HTX architecture at the beginning.

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[3] On 3 November 2001, the renegotiation of the FAO International Undertaking came to an end. The revised text, adopted through a vote, is called "International Treaty on Plant Genetic Resources for Food and Agriculture" (ftp://ext-ftp.fao.org/waicent/pub/cgrfa8/iu/ITPGRe.pdf). This new legally binding international agreement will enter into force when ratified by at least 40 states (see briefing by Geert Kleijer, p. 16).

At present the EWDB consists of 108 229 records collected from 18 data sources from 17 European countries (Table 1). The Internet application was recently converted to ASP structure, thereby becoming more user-friendly. A further 16 850 records have been gathered, although they have not yet been converted into the EWDB structure (Table 2). Considering that the total number of wheat accessions in European collections is 202 331, according to an estimate made in 1996 (Table 3), database managers would welcome receiving data for an additional 77 252 accessions.

Table 1. Number of accessions in the EWDB[4]

Inst. Code	Contributor	No. of records
BGR001	IIGR Sadovo	10034
CHE001	SFRAC Nyon	4362
CHE071	Schweizer Bergheimat Lucerne	4
CYP004	ARI PGRH Nicosia	80
CZE122	RICP Prague-Ruzyne	9421
DEU146	IPK Gatersleben	16757
ESP004	CRF Alcalá de Henares	2814
FRA051	GEVES Surgères	1949
GRC001	NAGREF Thermi-Thessaloniki	170
HUN003	IA Tápiószele	5461
LTU001	LIA Dotnuva Akademija	7
LVA010	PGLIB Salaspils	566
NLD037	CGN Wageningen	5123
POL003	IHAR Radzików	10397
RUS001	VIR St. Petersburg	34808
SVK001	RIPP Piešťany	2616
SWE002	NGB Alnarp	614
TUR001	PGRD AARI Izmir	3046
Total		**108229**

Table 2. Other collected data (not yet converted into EWDB structure)

Inst. Code	Contributor	No. of accessions
AUT001	BVAL Linz	884
BLR001	AAS Zhodino-Minsk	19
DEU001	BAZ Braunschweig	12188
FRA040	INRA Clermont Ferrand	227
HUN020	ARI Martonvasar	1230
ROM007	GB Suceava	798
YUG002	IFVC Novi Sad	1478
YUG040	ATRC Zaječar	26
Total		**16850**

Table 3. Missing data sets of some collection holders

Inst. Code	Contributor	Estimate (1996)
ALB002	ARC Lushnje	9650
BEL001	CRAE Gembloux	367
EST001	JPBI Jogeva	30
GBR011	JIC Norwich	7202
HRV015	IPBPP Zagreb	2319
IRL017	DAFRD Backweston, Leixlip	?
ISR002	IGB Bet Dagan (FVC Rehovot, LGB Tel Aviv, WIS Rehovot)	16588
ITA004	IDG Bari	31000
PRT004	ENMP Elvas	3992
UKR001	YIPB Kharkiv	8100
Total		**77252**

[4] (see list of acronyms in Appendix III)

I. Faberová continued with a list of actions proposed as the next steps in the development of the EWDB:

- **Data completion**
  - Encourage supply of missing data;
  - Harmonize passport data with the upcoming new version of the MCPDs;
  - Standardize institution codes in the EWDB;
  - Improve passport data quality;
  - Include pedigree information in proper standardized form according to Purdy *et al.* (1968)[5];
  - Harmonize descriptors for characterization and basic evaluation data and include them in the database;
  - Identify genes and alleles.
- **Data analysis**
  - Search for possible duplications;
  - Identify unique accessions in collections;
  - Define the role of the EWDB for the establishment of a partial wheat core collection.
- **Improvement of the Internet application**
  - Mirroring of the database at GEVES in France;
  - Link to other wheat information sources (information on pedigree and alleles identified by S. Martynov; wheat taxonomy, etc.);
  - Establish updating mechanism (possibly using the mechanism of the European Search Catalogue EURISCO, currently under development, see EPGRIS, p. 17);
  - Explore the possibility of direct links to accessions in other databases.

I. Faberová explained that the IBPGR *Wheat descriptors* (1985) would need to be revised. Regarding core collections, she mentioned that they are not centrally established, but only locally within genebanks.

In the discussion that followed L. van Soest enquired as to the main difficulties hindering completion of the database with data for all the existing collections.

A. Le Blanc replied that there is sometimes no reply to requests for data or else data are sent, but not in the right format. Because of the heterogeneity of data, the task of conversion is extremely time-consuming. I. Faberová said that coverage of 50% of the data is already a good result for a large collection such as wheat, especially considering the high level of duplication among the collections, which means that only a fraction of the remaining accessions is not already represented in the central database.

G. Kleijer remarked that a stable list of multicrop descriptors would prevent database managers from needing to continuously adapt their data to new standards.

L. Maggioni replied that changes to the standards were the result of requests from the users and said the need to make some improvements to the existing MCPDs was expressed by the project partners of the Europe-wide EPGRIS initiative when the project standards were established. It was, however, confirmed that changes would be limited in order to avoid the need for major modification of the databases.

EWDB data analysis

Iva Faberová presented the first results of a data analysis of the EWDB. At least 240 000 accessions are held in European wheat collections. Altogether 2 million accessions are kept in PGRFA collections in Europe (according to FAO). Most of them are cereals and the main one, wheat, is represented by more than 500 000 accessions conserved in Europe.

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

A first analysis of the EWDB focused on the search for unique material (accessions recorded as being present only once in the entire European collection), since this represents the most valuable part of the collections and should be safely conserved as well as safety-duplicated. The mechanism used for data handling during the search for the identification of duplicates and of unique material was presented. The search was made focusing on the field "Accession name". An additional field called "New name" was created to store information after corrections were made. These corrections resulted from a first run of automatic corrections (replacement of all dots, hyphens, double spaces, commas, quotation marks and apostrophes with single spaces; all names in capital letters) and from a second run of manual corrections, based on similarity of names and the possibility of variable transliteration of Cyrillic characters and abbreviations. Spelling mistakes were also corrected. Accession names in the new field were ordered according to their occurrence in EWDB and were indexed. Index numbers (stored in an additional field) were assigned to the different names recorded in the field "New name" (low name index for frequently occurring accession names, high name index for unique accession names).

Out of a total of 108 229 accessions documented in the EWDB, 29 414 (27%) records of accessions received from collecting missions were found to have the field "Accession name" empty (only about 50% of these accessions are documented with "Collecting information"). These accessions were not analyzed due to incompleteness of collecting data, but they are believed to be mainly single samples. A group of 11 750 different names were recorded for 43 735 accessions (41%). This group can therefore be expected to include many duplicates. Finally, 35 070 accessions (32%) were preliminarily identified as unique material. Different lists of unique material for each contributor and country were prepared and diskettes were distributed to the Working Group members, with the respective lists of unique material and an indexed file containing all the names to facilitate corrections.

In this way, the first step was made to receive feedback from data contributors and to make data updating possible. It was also noticed that, after the addition of new records, many "unique" accessions are expected to lose their status. At the same time, more unique material is expected to be identified among the missing data.

National collections status reports

(Full reports are included in Part II)

Representatives from the various countries presented the status of the national wheat collections.

Austria

Paul Freudenthaler gave a brief overview of the wheat collections in Austria, which are held at three genebanks: the Federal Office and Research Centre of Agriculture in Vienna, mostly concerned with commercial wheat varieties and also holding a large collection of durum wheat (total of 640 accessions); the genebank in Innsbruck (previously Institute for Seed Testing and Plant Breeding) in Rinn, run by the local government of Tyrol (total 231 accessions); and the Federal Office of Agrobiology in Linz, concerned with landraces and commercial varieties (total 1214 accessions). Passport data are available for most accessions. Governmental organizations dealing with genetic resources are the Federal Ministry for Agriculture and Environment (Vienna and Linz) and the local governments of Styria and Tyrol. Several NGOs such as Arche Noah are also active, as well as organizations involved in organic farming and individual farmers.

In response to questions, P. Freudenthaler agreed that the collection could include some duplicates. He confirmed that all data had been sent to the EWDB, except for possible gaps for Tyrol. However, I. Faberová clarified that the Austrian data had not yet been converted into the EWDB format and added to the database.

Bulgaria

A summary of the Bulgarian holdings was received prior to the meeting from the Bulgarian genebank manager, Siyka Stoyanova. The collection is quite large and contains 8118 accessions of *Triticum aestivum*, 2107 accessions of *T. durum*, and 104 accessions of other *Triticum* species (*T. turgidum, T. macha, T. sphaeroccocum,* etc.). A full report was received after the meeting and is included in Part II.

Croatia

Dario Novoselović gave the historical background of wheat breeding in Croatia, which dates back to the beginning of the twentieth century. The production of new varieties led to genetic erosion and loss of traditional local material. Today several institutes deal with wheat: the Agricultural Institute Osijek, holding 400 varieties of different origin and 1200 of research material; the Institute of Plant Breeding and Production of Field Crops, Zagreb, with 200 varieties of different origin and 1800 of research material; and the Faculty of Agriculture, University of Zagreb, holding 270 local populations, 320 varieties of different origin and 400 of research material. These collections suffer from a lack of adequate storage capacity and an adequate information system also needs to be developed. Efforts will focus on the creation and organization of a central wheat collection at national level with adequate storage facilities and complete data availability.

Czech Republic

Zdeněk Stehno explained that the gathering and maintenance of wheat genetic resources has a long tradition in former Czechoslovakia and in the Czech Republic. Small collections were transferred from former research and breeding stations at the beginning of the 1950s to the Research Institute of Crop Production in Prague (RICP), currently responsible for the Czech wheat collection. The wheat collection is divided into two sub-collections: (1) the winter wheat sub-collection, containing 6145 bread, 122 durum, 62 spelt, 81 einkorn and 31 emmer wheat accessions; and (2) the spring wheat sub-collection where bread wheat prevails (3260 accessions), followed by 785 durum, 101 emmer, 30 einkorn and 18 spelt wheat accessions. Other wheat species are minor in both sub-collections. As of November 2001, the Czech wheat collection contained 10 886 accessions in total, mostly of bread wheat (87%) and durum wheat (8%). Regarding the status of accessions, the whole collection consists of 6595 cultivars, 3220 breeders' materials, 694 local varieties, 193 special stocks and 170 wild wheat relatives.

Collecting missions are important sources of new wheat-related wild species and landraces. The collection is also increased by exchange of seed samples with other genebanks and with cultivars excluded from registration. Traditionally, registered cultivars are also included in the collection because of their interest to breeders.

Wheat accessions are systematically evaluated according to the National list of wheat descriptors for 2 years. At least 2 tester cultivars are included in each set of accessions tested. The characters evaluated include morphological characteristics, growth and developmental stages, canopy characteristics, responses to diseases, spike composition and grain quality parameters (protein content, gluten content, gluten index and sedimentation test). The results of evaluation for 5755 accessions (53% of the whole collection) have been transferred into the computerized documentation system EVIGEZ.

Wheat seed samples are maintained in the Czech genebank as a part of the active collection at under –5°C. The most valuable accessions are duplicated in the base collection and maintained at under –18°C. The number of wheat accessions stored in the genebank has reached 9654 samples (89% of the whole collection). Some samples, not yet stored, are still kept in the working collection. As for other crops, safety-duplicates of important wheat accessions are kept at the Research Institute of Crop Production in Piešťany in Slovakia.

In addition to these basic activities, participation in various international cooperation projects should be mentioned, such as the European Wheat Database (France/Czech Republic), the Genetic Resource Information System (Russia/Czech Republic), the Winter Wheat East European Regional Trial (organized by CIMMYT), and Barrande projects (France/Czech Republic).

France

Annick Le Blanc presented the French small seed cereal genetic resources network, in which both public and private research and breeding institutes participate. There is no Genebank for cereals in France but a network led by a coordination unit, overseen by a steering committee. Participants in the network sign the National Charter where rights and obligations are listed. The wheat group members participate in multiplication and evaluation of seed already held in the collection and of new accessions to be included in the collection. In 2001-2002, all private French breeders (18) and several INRA stations participated in this subgroup. The National Wheat Collection contains 1969 accessions of French material, freely available worldwide (list published in 1997). There is also a working collection of 1086 accessions of diverse origin, of which the distribution is restricted to the French network. The seed samples are divided between two conservation sites at INRA-Clermont-Ferrand and GEVES. Data are recorded in a centralized database called "ERGE" using the MCPDs and other descriptors for evaluation. Data with only 5 passport descriptors are available on the BRG Web site (http:/www.brg.prd.fr). Complete information is available from the coordination unit, but not yet on Internet.

In the discussion that followed, considering that only 20% of the approximately 10 000 accessions known to be stored in the INRA collection are included in the French collection, G. Kleijer asked about the availability of the remaining accessions. A. Le Blanc replied that the collection available in France was set up on the basis of a list of accessions proposed by the network members (of which INRA is currently the main one), according to a list of 10 criteria. Moreover, it was decided to limit the number of accessions to be managed at a national level. J. Koenig added that the remaining 80% could be distributed by INRA on an exchange basis (cf. Catalogue of INRA genetic resources of Wheat, 1997—available upon request). The selection of material to be included in the National Collection, i.e. not the foreign material, was said to be mainly a political decision, pending ongoing negotiations at international level on access to plant genetic resources.

Germany

Hansjörg Walther explained that the germplasm holdings of the BAZ Gene Bank would be moved from Braunschweig to IPK. There are currently 17 821 wheat accessions at IPK in Gatersleben and 11 118 at BAZ in Braunschweig, with some duplication to be expected. The temporary additional workload connected with the merging of the two germplasm collections and the development of a new information system for the Gatersleben genebank will be carried out as a 4-year project, jointly funded by the German Ministry of Education and Research (BMBF) and the Ministry of Consumer Protection, Food and Agriculture (BMVEL). A prominent task will be to bring together the databases of the two large genebanks, presently maintained under two different systems: Oracle (BAZ) and FoxPro (IPK). GBIS, the new Genebank Information System, will be developed under Oracle. The

existing export modules of both present information systems will be adapted to the new platform to allow an easy exchange of data with EWDB and other ECP/GR Central Crop Databases. The GBIS project will also take into account the requirements for data exchange with EPGRIS/EURISCO.

A national cereal evaluation network, EVA-2, coordinated by BAZ Aschersleben, and including genebanks, research institutes, the cereal breeders and ZADI, has been established. It has been built on the experience of the French evaluation network and deals with wheat and barley. H. Knüpffer (IPK) has offered to provide an overview of the Gatersleben wheat collection and related research activities, to be included in this report (see Part II).

Greece

Demetrius Gogas indicated that in Greece there are two institutions responsible for the national wheat collection: the Cereal Institute, holding nearly 20 old and 50 new cultivars and a number of promising breeders' lines, and the Greek Gene Bank, holding 170 accessions (*T. aestivum* 67, *T. durum* 60 and *T. boeoticum* 43). The Greek Gene Bank also holds 636 *Aegilops* accessions.

The Greek Gene Bank wheat collection works partly as an active collection, regenerated every 10-15 years, and as a long-term collection, regenerated every 40-45 years. Documentation of the collection is based on passport data.

The Cereal Institute wheat collection is an active collection, regenerated every 3 years. Documentation and characterization are based on pedigree and important characteristics such as grain quality, lodging, yield stability and resistance to three rusts. This active collection is a source of very useful genetic variation in the ongoing breeding programmes of the institute.

The level of use is high in the case of the Cereal Institute collection and very low for the Greek Gene Bank collection, owing to the lack of information about the basic characteristics that are very important in breeding programmes. Evaluation, characterization and documentation of all collections must be carried out according to breeders' needs because they are the most active users of genebanks.

Hungary

Lajos Horváth gave an overview of the current status of the six state-funded wheat germplasm collections in Hungary: the Institute for Agrobotany (ABI); Agricultural Research Institute of the Hungarian Academy of Science; Cereal Research Public Utility Company; Faculty of Husbandry and Agriculture, Saint Stephan University; Research Institute of Agricultural Sciences Centre, University of Debrecen; and Faculty of Agricultural Science, West-Hungarian University. He then provided detailed information on the wheat collection held at ABI (21 species for a total of 9869 accessions, of which 9007 of *T. aestivum* and 441 of *T. durum*). The active collection is kept at 0ºC and the base collection (1150 accessions) at -20ºC.

The volume of multiplication and characterization varies every year (500 accessions on average). Regeneration is ongoing and should be completed within the next 3 years. Evaluation trials have been carried out to test the adaptability to Hungarian conditions of so-called "underutilized" wheat species, on different soils (loam/sand) and with spring vs. winter sowing. Differences in mineral content of *T. dicoccon*, *T. spelta* and *T. monococcum* have been studied. Also 111 Hungarian landraces collected in the 1940s and 1950s have been characterized.

Data management (passport, characterization and genebank management data) is fully computerized. The ABI wheat database can also be found on the Internet (http://www.rcat.hu/).

In the discussion that followed, S. Denčić, commenting on the data shown by L. Horváth, expressed his surprise about the productivity of *T. spelta*, which was shown to perform better than *T. aestivum* in some cases.

Ireland

Richard Hackett indicated that a national advisory committee on Plant Genetic Resources had been established in Ireland. This committee is made up of representatives from the Department of Agriculture, Food and Rural Development (DAFRD); University College Dublin (UCD); Trinity College Dublin (TCD); Irish Genetic Resource Conservation Trust**;** Irish Seed Savers Association; and members of the Farming Organizations. The remit of this committee is to coordinate and fund activities at the national level and its ultimate objectives are to identify emergency needs in relation to the conservation of scarce resources, conserve and utilize these resources, promote public awareness of plant genetics and participate in international networks such as ECP/GR. The most important projects on wheat genetic resources that have been funded by the advisory committee include (1) evaluation of exotic germplasm as a potential resource for future breeding programmes: this work is being carried out by UCD, where Ethiopian landrace material was collected in different regions of Ethiopia; (2) establishment of the Plant Genetic Resources Trust—this programme is a direct multiplication of old/superseded varieties that have been accumulated by the stakeholders in the programme, and carried out by the Irish Genetic Resources Conservation Trust; and (3) establishment of the National Gene Bank. Accessions have been obtained from UCD, TCD, DAFRD and other stakeholders. These accessions were of questionable use for inclusion into the National Gene Bank, so a programme was undertaken at UCD to produce viable seed stock under uniform conditions, to undertake preliminary characterization of accessions and to resolve duplication and identity issues. Accessions are coming through the outlined processes for inclusion in this bank, with some very interesting inclusions, particularly relating to the exotic Ethiopian-derived germplasm.

A. Le Blanc said that she was happy to welcome Ireland and was looking forward to receiving the Irish data for inclusion in the EWDB.

Israel

Yehoshua Anikster indicated that the holdings of the Israeli Genebank for Agricultural Crops (IGB) include some 4000 accessions of different *Triticum* species, most of them of worldwide origin. A special series contains local landraces of bread wheat (120 accessions) and durum wheat (80 accessions). All accessions are fully documented. In addition to small research collections kept by different scientists and the Hazera Seed Company, the three main depositories for wheat and wheat relatives in Israel are (1) the Weizmann Institute of Science (2000 wild diploid and tetraploid Middle Eastern *Triticum* and *Aegilops* spp., as well as accessions of *Agropyron*, *Eremopyrum*, *Heteranthelium*, *Crithopsis*, and *Secale* accessions); (2) the Institute of Evolution, Haifa University (3800 *T. dicoccoides* lines from 33 Israeli populations and some 700 lines from neighbouring countries; some 2800 accessions of *Aegilops* species originating from 137 populations in Israel, Russia and Turkey); and (3) the Institute for Cereal Crops Improvement, Tel Aviv University (4000 accessions of *Aegilops* sect. *Sitopsis* species and 5000 accessions of *Triticum turgidum* subsp. *dicoccoides*).

Italy

Giambattista Polignano, representing Pietro Perrino, Director of the Bari Germplasm Institute, gave an overview of the Italian wheat collection held in Bari, one of the largest in the world. Collecting expeditions in the Mediterranean region and Ethiopia served as the basis for the collection, which was further increased by intensive exchange activity. It now contains 28 000 accessions belonging to 27 different species, mostly *T. aestivum* (8414).

About 11 400 accessions are not yet classified. Stored accessions with a low germination rate or small amounts of seeds are subjected to the regeneration programme. During regeneration, the accessions are characterized for agromorphological traits. The wheat collection is maintained under good storage conditions, in aluminium cans at -20°C for long-term storage, and in laminated aluminium bags under vacuum at 0°C and 30% air humidity for short- and medium-term storage.

More than 52 013 wheat samples were distributed worldwide, mostly to European countries (27 980). Exchanges with genetic resources collections at other genebanks are also frequent.

Data recorded during exploration, characterization and evaluation are all computerized to document diversity, to provide input for collection planning and contribute to the management of the wheat collection. In particular, the 28 000 accessions of the different *Triticum* species are all documented for passport data in SAS. A minimum of 13 descriptors is included with incomplete data for some accessions and evaluation data exist for parts of the collection. Access to the wheat passport data will soon be available on the Internet at the Institute's Web site (http://www.ig.ba.cnr.it/). The Bari wheat collection has been duplicated at three genebanks abroad: Fort Collins (USA), Kyoto (Japan) and the Vavilov Institute (St. Petersburg, Russian Federation).

In the following discussion, H. Walther questioned the possibility of managing passport data with a SAS system and I. Faberová confirmed that this is not possible. G. Polignano pointed out that Italian data are being transferred into an Oracle database and in a few months it should be possible to download them from the Web. He also confirmed that he and P. Perrino could be contacted as reference persons in accessing data from Bari until the on-line access is fully operational.

Latvia

Vija Stradziņa explained that so far there is no separate National Programme for PGR in Latvia, but that all PGR activities are running under the framework of the National Programme for the implementation of the CBD. The structure of the national PGR activities is currently being discussed. The Latvian Gene Bank of Cultivated Plants was established in 1997 with support from the Nordic Gene Bank (Nordic-Baltic cooperative programme in PGR). It is located in Salaspils at the Institute of Biology, University of Latvia and has accepted responsibility for maintaining accessions of Latvian origin (varieties, breeder's lines). In some cases accessions from foreign varieties are also included in the collection. NGB's model for storage conditions was adopted. Storage and documentation of accessions comply with internationally accepted standards. Safety-duplicates are kept at the NGB according to a bilateral agreement. The Latvian Gene Bank operates as a centre for the Latvian PGR network. Multiplication, evaluation and characterization are carried out by experts in particular crops, mainly in the plant breeding stations. Complete evaluation of accessions is planned, according to the descriptors agreed by the Baltic Cereal Working Group. Wheat multiplication and evaluation/characterization, and maintenance of the working collection are carried out at the State Stende Plant Breeding Station, where the first trials with wheat were started in 1923. During the Soviet period, working collections were created through the Vavilov Institute in St. Petersburg. When the national plant genetic resources programme was initiated an inventory was made of the wheat collection: advanced cultivars are available but all landraces have been lost. The Latvian Gene Bank currently maintains 20 accessions of *Triticum aestivum*. All 14 Latvian wheat varieties (including spring and winter) with available seeds are accepted for conservation in the Latvian Gene Bank with the highest priority. Seeds of these varieties are already prepared for long-term storage. The breeders' lines have been kept in the working collections for more than 10 years.

Lithuania

Vytautas Ruzgas presented the Programme for National Plant Genetic Resources that was launched in Lithuania in 1994. The Programme is coordinated by the Lithuanian Institute of Agriculture (LIA). The Lithuanian Genebank is located at LIA. The wheat collection is organized according to the following scheme: the newly obtained accessions (varieties or advanced breeding lines) are investigated under Lithuanian conditions for one or two years. The varieties that do not perform satisfactorily under local conditions, and in which valuable traits are not identified, are usually discarded. The varieties with some valuable traits are kept in the working collection, investigated for more detailed information and then included in the crossing block. The varieties are selected for long-term storage if they are of Lithuanian origin, bred and registered in Lithuania, or are Lithuanian varieties or breeding lines submitted to the Official Variety Testing or that have valuable traits, or else foreign varieties with valuable traits, etc. Accessions of Lithuanian origin are fully evaluated and characterized and all relevant information is available. The *Catalogue of the Lithuanian Plant Genetic Resources* includes 9 local winter wheat varieties and 2 of spring wheat, as well as 190 foreign varieties and lines. Data for long-term storage accessions collected after 1996 are included in the home page of LIA (http://www.lzi.lt) in the subsection "Gene resources". During over 79 years of wheat breeding activities, Lithuanian breeders investigated 2487 varieties in the working collections. The key task of the current wheat breeding programme is to collect winter wheat germplasm from different geographical regions, test it under local conditions and select valuable genetic material which will be used for the development of new varieties.

Macedonia (FYR)

Sonja Ivanovska indicated that there is no legal framework for genebank activities in the Republic of Macedonia (FYR). Since 1996, funding is carried out through a Programme for Agricultural Development Support, by the Ministry of Agriculture, Forestry and Water Economy. The wheat collection, maintained by the Institute of Agriculture in Skopje, Department for Field Crops, currently consists of 200 accessions of *T. aestivum* and 265 accessions of *T. durum*. The seeds are held in plastic jars in a cold chamber (2-6°C) for medium-term storage. Characterization and evaluation data are incomplete and are recorded in Excel. The collection is currently being evaluated for grain quality. Within the framework of the genebank activities, contact has been established with the USDA National Seed Storage Laboratory in Fort Collins where a total of 791 wheat landraces originating from Macedonia are maintained. Repatriation of the collection will be possible when conditions for its maintenance are organized at the Institute. At the beginning of 2000, a coordinating body was established under the auspices of the Ministry of Agriculture to prepare the National programme and legislation for regular functioning and funding of the genebank activities.

The Netherlands

Loek van Soest indicated that the wheat collection, with its 5475 accessions, is the largest collection of CGN. It is divided into 5051 accessions of cultivated *Triticum* species, 402 accessions of 17 wild species and 22 accessions of synthetic hybrids. The cultivated group comprises material of diploid *T. monococcum*, the tetraploids *T. turgidum* group and *T. timopheevi* var. *timopheevi* and the hexaploid *T. aestivum* group. The latter group includes *'spelta'*, *'compactum'*, *'sphaeroccocum'* and *'aestivum'* wheats, whereas the *'durum'*, *'dicoccon'*, *'carthlicum'*, *'turgidum'* and *'polonicum'* wheats belong to the tetraploid *T. turgidum* group. Nearly all wheat accessions are regenerated and stored under long-term storage conditions (-20°C) and are available to *bona fide* users. During regeneration, accessions are characterized for a minimal set of agromorphological traits using a list of descriptors developed by CGN. In the past 3 years, 1290 accessions of winter wheat were evaluated under field conditions

for the following diseases: *Erysiphe graminis* (mildew), *Septoria tritici, Puccinia recondita* (brown rust) and *Puccinia striiformis* (yellow rust). The evaluation took place at four private breeding companies in The Netherlands. Data of the CGN wheat collection can be found at CGN's Web site (http://www.plant.wageningen-ur.nl/cgn/). Since 1987 nearly 6000 accessions have been distributed to 78 different institutions all over the world. Nearly the whole wheat collection of CGN is safety-duplicated in the genebank of the Federal Office of Agrobiology in Linz, Austria.

Nordic countries (NGB)

Merja Veteläinen presented the wheat genetic resources at the Nordic Gene Bank (NGB). This institution is responsible for the long-term conservation of the genetic resources of agricultural and horticultural crops in the Nordic region. Thus, the main Nordic wheat collection is located at the NGB. The other wheat collections in the area are mostly working collections at the breeding stations or research material at the universities. As of October 2001, the wheat collection at the NGB included a total of 1316 accessions. The most important part of the collection is a set of 339 accessions accepted for long-term conservation. However, there are also 914 accessions that are temporarily preserved at the NGB and a minor part of pending material. The temporary collection is of non-Nordic origin or is classified as breeding material. NGB's mandate is to preserve only material of Nordic origin. NGB has wheat accessions from all of the Nordic countries except Iceland. Most wheat accessions (40%) originate from Sweden.

Portugal

Benvindo Maçãs outlined the organization of the National Institute for Agrarian Research (INIA), responsible for research and development activities for the Portuguese Ministry of Agriculture. Priorities are centred on five programmes: Environment and production systems, Crops and products, Animal production and products, Forests and products, and Rural development. To fulfil this strategy, INIA is organized in National Stations that develop specific scientific activities: National Agricultural Research Station–Lisbon; National Forestry Station–Lisbon; National Research Station for Viticulture and Enology–Dois Portos; National Plant Breeding Station–Elvas; and National Station for Animal Production–Santarém. Each national station is responsible for the species considered within their programmes, coordinated by the Agrarian Genetic Resources Committee. All annual crops, cereals, pastures, forages and wild species, are committed to the National Plant Breeding Station in Elvas. These species represent 83% (11 844 accessions) of the total *ex situ* collections belonging to INIA. Only a small amount of that total is regenerated and characterized. Recently, 100 wheat accessions have been repatriated from the old German collection in Gatersleben. These include 53 tetraploids. Molecular characterization is used to identify sources of resistance to *Erysiphe*. Old material can be a valuable source of traits (e.g. good rooting system) to be introduced into varieties suitable for organic farming, for which there is currently an important niche.

Romania

Liliana Vasilescu presented the status of the national *Triticum* collection in Romania. The whole *Triticum* collection comprises 3088 accessions including 1173 accessions kept by the Suceava Genebank, stored under standard conditions under long- and medium-term conservation. *Triticum aestivum* is the dominant species, being the major useful species in the breeding programmes. The collection contains 1271 Romanian accessions and 1559 accessions from other European countries. The composition of the collection according to the status of samples is as follows: breeders' lines 1797, advanced cultivars 826, landraces 251, wild 16, unknown 198. Passport data about the *Triticum* collection are included in the *Romanian Catalogue of Plant Genetic Resources*, published by the Suceava Genebank in 2000.

Russian Federation

Olga Mitrofanova gave a detailed overview of the wheat collection held in VIR, St. Petersburg. It contains more than 44 000 accessions including spring bread wheat (31%), winter bread wheat (32%) and durum wheat (13%). Wild wheat is also represented with primitive wheat, goat grass (*Aegilops*) and *Triticale* (7-9% of accessions each). The durum wheat accessions originate from 66 countries and those of bread wheat from 85 countries. A considerable part of each crop is represented by accessions collected from 1907 to 1940. The taxonomic system used is that of Dorofeev.

The base or long-term collection is kept at 4°C at the Seed Store (Krasnodar Territory). Access to this collection is restricted. The active collection or short-term collection is kept at room temperature at VIR's Department of Wheat. In addition, collections for safety-storage are located at VIR's experimental stations for regular and urgent seed multiplication.

Documentation is one of the most important priorities for the management of the collections. Several databases and electronic botanical and geographical dictionaries have been developed. The TRIT database, structured in 31 fields (21 passport and 10 additional), contains passport data for 36 589 accessions. The version submitted to the EWDB (34 808 records in 14 fields) is available on the Internet (http://genebank.vurv.cz.ewdb). An evaluation database has also been developed, containing results of long-term (1972-1991) field studies on spring bread wheat carried out in the Krasnoyarsk Region, for about 4534 accessions.

The transcription of Chinese names is an important issue. Proper standardization is necessary to identify duplicates.

Evaluation and utilization of the collection are priorities. From 1996 to 2000 more than 5000 accessions were involved in different evaluation experiments and about 1030 interesting new sources for breeding were identified.

In the ensuing discussion, H. Walther asked how the more than 900 accessions consisting of populations of mixed genotypes are managed and, in particular, how they are multiplied in order to reduce the risk of genetic drift.

O. Mitrofanova explained that the populations are maintained as sublines (pure lines) and reproduced in bulk. Checks are made to ensure that the morphological combination of traits remains unaltered and protein and DNA markers are also used for this purpose.

Slovakia

Iveta Čičová indicated that wheat growing in Slovakia is a longstanding tradition. The area under wheat in 2001 was 446 526.5 ha, i.e. 30.1% of the arable land. The Gene Bank in Piešťany, which started operating in 1996, is responsible for long-term genetic resource conservation in Slovakia. The national wheat collection contains 3475 accessions, including 448 from Slovakia and 3027 of foreign origin. Regarding the status of samples, the collection is made up of 2058 varieties, 1374 breeding lines and 42 landraces. The collection is enriched by collecting, introduction of accessions from other institutes and from abroad, and also from private breeders. Five new varieties have passed through the state variety tests and were registered in 2001. All samples are evaluated according to the descriptor list for the genus *Triticum* L. Milling and bakery analyses have begun. All research results are stored in the database. The documentation system runs under FoxPro.

Spain

On behalf of Magdalena Ruiz, Dolors Villegas presented the wheat collection maintained at Centro de Recursos Fitogenéticos (CRF-INIA). The main aims of CRF-INIA are to conserve the base collection (maintained at -18ºC) of the Network of the National Plant Genetic Resources Programme, and to conserve and regenerate the active wheat collection (-4ºC). Information is arranged in three groups: passport, management and

characterization/evaluation data. The wheat collection at CRF holds 2906 accessions, mostly from Spain. Other countries historically related to Spain are also widely represented. The most important species are *Triticum aestivum* (1773 accessions) and *T. turgidum* (1107 accessions). The origin of the Spanish wheat accessions is mainly Castilla-La Mancha region (southern-central Spain), as well as Andalucía (southern Spain) and Castilla-León (northern-central Spain). The majority of entries held at CRF are landraces, followed by commercial varieties and breeding material. Wild relatives are poorly represented. A detailed characterization of durum wheat material is currently being carried out. Such characterization takes into account agromorphological traits as well as molecular markers.

Switzerland

Geert Kleijer indicated that in Switzerland, conservation of plant genetic resources is carried out by more than 25 public and private organizations. Three of these organizations deal with wheat, the Federal Research Station for Plant Production of Changins (RAC), the "Sortengarten Erschmatt" and the foundation Pro Specie Rara.

RAC holds the most important collection of 7148 accessions in the base collection and 1533 accessions in an introduction collection, of which a part will be put into the genebank. Most of the accessions belong to *T. aestivum* (4508) and an important collection of *T. spelta* (2252) is also conserved at RAC. About 74% of the accessions are winter wheat and 26% spring type. Accessions of Swiss origin amount to 2388 and 4760 are mostly from European countries. The material consists of landraces (about 2700), old and modern varieties and breeding lines. Except for the *T. spelta* and the *Aegilops* accessions, the material is well characterized and evaluated. About 80% of the accessions are conserved in long-term storage at -20°C in aluminium foil bags. Security storage will be assured by IPK, Gatersleben, Germany. All the passport and evaluation data are computerized in a specific but Excel-compatible software system.

The "Sortengarten Erschmatt" holds 107 accessions. This organization promotes the cultivation of landraces in a region of Switzerland (Valais) where some 100 years ago many landraces were cultivated. Pro Specie Rara holds 19 accessions of wheat and is specialized in on-farm conservation. The accessions of both organizations originated partially from RAC's genebank. The other accessions are also stored in RAC's genebank for security reasons.

Since 1999, projects have been financed by the Government, filling the gaps of the 20 priority actions of the Global Plan of Action. Seventeen of these projects have concerned cereals, of which five were accepted, three of those involving wheat, including on-farm conservation. The national database will be established in 2002, using the new FAO/IPGRI *Multi-crop Passport Descriptors*[6], including some relevant descriptors for each group of crops. As a second step, it is foreseen that the database will be extended to include characterization and evaluation data.

In reply to a question from Z. Stehno, G. Kleijer explained that the material selected for on-farm conservation must be of Swiss origin.

Turkey

Ali Aydin pointed out that two of Vavilov's Centres of Origin extend into Turkey. This indicates that Turkey is the origin and/or centre of diversity of several crop plants, as well as one of the domestication centres where ancient agriculture started. Turkish plant genetic resources activities began in 1964. Because of the importance of PGR for the country these studies were implemented within the framework of National Plant Genetic Resources/Diversity Research Programme (NPGRRP) in 1976. The Department of Plant Genetic Resources of the Aegean Agricultural Research Institute (AARI) has taken over all

[6] The new list is available at http://www.ipgri.cgiar.org/system/page.asp?frame=catalogue/select.asp

responsibility at national level on behalf of the Directorate of AARI as project centre. Cooperation with various institutions is arranged according to the National Regulation on Collection, Conservation and Utilization of Plant Genetic Resources (NPGRRP) prepared in 1992. All joint programmes are conducted on a project basis with agreements. The objectives of the NPGRRP are the survey, collection, conservation (both *ex situ* and *in situ*), documentation and evaluation of existing plant genetic resources and plant diversity in Turkey. *Ex situ* conservation of wild species and landraces of wheat, *in situ* conservation of wild progenitors and/or wild relatives of wheat and on-farm conservation are carried out. Until 2000, characterization studies were carried out for over 1000 *Triticum* accessions in AARI and over 3000 regenerated accessions have returned to the AARI National Gene Bank. The number of *Triticum* spp. accessions stored in the AARI genebank in October 2001 is over 5000. The storage of safety-duplicates of the Turkish wheat collection has been started at the Central Research Institute of Field Crops in Ankara.

In reply to a question from H. Walther, asking how is it possible to guarantee that landraces remain stable during the on-farm conservation, A. Aydin replied that on-farm conservation is under study for hulled wheat landraces. The demand, awareness and participation of farmers for the *in situ* conservation of landraces on-farm are important for their stability. In marginal areas this stability is much higher, since the landraces are still grown intensively in such areas.

Ukraine

Oleg Leonov indicated that in the Ukraine, 15 research institutes, universities and experimental stations are dealing with wheat breeding. Five institutes maintain wheat collections: Yurjev Plant Production Institute; Breeding and Genetics Institute; Myronivka Wheat Institute; South Region Agricultural Research Institute; and Ustymivka Experimental Station. The National Centre for Plant Genetic Resources of Ukraine (NCPGRU), based at the Yurjev Plant Production Institute (PPI), coordinates genetic resources work and maintains bread wheat and spring durum wheat base collections. Other institutes duplicate in many respects the collection of PPI. As of November 2001, the National Depository contained about 4800 samples of bread wheat and over 700 of durum wheat. The passport and introduction database structure is common for all crops in NCPGRU. The wheat pedigree database is connected with the passport database. Yurjev Plant Production Institute and Ustymivka Experimental Station are the leading institutes for this passport database. Most information is computerized under FoxPro. Improvement of the documentation system is ongoing.

Yugoslavia, F.R.

Srbislav Denčić indicated that in the present F.R. Yugoslavia, wheat collections can be found at six research centres and at the Ministry of Agriculture: Institute of Field and Vegetable Crops in Novi Sad; Small Grains Centre in Kragujevac; Centre for Agricultural and Technological Research in Zaječar; Agricultural Institute in Podgorica; 'INI Agroekonomik' PKB Beograd in Belgrade; Faculty of Agriculture in Zemun in affiliation with 'PIK Agrounija' in Indija; and Federal Department for Plant and Animal Genetic Resources. All of these are active collections that maintain a total of 6813 wheat genotypes, including 2856 domestic and 3957 of foreign origin with around 22% and 10% of duplicates, respectively. The dominant categories among the accessions in the collections are advanced lines and current cultivars, since most organizations maintaining the collections are engaged in breeding. There is no long-term conservation scheme for wheat in F.R. Yugoslavia. The largest collection is kept at the Institute of Field and Vegetable Crops in Novi Sad (3557), followed by the Small Grains Centre in Kragujevac (1291), while the other centres have considerably smaller collections. Evaluation activities differ from one centre to another. The most detailed programme is

carried out in Novi Sad. The level of documentation and computerization of the collections is low, and only the characterization and evaluation data in the Institute of Field and Vegetable Crops, Novi Sad are fully computerized.

Update from the international context

Revision of the International Undertaking

Geert Kleijer summarized the events leading to the recent adoption of a revised International Undertaking, now converted into a Treaty to facilitate access to genetic resources for Food and Agriculture and to ensure the sharing of the benefits deriving from their use. He explained that the revision of this 1983 agreement was started in 1993, with the objective of making it legally binding and in harmony with the Convention on Biodiversity. After seven years of negotiations, the International Treaty was endorsed on Saturday 3 November 2001 in Rome, with 116 countries voting in favour and two abstaining (Japan and the USA).

Main issues during the negotiations were: access to genetic resources, the definition and implementation of farmers' rights, the provisions for benefit-sharing, the Intellectual Property Rights over derived material and the financial mechanism to implement the Treaty.

G. Kleijer explained that benefit-sharing would mainly consist in access to the material itself. A Multilateral System for facilitated exchange, as proposed by the European Union, was accepted. The system will guarantee facilitated access for a list of crops including 35 genera of food crops (including *Triticum et al.*[7]) and 29 forage species. The list had to be defined by consensus and the veto raised by individual countries excluded from the list a few important crops, such as soybean and tomato. Material Transfer Agreements will have to be signed whenever germplasm is exchanged.

Some difficulties can already be envisaged for the near future, since the definition and implementation of a text for Material Transfer Agreement still needs to be negotiated and additions to the list of crops have to be made by consensus. Moreover, the legal interpretation of parts of the document will not always be straightforward; the regime of access to CGIAR material, which is not all included in the Multilateral System, remains unclear. Problems could also arise specifically in Europe, should a few countries decide not to endorse the Treaty.

The adoption of the "International Treaty on PGRFA" is seen as a very positive development, although several questions remain unanswered. In order to address issues raised by this and other international agreements, an ECP/GR Task Force established by the Steering Committee will discuss in the near future how genebank operations will be affected and the best way to implement international obligations.

EPGRIS - European Plant Genetic Resources Information Infra-Structure

This 3-year project (2000-2003), developed within the ECP/GR Documentation and Information Network, was approved for funding within the Fifth Framework Programme of the European Union. The objective is to establish a European Internet Search Catalogue (EURISCO) with passport information of plant genetic resources maintained *ex situ* in Europe. The catalogue will be frequently updated and publicly accessible via the Internet. Initial data sets will be derived from the European Central Crop Databases (ECCDBs), however, the project will promote the creation of national inventories, which are planned to become the main source of data. PGR National Coordinators of the large majority of European countries have nominated national inventory focal persons. These people will be invited to attend three subregional meetings, to discuss coordination and standardization of the data flow from the national inventories to the central catalogue. The project partners will

[7] As stated in Annex I of the International Treaty: "Including *Agropyron*, *Elymus*, and *Secale*".

also provide technical support to the focal persons and a limited number of training visits to the main European documentation support centres will be arranged. EURISCO will hold an important minimum set of passport data, frequently and automatically updated from the national inventories. These data will be based on the IPGRI/FAO *Multi-crop Passport Descriptor List*. A Web-based interface will allow easy searching of the European national inventories, in the same way as it is possible today to use SINGER (System-wide Information Network for Genetic Resources) to search the CGIAR collections and GRIN to search the USDA collections.

EURISCO can be seen as an important European contribution to the Clearing House Mechanism (CHM) of the Convention on Biodiversity and the implementation of the Global Plan of Action.

Discussion

During the discussion, L. Maggioni confirmed that the maintenance of the EURISCO catalogue will be guaranteed by IPGRI after the end of the project, while maintenance of the national information systems will remain a responsibility of the individual countries.

L. van Soest commented that there should be opportunities to extend this concerted action project into a new project within the EU Sixth Framework Programme.

It was then specified that the most immediate effects of the EPGRIS project on the EWDB will be the provision of a revised *Multi-crop Descriptors List*, which is, however, not expected to bring substantial changes to the EWDB database structure.

I. Faberová, as database manager and partner in EPGRIS, commented that she could understand the concerns of other database managers regarding the changes that EPGRIS might bring, but she expected to see several advantages result from the implementation of the EURISCO catalogue, such as the possibility of doing multicrop searches. She also considered the harmonization of data as a necessary step to reach a structure comparable to the GRIN system of the USDA. An EPGRIS draft document on the future role of the European Central Crop Databases (ECCDBs) was distributed to all participants.

Establishing a workplan for the Working Group on Wheat

Annick Le Blanc and Iva Faberová introduced the discussion summarizing the topics that needed decisions to be taken and a workplan to be defined.

The European Wheat Database (EWDB)

Annick Le Blanc expressed satisfaction with the progress made by the Group in the different countries (organization of genetic resources management, computerization of data, documentation, etc.) since the *ad hoc* meeting in 1996 in Paris, as well as in the development of the central database. She thought that this last point was the most visible output of the Working Group and a task still deserving major attention. It was noted that a diskette containing the unique accessions data sets from the EWDB had been distributed during the meeting to the respective Working Group members for passport data completion and validation. It was agreed that the future responsibility for the management of the database would remain solely with the Research Institute for Crop Production, Prague. J. Koenig offered to assist with the revision of the French data. It was then proposed that each member revise data of accessions originating from their respective countries, whoever the holder of the accessions might be. In the same way, each country could be provided with feedback regarding respective data they transferred to the EWDB, in order to validate the data and adapt their own structure and decoding table to the EWDB; this process could facilitate further data transfer. All these problems of revision, validation and updating (not on-line) would be resolved by making the EWDB downloadable from the Web (see paragraph on workplan below).

Regarding the further development of the database, it was acknowledged that the breeders' needs would only be satisfied when a good coverage of characterization and evaluation data would be made available. However, it was also considered that a large quantity of passport data still needed to be included and this remained a time-consuming task for the database manager. It was also mentioned that a new version of the FAO/IPGRI *Multi-crop Passport Descriptors* was expected to be finalized by the end of the year, also to be adopted by the EPGRIS project.

A. Le Blanc said that it would be possible to include in the EWDB evaluation data already available within the different European data management systems, provided that minimal changes were made to the database structure, i.e. decoding table for descriptors and separate description table filled in/completed only if information is available.

The following **workplan** was therefore agreed:

1. *I. Faberová, database manager, will send to all Working Group members the new structure of the database, in harmony with the upcoming revised IPGRI/FAO MCPDs (within one month of the publication of the revised MCPDs list);*
2. *I. Faberová, database manager, will convert into the EWDB structure all passport data already received by her and A. Le Blanc, and will make them available on-line (by mid-2003);*
3. *Working Group members from countries that have not yet provided their data sets (Albania, Belgium, Croatia, Estonia, Ireland, Israel, Italy, Portugal, Ukraine, United Kingdom and other missing countries) will make sure that their country passport data are sent in the correct EWDB format to I. Faberová within one year from receipt of the correct data structure;*
4. *Working Group members will make sure that their country data are sent to the database manager for the following 6 characterization descriptors—characterized according to the EWDB agreed scoring scales (within one year from receipt of the correct data structure) (see descriptors' scale in Appendix II):*
    - *Awnedness*
    - *Grain colour*
    - *Glume colour*
    - *Glume hairiness*
    - *Spike density*
    - *Plant height*
5. *The database manager will establish links from the on-line database to Web sites publishing characterization and evaluation data of wheat accessions, such as the Nordic Gene Bank site. All Working Group members will alert the database manager of the existence of such sites for their own country's data;*
6. *The database manager will ensure that all the data are downloadable from the Web site (by the end of 2002). This will facilitate verification and validation of data by the Working Group members;*
7. *The Chair and database manager will set up conditions so as to include evaluation data as soon as possible.*

The Group decided that it was premature to plan for additional descriptors for the EWDB. However, it was agreed that the descriptor "1000-kernel weight" should be included among the evaluation data, not the characterization data. The possibility of engaging in a thorough revision of the 1985 IBPGR *Wheat descriptors* was given some consideration, but it was concluded that the Group could not afford to take up this commitment at the present time.

The Group reconfirmed what had been agreed in Paris in 1996, i.e. that information sent to the central database should be related to material that is available for distribution. It was also decided that the home page of the Wheat Database should clearly specify that the database manager is not responsible for seed supply and that requests should be sent

directly to the data contributors or collection holders. Moreover, it was recommended that providers of the data promptly respond to requests for seed supplies.

Rationalization of the collections

Marie-Hélène Lamarre presented the results of a study undertaken during her internship at IPGRI on the elaboration of a methodology to identify duplicates and most original samples in *ex situ* germplasm collections. The proposed methodology was based on computer matches of passport data of databases using numerous techniques to identify probable duplicates. The results of the practical application showed that a human contribution is necessary to confirm the results obtained by the computer alone. M.-H. Lamarre pointed out that the only way to search reliably for duplicates and the most original samples in the germplasm collection is with the contribution, at an early stage of information management, of the knowledge of the persons working with these collections.

As shown by the analysis made by I. Faberová, the level of duplication in the European wheat collections is very high, as measured by the presence of a large number of accessions with the same name. The identification of these probable duplicates is considered useful information if limited resources at the European level need to be targeted on the conservation of priority accessions. Within a series of "duplicate accessions", it would be sufficient that one or two, identified as "primary accessions", are guaranteed long-term storage, facilitated access and are properly safety-duplicated. "Unique" accessions (conserved at only one site), that can equally be identified through a search for duplicates, should receive even more attention.

I. Faberová announced that contributors to the EWDB had received a diskette with the list of material considered "unique" in Europe kept in their national collection, after preliminary analysis of the database. Feedback on the validity of this analysis was expected from the Working Group members. Everybody was also encouraged to plant seed samples from possible duplicate accessions and to test whether they are effectively identical.

Sharing of responsibilities

As a follow-up to the ongoing discussion within ECP/GR about the importance of finding a mechanism for sharing responsibilities for conservation at the European level, and in line with the recommendations made by the Cereals Network Coordinating Group in Radzików, Poland (2000), the Group agreed on the principle of establishing a decentralized wheat collection, whereby every country takes responsibility for the long-term conservation of a subset of the collection, and endorsed the following:

Workplan

1. *Working Group members, in liaison with their National Coordinators, will encourage genebank curators to offer to take responsibility for maintenance and distribution to* bona fide *users of a list of accessions on behalf of the other ECP/GR countries (suggested criteria: material of local origin, especially unique material; material from extra-European countries, especially unique material). They will then inform the database manager of the detailed offers made. This task will be facilitated by the following workplan item.*
2. *As soon as the EWDB is downloadable, the Working Group Chair will provide the different holder countries (i.e. EWDB contributors) with data extracted from the EWDB, including the following information related to the respective countries:*
   - *List of all accessions conserved in the respective countries.*
   - *List of all accessions originating from the respective countries conserved in the European collections. The list will specify which accessions are unique and where they are stored.*
   - *List of accessions that could be proposed for repatriation, in case the country of origin wished to take responsibility for conservation on behalf of the Group.*
3. *On the basis of the offers received, the database manager will record the status of "primary ECP accessions" for the accessions accepted by the genebanks.*

4. *WG members will report to the WG Chair about the outcomes of the above initiative by the end of the year 2002.*

Safety-duplication

Geert Kleijer reminded the Group of the importance of safety-duplication, since genebanks can encounter unexpected problems and lose their samples. He also mentioned the risk of losing the safety-duplicates themselves. He quoted the example of the Braunschweig genebank, which is in the process of merging with the Gatersleben genebank. In that particular case both genebanks have undertaken the necessary precautions to secure duplicate Swiss accessions from Nyon and Reckenholz. Until today, the BAZ Gene Bank has managed this Swiss material in trusteeship. The Swiss genebank has been informed early and is involved in the current decision-making process so as to guarantee that no accession is lost while both German collections are merged.

Cases of bilateral arrangements for safety-duplication were quoted by L. van Soest (Netherlands/Germany; Netherlands/UK), G. Kleijer (Switzerland/Germany) and Z. Stehno (Czech Republic/Slovak Republic).

M. Veteläinen said that the NGB in principle accepts safety-duplicates. L. van Soest also confirmed that CGN normally offers space for safety-duplicate samples, but is currently in the process of building a new genebank facility where the available space is not yet defined. G. Kleijer agreed to accept some material for safety-duplication.

Recommendation

*It was **recommended** that every genebank manager provide for safety-duplication of all the accessions, possibly in a different country, and inform the database manager about the official location of the safety-duplicate. It is advisable that bilateral arrangements between concerned genebanks be formalized. Specific and remaining problems of safety-duplication will then be reconsidered by the Group.*

Utilization of the collections

Organization of wheat germplasm collections

Srbislav Denčić presented the organization of the collection at the Institute of Field and Vegetable Crops in Novi Sad. He stated that it is widely accepted that evaluation of genetic resources is an essential preliminary step to facilitate utilization and therefore the more information is available, the more valuable the collection. Today it is clearly confirmed that core collections are established and organized in order to increase effectiveness of evaluation and utilization of genetic resources. In his presentation, S. Denčić outlined his Institute's approach to organizing wheat germplasm, where the breeders evaluate and use the collections. Wheat germplasm was organized at three levels. The "world collection" (whole collection) comprises 2291 accessions. This collection is first evaluated for some important characters. The next level is the "genetic collection" (core collection) with 750-800 entries. The genetic collection is organized in subunits according to the traits considered important for breeding. The intensive evaluation of the genetic collection includes 54 characters. The third level of wheat genetic resources is the "crossing collection". This collection is strictly connected with breeding and comprises 300-350 potential parents intended for crossing.

French core collection project on wheat

Jean Koenig reported on an INRA project aimed at developing a core collection from a large wheat germplasm collection in France. As part of this 3-year study (2000-2002), the 10 000 accessions from INRA and GEVES wheat collections are being evaluated for

morphological, agronomic, biochemical and molecular traits. The aims of this work are to: describe the genetic diversity of these collections; establish a core collection based on a combination of descriptors: establish passport data (including pedigrees) and all evaluated traits; optimize genetic resources management and establish breeding populations for several purposes. The expected outcomes include: (1) identification of a core collection in 2003 and a survey of allelic diversity in this core collection at loci of interest using SNPs markers; (2) optimization of genetic resources management in the wheat collection: in 2002, all accessions will be regenerated; a sample of seeds available upon request and reference ears, will be conserved in a cold room at 4°C and 30% moisture; and (3) enrichment of the ERGE database (maintained under Microsoft® Access): evaluation data will progressively be added to the database to provide a better understanding of the genetic structure of diversity in wheat and enhance the use of this diversity in breeding programmes.

In situ and on-farm conservation

Pilot studies towards in situ *conservation of populations of wild emmer wheat in their native habitats*

Yehoshua Anikster presented a study carried out in Israel on wild emmer. Prior to implementing *in situ* conservation of one of the progenitors of cultivated wheats, *Triticum turgidum* subsp. *dicoccoides,* wild populations of this species are being monitored in their natural distribution area. In order to understand dynamics in the wild, demographic changes over time and genetic and phenotypic differences between the wheat stands in different habitats and different years were recorded. The effects of grazing, fires and years of drought were also taken into account. Until recently, polymorphism in allozymes and high molecular weight glutenin subunits, and polymorphism in qualitative morphological traits were used in the studies of genetic variation. Variation in morphometric and phenological phenotypic traits with a large environmental component were used to investigate the plants' interaction with their ecosystems. The analyses were performed in annually collected progenies of plants growing on permanent sampling points. The main station which has been under observation since 1983 is situated on pasture land near the settlement of Ammiad, west of the Sea of Galilee, on the edge of the distribution area of the species. This small station (a sampling area of 6 ha) which is very variable in rock micro-relief and slope exposures, proved to be extremely rich in genotypes and phenotypes that showed distinct affinities to specific habitats. The genetic structure and composition of the Ammiad populations has remained stable over time, with only minor oscillations. A number of populations in the Yahudiyya Reserve in the Golan Heights, also in the central part of the distribution area, were also partly distinct from each other and stable during an observation period of four years. During the same period, small wheat patches in the Mt. Meron Reserve in Upper Galilee outside the main distribution area lacked stability. Here, *ex situ* conservation would have to be ensured to conserve the less common genotypes.

Since the conservation sites are to function as long-term reservoirs of genetic variation, managerial practices that can increase variation are discussed.

Scientific research on wheat genetic resources

The variability of durum wheat across the Mediterranean region

Dolors Villegas presented the results of a study carried out at Centre UdL-IRTA, Lleida, Spain. Assessing variability within Mediterranean durum wheat is important to maintain valuable characters that could be used in the future. AFLP markers have been used to

genetically characterize this germplasm. Cluster analysis from AFLP data matrix showed that there was a wide genetic variability within a set of 42 genotypes from the Mediterranean area. Furthermore, this analysis grouped genotypes according to their country of origin. The variability found could be useful when exploited in breeding programmes.

A new model for selecting quantitative traits in wheat

Hansjörg. Walther presented the results of a long-term breeding programme undertaken by BAZ during the years 1978-2000 with the objective of simultaneously selecting for morphology, quality, yield and resistance traits. Many accessions obtained from genebanks were tested in the first 3 years of the programme in order to find suitable parents; then the crossings were made. A technique for selection of multiple resistance was developed during the project. Several high-yielding lines, resistant to the main fungal diseases, were obtained. The durability of resistance was shown to be stable after 12 years. The success of the project depended on the extensive use of variable germplasm and the implementation of a carefully planned selection strategy. The lines obtained were distributed to all the German breeders and are available from the German genebank.

History of wheat landraces in Austria

Paul Freudenthaler summarized a study carried out on the distribution of wheat varieties in the subalpine region. Commercial varieties and landraces appeared scattered in a ring-shaped distribution, like waves in a pool, with the most recently bred varieties in the centre and the landraces on the periphery, varieties becoming older and older from the centre to the periphery. Two wheat landraces (or rather, groups of landraces) were present, an older one called 'Alpine-Beard-Wheat' ('Alpiner Bartweizen') in the outermost ring, also collected by Mayr in the 1920s even further into the mountains, and a younger landrace, 'Sipachzeller Wheat' ('Sipachzeller Weizen'). There is clear evidence from the literature that the replacement of the older 'Alpine Beard Wheat' by the younger 'Sipachzeller Wheat' occurred between 1840 and 1860. Landraces were used in breeding and several commercial varieties were obtained.

The oldest germinable wheat was found at the University of Agriculture. It dates from 1877 and was induced to germinate by P. Ruckenbauer by applying low temperatures. This wheat is clearly distinct from the other two big groups of wheat landraces in the subalpine and alpine region, and represents the typical landrace quite common and widely sown in the Pannonian part of eastern Austria and in neighbouring Hungary.

A note on recent information sources on wheat

Iva Faberová informed the Group about two new important information sources on wheat.

Translation into English of a fundamental Russian publication on Triticum *taxonomy*

The fundamental publication on *Triticum* taxonomy by Dorofeev *et al.* (1979)[8] has been translated from Russian into English. It is the most comprehensive publication providing a detailed infraspecific classification of all cultivated and wild wheat species. This information has so far only been published in Russian and has therefore escaped the attention of wheat researchers in many countries of the world. The translation project will also make this wealth of information accessible to the international scientific community.

[8] Dorofeev, V.F., A.A Filatenko, E.F. Migushova, R.A. Udaczin and M.M. Jakubziner. 1979. Wheat. *in* Flora of cultivated plants. Vol. 1 (V.F. Dorofeev and O.N. Korovina, eds). Kolos, Leningrad (St. Petersburg), Russia. [in Russian]. 346pp.

The translation project was established during the Percival Symposium (Reading, UK, 1999) as a voluntary initiative by Laura Morrison (Oregon University, USA), Anna Filatenko (retired from VIR, St. Petersburg, Russia), Helmut Knüpffer (IPK-Gatersleben, Germany), Karl Hammer (University of Kassel-Witzenhausen, Germany) and Iva Faberová (RICP Prague, Czech Republic).[9] A call for financial support for the publication of the book, which is scheduled for 2003, was also presented.[10] A project fund that was started by a donation from CIMMYT of US$ 5000 has been established at the Society for the Support of Research on Cultivated Plants in Gatersleben (GFK). The translation has been carried out, and the text is currently being revised and updated by A. Filatenko. During 2002, it will be revised linguistically by Charles Jeffrey (St. Petersburg, Russia) and after final editing by the members of the international consortium, it will be published in 2003.

Wheat pedigree (genes and identified alleles) now available on-line

The Internet Catalogue of pedigrees and identified alleles, developed in collaboration between VIR St. Petersburg and RICP Prague, is now available on-line. This includes the genealogies of 69 632 accessions, linked to 2529 bibliographical references (data collected by P. Martynov, VIR). The first version of the catalogue is available on the Internet (http://genbank.vurv.cz/wheat/pedigree/). I. Faberová gave an on-line demonstration of the search functions available.

Conclusion

Presentation and adoption of the report

The section *Discussion and Recommendations* of the report was presented to the participants and was approved with minor modifications.

Election of the Chair and Vice-Chair

The Group wished to thank the co-Chairs for the enormous amount of work carried out in the past five years that enabled the formal establishment of the Group and the development of the database. It was suggested that A. Le Blanc and I. Faberová continue to share the chairing of the Group in the future. They accepted, but specified that the roles would be subdivided as follows: database matters would be dealt with by I. Faberová, while A. Le Blanc would be focal point for general coordination of the Group.

Any other business

L. van Soest suggested that during the upcoming Cereals Network meeting, planned for the year 2003, a half or whole day be specifically dedicated to separate meetings of the three Working Groups, in order for the Working Group on Wheat to discuss its progress.

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[9] Knüpffer, H., L.A. Morrison, A.A. Filatenko, K. Hammer, A. Morgounov and I. Faberová. 2002. English Translation of the Russian taxonomic monograph of *Triticum* L. by Dorofeev *et al*. Project progress report *in* Proc. 4th International Triticeae Symposium, Córdoba, Spain, 10-12 September 2001 (submitted). (A copy of the manuscript, which includes text of the translation of the chapter on *Triticum urartu* Thum. ex Gandil., can be requested from the first author).

[10] Morrison, L.A., I. Faberová, A. Filatenko, K. Hammer, H. Knüpffer, A. Morgounov and S. Rajaram. 2000. Call to support an English translation of the 1979 Russian taxonomic monograph of *Triticum* L. by Dorofeev *et al*. Wheat Inform. Serv. 90:52-53. (See also http://wheat.pw.usda.gov/ggpages/GrainTax/Wisdorofeev2.html).

Closing remarks

A. Le Blanc thanked I. Faberová on behalf of the Group for the excellent organization of the meeting. The latter replied by saying that it was an honour to have hosted the meeting and looked forward to seeing everybody again at the next meeting.

PART II. PRESENTED PAPERS

National Collections

Status of wheat collections in Austria

Paul Freudenthaler
Federal Office of Agrobiology, Linz, Austria

The Austrian genebanks

In Austria three genebanks are dealing with wheat collections:

1. the Federal Office and Research Centre of Agriculture in Vienna, mostly concerned with commercial wheat varieties and durum wheat;
2. the Genebank in Innsbruck, previously the Institute for Seed Testing and Plant Breeding in Rinn, run by the local government of Tyrol; and
3. the Federal Office of Agrobiology in Linz, concerned with landraces and commercial varieties.

The most valuable collection is maintained in Innsbruck and comprises landraces collected by Mayr in the 1920s, at a time when they were not at all influenced by plant breeding.

The wheat collection in the Federal Office of Agrobiology in Linz was established in 1968 based on the wheat collection of the Upper Austrian plant breeding cooperative, Saatbau Linz (collected by Körber) and extended by collecting activities carried out by the Federal Office of Agrobiology (Schachl). Those activities aimed mainly at collecting wheat landraces still existing at that time. Apart from Austrian commercial varieties, this collection also includes a large number of German varieties thought to be of potential interest for breeding efforts.

The wheat collection of the Federal Office and Research Centre in Vienna is composed mostly of commercial varieties, including a complete collection of the varieties released after 1970, as well as a large collection of durum wheat, since cultivation and breeding of hard wheat has a long-standing tradition in eastern Austria.

Certain NGOs also deal with wheat genetic resources, such as Arche Noah, organic farming organizations and individual farmers in collaboration with millers and bakers.

Status of the collections

Table 1 lists the wheat collections held in the Austrian genebanks.

Table 1. The Austrian wheat collections

	Genebank		
	Innsbruck	**Vienna**	**Linz**
Spring wheat	**161**	**337**	**341**
Wild	0	0	3
Landraces	150	18	111
Breeding lines	8	131	0
Advanced cultivars	5	188	227
Winter wheat	**70**	**303**	**873**
Wild	0	0	15
Landraces	39	13	215
Breeding lines	0	98	21
Advanced cultivars	31	192	622
Total	**231**	**640**	**1214**

Status and development of wheat collections in Bulgaria

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Introduction

Wheat is the most important crop in Bulgaria and is represented by large collections which are developed to meet the needs of wheat breeding. The first evaluation results of local and foreign wheat accessions in Bulgaria date back to 1887-1888, in reports from the two agricultural schools—Obrazcov Tchiflik in Russe and the Governmental agricultural school in Sadovo. Results of research studies on 8 foreign winter wheat cultivars and 9 Bulgarian summer wheats were published by K. Malkov in the first annual report of the Sadovo Experimental Station (Anonymous 1903).

Wheats grown in Bulgaria in the beginning of the 19th century were known as low productive variable populations (Popov *et al*. 1965). Wheat improvement is carried out both by selection based on the local primitive cultivars and by introduction of valuable material from abroad. During the period 1905-1945 cultivars 'Noe' and 'Mentana' were found suitable for direct introduction and for breeding (Popov *et al*. 1964, 1965). Later several new wheat cultivars were introduced and multiplied for direct use: 'San Pastore', 'Bezostaya 1', 'Avrora' and 'Kavkaz'. The year 1965 marks a turning point after which wheats sown in Bulgaria originate mainly from the breeding programmes and new entries are used only for breeding.

In 1940 Acad. D. Kostov started organizing plant genetic resources collections and their maintenance in Bulgaria. In 1952 this responsibility was entrusted to the Institute for Genetics in Sofia, but later in 1977 the Institute for Plant Genetic Resources (IPGR) in Sadovo was nominated as the national coordinating centre for the collecting, evaluation and conservation of plant germplasm. Sadovo hosts the National Genebank which provides medium- and long-term storage.

Status of seed collections

Wheat collections are maintained in three institutes in Bulgaria: IPGR-Sadovo, Institute for Wheat and Sunflower-Dobrich, and Institute for Cotton and Durum Wheat-Tchirpan (Table 1). The number of accessions is high because the identification of duplicates between the national genebank and other Bulgarian collections is not yet complete. The Bulgarian National Inventory carried out for the EURISCO Catalogue will clarify this issue.

Table 1. Status of wheat collections in Bulgaria

Institute name and wheat collections	No. of accessions									
	R[1]	E[2]	Origin		Type of material*				Storage type**	
			BGR	Foreign	CV	BR	POP	W	LT	MT
BGR01 - Institute for Plant Genetic Resources "K. Malkov", Sadovo										
Triticum aestivum L.	8577	6789	700	7877					6789	
Triticum durum Desf.	2107				707	1400			1982	
Triticum spp.	558							558	558	
BGR02 - Institute for Wheat and Sunflower "Dobrudja", Dobrich										
Triticum aestivum L.	10735	7600	4950	5785	2412	8090	120	113	2885	1720
BGR20 - Institute for Cotton and Durum Wheat, Tchirpan										
Triticum durum Desf.	1174		797	377	25	1123			25	1149

1 = R = recorded; 2 = E = evaluated; * CV = cultivars; BR = breeding lines; POP = populations; W = wild;
** LT = long-term: MT = medium-term

Evaluation

Evaluation and characterization of accessions are based on several descriptive traits: morphological (29), biological (7), disease resistance (3), productivity (8) and bread-making quality (3). The disease resistance of wheat genotypes to *Pseudomonas syringae* pvs. *atrofaciens*, *Erysiphe graminis* subsp. *tritici* and *Fusarium* (*F. graminearum, F. culmorum* and *F. avenaceum*) is screened in field collections and further by artificial inoculation in the laboratory (Vasilev *et al.* 1995; Kolev and Dobrev 1998). So far 6789 wheat accessions have been evaluated in Sadovo. Evaluation data for 3100 accessions are computerized.

Gliadin electrophoresis is used for genotype identification and characterization of the heterogeneity of accessions: 32 winter bread wheat and 20 durum wheat accessions originating from Bulgaria were studied by gliadin spectra (Stoyanova and Kolev 1996). Results showed that 22 *Triticum aestivum* and 17 local origin *T. durum* accessions were composed of several genotypes. The index of similarity (SI) for heterogeneous accessions was calculated by comparison between matching gliadin components based on band migration distances, band density and number of protein components. SI varies from 36% to 97% between the compared genotypes. It should be pointed out that the genotypes observed in different wheats of local origin are quite distinct from genotypes represented by wheat cultivars.

The discrimination power between the genotypes studied was further observed in the field during 2 successive years (Kolev and Stoyanova 1999). Genotypes differing in their gliadin spectra were isolated from heterogeneous durum wheat accessions. In most cases they appeared to differ in spike characters (spike length, number of spikelets per spike, number of seeds per spike, kernel row weight per spike). The variation of agronomic characters is accompanied by a corresponding variation of gliadin patterns between genotypes, due to the linkages between gliadin patterns and the traits affected by selection pressure in the breeding programmes.

Previous research showed that the loss of single seeds per cultivar due to ageing leads to the loss of genotype groups. This constitutes an undesirable selection and results in the narrowing of the genetic base of the cultivar (Stoyanova 1991). Evaluation during 4 successive years established that every regeneration event could be affected by the ecological conditions (Stoyanova 1992, 1996). Results showed that seed productivity of every gliadin genotype making up a wheat accession was influenced differently and unforeseen consequences to the genetic composition were detected.

Because the genotypes separated by gliadin electrophoresis are genetically different, they are affected differently by the environment during multiplication and by storage conditions. The common effect of seed ageing and regeneration on the genetic integrity observed in our studies may be described as a function of inter-cultivar gliadin composition, seed productivity per genotype, number of regeneration cycles and seed sample size (Stoyanova 1992, 1996). For this reason, each genotype identified in a wheat sample heterogeneous for gliadin spectra should be multiplied and stored as an individual accession.

Recently gliadins have been used for comparison of duplicates having the same name (Stoyanova and Kolev, unpublished). In 2000-2001 182 accessions were evaluated both agronomically in the field and for gliadin patterns. This parallel study aimed at illustrating the links between similarity of gliadin patterns and similarity of the observed agronomic traits, which were found to be very significant for 52% of the accessions. However, also some specific situations where the linkage is not so clear can be found. The preliminary results suggest that gliadin electrophoresis is an appropriate method for discriminating between similar genotypes. This simultaneous evaluation, both at the molecular level and in the field, is a helpful approach for the discrimination of true duplicates and similarity indices between wheat genotypes.

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Status of wheat collections in Croatia

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Introduction

The history and development of wheat collections in Croatia is closely related to the development of wheat breeding in the country.

The improvement of winter wheat varieties was initiated by Gustav Bohutinsky at the Agricultural School in Križevci near Zagreb in 1905 (Jošt and Cox 1989). He was able, in 1911, after testing of a number of introduced varieties from different European countries, to offer to Croatian farmers the variety 'Sirban Prolific' of unkown pedigree, introduced from Hungary. This variety was later replaced by the variety 'Osječka šišulja' (or U-1) produced by Mirko Korić in 1936, resulting from a direct cross K6/Marquis.

However, the intensification of wheat production in 1955 would have been impossible without the introduction of the high-yielding Italian varieties 'San Pastore' and 'Libellula' and others (e.g. the Russian variety 'Bezostaya-1'). A few years later, Croatian breeders were able to offer new improved semi-dwarf varieties that successfully replaced all introduced germplasm such as the variety 'Zlatna dolina' (Golden Valley) created by Josip Potočanac in 1971, which was also successfully grown in Italy and other countries (Tomasović *et al.* 1996).

Afterwards, new, high-yielding and well-adapted domestic varieties ('Super zlatna', 'Sana', 'Marija', 'Slavonija', 'Žitarka', 'Srpanjka', etc.) were produced by breeders. This situation was leading to genetic erosion of traditional Croatian wheat materials because the genebank was not established and traditional materials were unattractive to breeders.

Status of Croatian wheat collections

Nowadays, there are several public institutions and private companies dealing with wheat breeding and the introduction of wheat varieties. Three institutions in the country keep active wheat collections, including a total of 270 local populations, 920 varieties of different origin and 3400 research materials, distributed as follows:

1. Agricultural Institute Osijek: 400 varieties of different origin and 1200 research materials;
2. Institute of Plant Breeding and Production of Field Crops Zagreb: 200 varieties of different origin and 1800 research materials; and
3. Faculty of Agriculture of the University of Zagreb: 270 local populations, 320 varieties of different origin and 400 research materials.

Seeds are kept in paper bags at 2-4°C and regenerated every 2-4 years in the field. Passport, characterization and evaluation data are currently not available. These collections suffer from a lack of adequate storage capacity.

Traditional varieties that can properly represent Croatia in the European Wheat Collection are 'Sirban Prolific' and 'Osjecka šišulja' (or U-1).

Croatian wheat breeders believe that national, regional and global genebanks should become donors of genes of different origins for important agricultural traits and should permanently store genotypes with alleles influencing the expression of important traits, and that the distribution of requested genotypes should be organized on a reciprocal basis.

Future activites are strongly dependent on financial support from the Croatian Ministry of Agriculture and Forestry. However, further efforts will be focused on the creation and organization of a central wheat collection at the national level with adequate storage facilities and complete data availability.

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The Czech wheat collection

Zdeněk Stehno, Iva Faberová and Ladislav Dotlačil

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Introduction

Wheat is traditionally a very important crop in the Czech Republic. The total wheat growing area varied between 825 000and 971 000 ha during the last 7 years (Table 1). Spring wheat cultivars are grown on 5–10% of the total wheat growing area. Wheat occupies over 50% of the total cereal growing area (Fig. 1). Grain yield ranged recently from 4.21 to 4.85 t/ha and the average production of wheat grain reached nearly 4.5 million tons in 2001.

Wheat flour is used as a main component in mixtures with rye flour for baking purposes. Therefore bread-making quality is evaluated very carefully. Registered cultivars are classified according to quality parameters into four categories. Wheat cultivars with top bread-making quality parameters are included in the first class E (Elite). Class A (high baking quality) comprises cultivars having very good baking quality. Wheat cultivars with acceptable bread-making quality are classified as B. The last category C contains cultivars unsuitable for bread. Most of the 52 winter wheat cultivars registered in the Czech Republic in 2001 (Anonymous 2001) belong to categories A, B and C. Category E (Elite) is represented by only a few top quality cultivars (Table 2). The grain of wheat cultivars in category C and some of that in B is used as fodder for pigs, poultry and cattle.

In addition to the 52 winter bread wheat cultivars, 9 spring bread wheat cultivars, 2 durum and 2 spelt wheat cultivars are also registered (Anonymous 2001).

Table 1. Wheat growing area, yield and grain production in the Czech Republic (1995-2001)

	Year							
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Average**
Growing area (x 1000 ha)	830	899	825	912	867.5	970.5	923	889.57
Grain yield (t/ha)	4.60	4.67	4.41	4.21	4.35	4.21	4.85	4.47
Grain production (x 1000 tons)	3818	4198	3638	3839	3774	4086	4476	3975.57

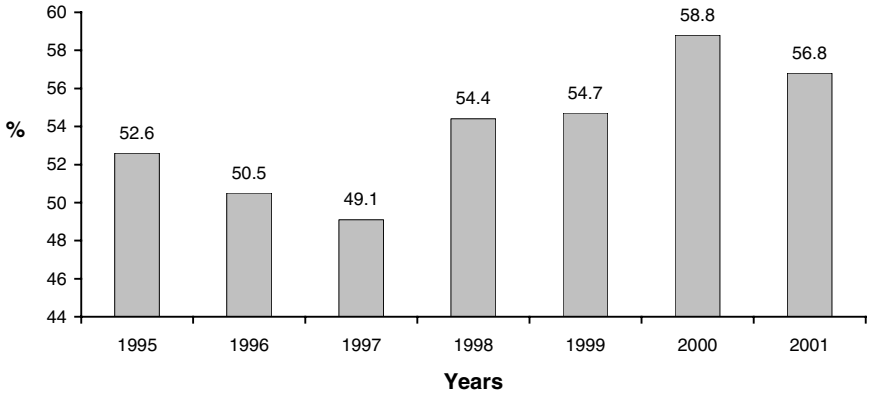

Fig. 1. Wheat growing area (% of total area of cereals)

Table 2. Distribution of the 52 winter wheat cultivars registered in the Czech Republic in 2001 according to bread-making quality categories

Bread-making categories	No. of cultivars
E (elite)	4
E–A	1
A (high baking quality)	14
A–B	1
B (bread-making quality)	15
C (unsuitable baking quality)	14
Unclassified	3
Total	**52**

History of wheat genetic resources in former Czechoslovakia and in the Czech Republic

The gathering and maintenance of wheat genetic resources have a longstanding tradition in former Czechoslovakia and in the Czech Republic. Breeders launched the first wheat working collections for their own needs at the end of the 19th century. Similar activities aimed at practical use of wheat assortment for breeding purposes continued in the period between the World Wars. The collections were located at the breeding and research stations Postoloprty, Kaštice, Valtice, Diosek, Jeneč and others. After World War II the small collections were transferred from former research and breeding stations at the beginning of the 1950s to the Research Institute of Crop Production (RICP)-Prague, the Agriculture Research Institute (former Research Institute for Cereals)-Kroměříž and the Research Institute of Plant Production-Piešťany. RICP-Prague coordinated cooperation between the institutes and has been responsible for the Czech collection of wheat genetic resources since 1993, when the former Czechoslovak wheat collection was divided into two national collections.

Description of the Czech wheat collection

The wheat collection is divided into two sub-collections according to growth characteristics. The winter wheat sub-collection consisted at the beginning of 2002 of 6145 bread, 122 durum, 62 spelt, 81 einkorn and 31 emmer accessions. Similarly, bread wheat accessions dominate the spring wheat sub-collection with 3260 accessions, completed by 785 durum, 18 spelt, 30 einkorn and 101 emmer wheat accessions. Other wheat species are minor in both sub-collections (Table 3, Fig. 2). At the end of 2001, the collection of wheat genetic resources in the Czech Republic contained a total of 10 886 accessions. The largest part of the whole collection is formed by bread wheat (87%) and durum wheat (8%) accessions.

Regarding the status of accessions, the whole collection consists of 6595 cultivars, 3220 breeding lines, 694 local varieties, 193 special stocks and 170 wild wheat relatives.

Sources of new accessions

Collecting missions are important sources of new wheat-related wild species and landraces. Wild relatives of wheat are maintained and documented as a separate collection consisting of over 1000 accessions. The small samples of seeds collected are multiplied and afterwards evaluated, focusing particularly on responses to diseases and grain quality parameters.

Exchange of seed samples with other genebanks also increases the size of the collection. Traditionally, registered cultivars are also included in the collection because of their interest to breeders. In such cases, breeders' rights are respected.

Table 3. Composition of the wheat collection at RICP Prague

Taxon	No. of accessions	Status*					
		U	W	L	CV	BR	SS
Winter wheat (crop code C01)							
T. aestivum L.	6145	1		268	3888	1890	98
T. araraticum Jakubz.	7		3	3		1	
T. boeoticum Boiss.	53		53				
T. compactum Host	20		1	7	9	3	
T. dicoccoides (Koern. ex Aschers. et Graeb.) Schwein	19		19				
T. dicoccum (Schrank) Schuebl.	12			11		1	
T. durum Desf.	122			4	70	48	
T. karamychevii Nevski	2		1			1	
T. macha Dekapr. et Menabde	4			3		1	
T. monococcum L.	28		1	27			
T. palmovae G. Ivanov	1					1	
T. spelta L.	62			26	27	9	
T. timopheevii (Zhuk.) Zhuk.	1			1			
T. turanicum Jakubz.	2			2			
T. turgidum L.	26			8	11	7	
T. urartu Thum. ex Gandil.	12		12				
T. vavilovii (Thum.) Jakubz.	3			2	1		
T. zhukovskyi Menabde et Eritzjan	1				1		
Winter wheat - subtotal	**6520**	**1**	**90**	**362**	**4007**	**1962**	**98**
Spring wheat (crop code C02)							
T. aestivum L.	3260	10	1	102	2039	1013	95
T. aethiopicum Jakubz.	2				2		
T. araraticum Jakubz.	41		41				
T. boeoticum Boiss.	2		1	1			
T. carthlicum Nevski	16		3	11	1	1	
T. compactum Host	29		1		12	16	
T. dicoccoides (Koern. ex Aschers. et Graeb.) Schwein	10		5	1		4	
T. dicoccum (Schrank) Schuebl	91		6	65	11	9	
T. durum Desf.	785	1	2	92	516	174	
T. flaksbergeri Navr.	1					1	
T. fungicidum Zhuk.	3					3	
T. ispahanicum Heslot	1			1			
T. kiharae Dorof. et Migusch.	1		1				
T. macha Dekapr. et Menabde	2					2	
T. miguschovae Zhir.	1		1				
T. militinae Zhuk. et Migusch.	1					1	
T. monococcum L.	28		6	16		6	
T. petropavlovskyi Udacz. et Migusch.	2		1	1			
T. polonicum L.	19		3	11		5	
T. sinskajae A. Filat. et Kurk.	1			1			
T. sp.	1	1					
T. spelta L.	18		4	3	2	9	
T. sphaerococcum Perciv.	12		1	9	1	1	
T. timococcum Zhuk.	1					1	
T. timonovum Heslot et Ferrari	1					1	
T. timopheevii (Zhuk.) Zhuk.	4		1	1		2	
T. turanicum Jakubz.	3		1			2	
T. turgidum L.	29	1	1	17	4	6	
T. zhukovskyi Menabde et Eritzjan	1					1	
Spring wheat - subtotal	**4366**	**13**	**80**	**332**	**2588**	**1258**	**95**
Grand total	**10886**	**14**	**170**	**694**	**6595**	**3220**	**193**

* U = unknown; W = wild; L = local varieties; CV = cultivars; BR = bredeers' material; SS = special stocks

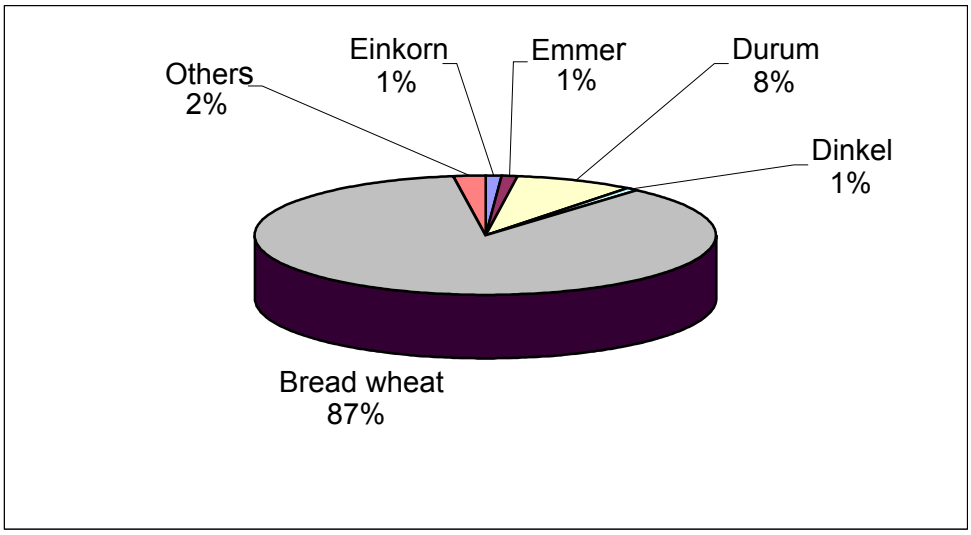

Fig. 2. Distribution of the main species in the Czech wheat collection

Standard evaluation

Wheat accessions are systematically evaluated and described according to the national descriptor list for genus *Triticum* L. (Bareš *et al.* 1985) for 2-3 years. At least 2 tester cultivars are included in each set of accessions tested. The standard plot size is 4.5 m^2. During growth, morphological characteristics important for sample characterization, growth and developmental stages and canopy characteristics are evaluated. Responses to disease, primarily to rusts, are tested under strong infection pressure in the infection nursery and evaluated by specialists. The composition of spikes is analyzed after harvest and at the same time seed samples are evaluated for grain quality. Parameters such as protein content, gluten content, gluten index and sedimentation (Zeleny test) are evaluated and considered as standard grain quality characters. The results of characterization and evaluation for 5755 accessions (= 53% of the whole collection) have already been included in the documentation system EVIGEZ.

Maintenance of seed samples

Wheat seed samples are maintained in the Czech genebank as part of the active collection at a temperature of –5°C. The most valuable accessions are duplicated in the base collection kept under –18°C. The number of wheat accessions stored in the genebank has reached 9654 samples (= 89% of the whole collection). Some samples, not yet stored, are still kept in the working collection under evaluation. As for valuable accessions of other crops, safety-duplicates of important wheat accessions are stored in the Research Institute of Plant Production in Piešťany, Slovakia.

Documentation of the Czech wheat collection

Data on wheat genetic resources represent an important part of the EVIGEZ database—the Czech documentation system of plant genetic resources consisting of passport, characterization and evaluation data and genebank management data. Passport data of wheat together with other crops are available on the Internet (http://genbank.vurv.cz/genetic/resources/).

Rationalization of the wheat collection

The first steps towards the creation of a wheat "core collection" have been made recently. Valuable information has been obtained from pedigree analyses. As well as cluster analysis of parentage coefficients, the model collection has been divided into clusters and cluster representatives were selected. A study of morphological characters, composition of storage proteins and DNA fingerprinting are proposed as further steps to refine the selection of accessions for the core collection.

International cooperation

In addition to the basic activities mentioned above, international cooperation is supported and developed through participation in the ECP/GR European Wheat Database (EWDB) (France/Czech Republic), Genetic Resources Information System—"core" collection (Russia/Czech Republic), Winter Wheat East European Regional Trial (organized by CIMMYT), Barrande projects (France/Czech Republic) and others.

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Wheat genetic resources in France

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Introduction

Wheat genetic resources in France are managed within the French small-seed cereal cooperative network. This network associates public and private research and breeding institutes according to the strategy elaborated within the framework of the National Charter for the conservation of genetic resources. The purpose of this network is to manage the National Collection and a working collection. It is led by a coordination unit and overseen by a steering committee. The members of the network participate in the multiplication of seed and evaluation of genotypes from the collection and new accessions to be included in the collection. The seed samples are divided between two conservation sites: INRA-Clermont-Ferrand and GEVES-Le Magneraud. Data are recorded in a centralized database called ERGE using the MCPDL and other descriptors for evaluation.

Wheat subgroup of the cereal network

In 2001-2002, all (18) French private breeders, GEVES and several INRA stations participated in the wheat subgroup. All participants signed the National Charter defining rights and obligations. The involvement of breeders in the management of genetic resources of wheat, as of all cereals, became essential when the network was established. This was to create a dynamic collection which would be actively used. Nevertheless, members of the network remain aware of the need to maintain in collections the heritage of mankind represented by cultivars (as they are removed from the catalogue of cultivated varieties), old varieties, parent material, botanical varieties and progenitor species of cultivated species.

- The involvement of **private companies** in the establishment of the collection varies according to the company. An inventory has been made of 839 wheat genotypes from their collections. Often, the objective of a private collection is to supply genetic variability which has a direct advantage for selection programmes in progress. For this reason, these collections are usually restricted or not readily open to exchanges. The private sector contribution in the network collection concerns essentially cultivars as they are removed from the catalogue of cultivated varieties. They participate in the multiplication of seeds and also in the observation and evaluation of genotypes from the collection and of new accessions to be included in the collection.
- **GEVES**, whose usual role is to examine varieties presented for registration in the catalogue of species and varieties of cultivated plants, however proposed to coordinate the activities of the cereal genetic resources network. As it maintains large collections of cultivars, it has the responsibility to conserve seeds from the network collection, especially those bred by private companies and also genotypes especially introduced by the network on the basis of reciprocal exchanges. Seeds are conserved in aluminium/plastic bags soldered by heat in a +4°C cold room at 30% humidity (active bank) and in a -18°C frost-free freezer (long-term storage). A safety-duplicate is conserved at INRA-Clermont-Ferrand in –18°C frost-free freezers.
- **INRA-Clermont-Ferrand** coordinates INRA activities on cereal genetic resources and is the main partner of the French network. Five INRA laboratories, namely Clermont-Ferrand, Dijon, Montpellier, Rennes and Versailles-Mons, are involved in the establishment of the INRA collection. Seeds of accessions from all INRA collections are centralized in Clermont-Ferrand, in plastic bags, in a +4°C cold room at 30% humidity. A drying chamber is used to reduce seed humidity to below 10%. A safety-duplicate of the

wheat national network collection is conserved at GEVES Le Magneraud in –18°C frost-free freezers.

The INRA collection contains over 10 000 accessions of soft wheat for approximately 7000 original genotypes. A collection of durum wheat containing some 1000 accessions is stored at Montpellier. These accessions can be distributed by INRA on the basis of reciprocal exchanges (see the *Catalogue of INRA genetic resources of wheat* (1997), available upon request).

The French wheat collection

The National Collection represents a group of genotypes maintained under the principle of free access which is promoted by France within the international community. As a general rule, it includes genetic resources exclusively of French origin and incontestably belonging to France. It contains cultivars, bred lines, old varieties and landraces. In the future, foreign material may be admitted to the National Collection at the request or with the permission of the owner country concerned, especially if this material has been lost elsewhere, or if safe maintenance in its original collection is uncertain or subject to risk of loss.

The National Wheat Collection contains 1969 accessions, all French material, available freely worldwide (list published in 1997).

The Wheat Working Collection includes 1086 accessions of diverse origin whose availability is restricted to the French network.

The Multilateral System concept supported by the European Union and recently accepted by the International Treaty could modify, in the coming years, the current French policy regarding the exchange of foreign material, whose availability is limited by the existing international legislation.

Part of the originality of the constitution of these two collections lies in the justification of each accepted sample by one of the 10 admission criteria defined by the members of the network. This criterion can be considered as a primary descriptor of a genetic resource. It gives information about why it is of interest for the collections and what justifies its inclusion therein. Moreover the database devotes a special column to principal attributes (or characteristics) of each genetic resource. This information is more relevant than the single reason for admission.

Evaluation of wheat genetic resources

Breeders' interest in a programme for the management of genetic resources can only be maintained if the collection established offers mainly material which can be used as a parent for breeding. It was with this in mind that the partners of the wheat subgroup set up nurseries at various locations, from 1990 onwards, for evaluation and characterization.

Each year these networks assign a number of genotypes from the National Collection for evaluation to different members, or simply genotypes offered to this collection, so that they can be described more thoroughly.

These evaluations have three purposes:

- better knowledge of certain genotypes chosen among the genetic resources of the National Collection;
- primary description of material proposed for admission to the National Collection and choice of material admitted; and
- rapid utilization of genetic resources in breeding programmes.

In 2001-2002, 70 wheat genotypes including 21 standards were planted and observed in 23 different places in France. From 1990 to the present, 705 wheat accessions were observed within the network and provided 257 new accessions to be entered into the Network Collection. About 15% of them have been used as parents in breeding programmes.

Data recovered from the network nurseries are computerized in a centralized database connected to the central database for small-seed cereal genetic resources (Le Blanc 2001).

The currently used 1-9 scoring scale has been reduced to five categories. This was done in order to take into account the multiple origins of the data: several assessment sites, different evaluators, different years, unplanned observation, etc. These five categories correspond to a regrouping of the evaluator's scores as follows: 1-2, 3-4, 5, 6-7, 8-9. In the case of susceptibility to disease, 1 corresponds to very strong resistance and 9 to high susceptibility. As for the date of heading, 1 = very late and 9 = very early. For plant height, 1 = very short and 9 = very tall. Reference to a control variety is necessary in case of environmental influence and, for diseases, the reference genotypes must accurately display their expected levels of susceptibility or resistance, otherwise scores cannot be trusted.

The number of times a genotype receives the same score is counted for each of the five categories. Two further fields are available to add comment/information regarding the scoring results.

This system has the advantage of showing the disparity or similarity of results from different sites at a glance, while still showing, in most cases, the assessment of the intrinsic value of a genotype. The majority of results fall into one category, or two adjacent categories.

Near-future new objectives

A programme has just been accepted by the Ministry of Research following a call for proposals for a "Genetic Resources Centre" with the collaboration of the BRG (Genetic Resources Board), from 2002 to 2003. The main objectives of this project, as far as wheat is concerned, are the following:

- improvement of the system (seed conservation, multiplication, distribution, database management, etc.);
- inventory of durum wheat and wheat-related species collections;
- commencement of a minimum description of the whole collection;
- inclusion of molecular descriptors; and
- definition of a core collection.

Seed and data access

Access to the national genetic resources is unrestricted and free of charge for partners of the network (for the supply and distribution of seeds) and for non-members in case of exchange. For the latter, non-reciprocal requests for more than 20 samples can be charged for, along with a postage fee. Members of the evaluation network have unrestricted use. Access to the working collection material is restricted to network members. Depending on the quantity available, 20 to 50 seeds are supplied. Seeds are supplied all year round if there is sufficient available stock. Requests for seeds or information on the National Collection should be sent to the coordination unit.

Data are available on the BRG Web site (http:/www.brg.prd.fr). This gives access to a limited set of five passport descriptors. The whole description is available upon request submitted to the coordination unit.

Reference

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The wheat collection of the Genebank of IPK Gatersleben, Germany[11]

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Introduction

The former Institute of Cultivated Plant Research was founded in 1943 by Hans Stubbe. Its aim was the comprehensive study of the genetic diversity of a wide spectrum of cultivated plants and their wild relatives. After the reunification of Germany in 1992, the institute became the Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK, Institute of Plant Genetics and Crop Plant Research). At present the genebank of IPK at Gatersleben comprises more than 90 000 accessions of cultivated plant species and their wild relatives, belonging to more than 2300 species, more than 700 genera and 90 families (after Knüpffer 1999a, updated). The genus *Triticum* with 17 669 accessions is by far the largest collection. During the coming years, this number will double as a result of the planned merging with the collections of the present Braunschweig genebank, which will contribute another 17 798 wheat accessions (cf. Table 1). After reduction of duplication, the final number is expected to be below 35 000 accessions.

Throughout the history of the Gatersleben institute and the genebank, wheat has always been one of the main targets of collecting, research and evaluation. This can be seen from the large number of publications on wheat genetic resources by IPK staff, with emphasis on the genebank, and by cooperation with partners for evaluation.

Composition of the Gatersleben wheat collection

The present species composition of the wheat collection is given in Table 1. The accessions referred to as *Triticum* sp. are recent acquisitions which will be taxonomically determined during future rounds of multiplication. Most of the material belongs to bread wheat, *Triticum aestivum* (12 277 accessions). Other species with a large number of accessions are *T. durum* (1528), *T. aethiopicum* (619) and *T. dicoccon* (474). After merging the two genebank collections, the *T. spelta* collection will increase by 2277 accessions.

Of the Gatersleben collection, ca. 53% are landraces and wild species which have been collected and 47% are cultivars and lines received through exchange. Forty-three percent are winter wheats and 57% spring wheats.

[11] Update of a poster presented at The Percival Symposium: Wheat—Yesterday, Today and Tomorrow. A meeting to celebrate the life and work of John Percival (1863-1949), 12-13 July 1999, School of Plant Sciences, The University of Reading, United Kingdom.

Table 1. Species composition of the Gatersleben wheat collection. The second figure in the third column gives the additional accessions expected to be added from the Braunschweig collection (figures from C. Germeier, pers. comm.). The number of different botanical varieties of each species represented in the Gatersleben collection is indicated in the fourth column. The most frequent varieties for each species are listed under the species names.

Species, most frequent varieties		Accessions	Varieties
***Triticum aestivum* L. em. Fiori et Paol.**		12 277+11 450(*)	170
var. *lutescens* (Alef.) Mansf.	2872		
var. *aestivum*	2663		
var. *ferrugineum* (Alef.) Mansf	1307		
var. *milturum* (Alef.) Mansf.	989		
var. *aureum* (Link) Mansf.	515		
var. *graecum* (Körn.) Mansf.	467		
var. *erythroleucon* (Körn.) Mansf.	388		
var. *albirubrum* (Körn.) Mansf.	209		
var. *villosum* (Alef.) Mansf.	197		
***T. aethiopicum* Jakubz.**		619+2	79
var. *brownii* (Perciv.) A. Filat.	64		
var. *arraseita* (Hochst. ex Körn.) A. Filat.	55		
var. *nigrimarginatum* (Chiov.) A. Filat.	29		
var. *nigriviolaceum* (Orlov) A. Filat.	28		
var. *rufescens* (Perciv.) A. Filat.	28		
var. *schimperi* (Körn.) A. Filat.	23		
var. *albinigrum* (Vav.) A. Filat.	22		
***T. araraticum* Jakubz.**		61+5	6
var. *nachitschevanicum* (Jakubz.) Jakubz.	8		
var. *thumanianii* (Jakubz.) Jakubz.	7		
***T. baeoticum* Boiss. em. Schiem.**		97+69	32
var. *baeoticum*	4		
var. *abovjanii* A. Filat. et Dorof.	3		
var. *mayssuriani* (Zhuk.) A. Filat. et Dorof.	3		
var. *reuteri* Flaksb.	3		
***T. carthlicum* Nevski**		39+28(**)	4
var. *carthlicum*	15		
var. *stramineum* Zhuk.	5		
***T. dicoccoides* (Körn. ex Aschers. et Graebn.) Schweinf.**		89+43	20
var. *kotschyi* Jakubz.	8		
var. *arabicum* Jakubz.	4		
var. *aaronsohnii* (Flaksb.) Perciv.	3		
var. *macraaronsohnii* Jakubz.	3		
var. *namuricum* Jakubz.	3		
var. *pseudojordanicum* Jakubz.	3		
var. *safedicum* Jakubz.	3		
var. *vavilovii* Jakubz.	3		
***T. dicoccon* Schrank**		474+325	38
var. *dicoccon*	82		
var. *haussknechtianum* A. Schulz	57		
var. *volgense* Flaksb.	45		
var. *rufum* Schübl.	39		
var. *aeruginosum* Flaksb.	32		
var. *serbicum* A. Schulz	28		
***T. durum* Desf.**		1528+1629	53
var. *hordeiforme* (Host) Körn.	196		
var. *reichenbachii* Körn.	183		
var. *affine* Körn.	177		
var. *leucurum* Alef.	174		
var. *leucomelan* Alef.	155		
var. *melanopus* Alef.	115		

(*) This figure includes 233 accessions designated as *T. compactum* and 21 accessions designated as *T. speltiforme*

(**) This figure includes 1 accession designated as *T. persicum*

Table 1 (cont.). Species composition of the Gatersleben wheat collection

Species, most frequent varieties		Accessions	Varieties
***T. fungicidum* Zhuk.**		7+1	-
***T. ispahanicum* Heslot**		7+4	1
var. *ispahanicum*	4		
***T. jakubzineri* Udacz. et Schachm.**		2	1
var. *jakubzineri*	1		
***T. karamyschevii* Nevski**		8+2	1
var. *karamyschevii*	7		
***T. macha* Dekapr. et Menabde**		16+41	7
var. *subletshchumicum* Dekapr. et Menabde	5		
var. *macha*	2		
var. *palaeoimereticum* Dekapr. et Menabde	2		
***T. militinae* Zhuk. et Migusch.**		3	1
var. *albimilitinae* A. Filat. et Migusch.	1		
***T. monococcum* L.**		149+200	13
var. *vulgare* Körn.	61		
var. *macedonicum* Papag.	27		
var. *hornemannii* Clem.	17		
***T. petropavlovskyi* Udacz. et Migusch.**		6	2
var. *petroferrugineum* Udacz. et Migusch.	1		
var. *petropavlovskyi*	1		
***T. polonicum* L.**		69+65	20
var. *chrysospermum* Körn.	14		
var. *polonicum*	9		
var. *villosum* Desv.	5		
***T. sinskajae* A. Filat. et Kurk.**		5+1	-
***T. soveticum* Zhebrak**		1	-
***T. spelta* L.**		113+2277	15
var. *duhamelianum* (Mazz.) Körn.	38		
var. *album* Alef.	29		
var. *arduini* Mazz.	11		
***T. sphaerococcum* Perciv.**		26+21	7
var. *rubiginosum* Perciv.	6		
var. *rotundatum* Perciv.	3		
var. *tumidum* Perciv.	3		
***T. timonovum* Heslot et Ferrari**		3	-
***T. timopheevi* Zhuk.**		14+32	3
var. *timopheevi*	8		
***T. turanicum* Jakubz.**		17+7	6
var. *notabile* (Perciv.) Gökg.	10		
var. *insigne* (Perciv.) Gökg.	2		
***T. turgidum* L.**		135+177	31
var. *salomonis* Körn.	12		
var. *martensii* Körn.	11		
var. *megalopolitanum* Körn.	10		
var. *dinurum* Alef.	9		
var. *speciosissimum* Körn.	9		
***T. urartu* Thum. ex Gandil.**		53+8	10
var. *nigrum* Thum. ex Dorof. et al.	7		
var. *spontaneoalbum* Thum. ex Dorof. et al.	5		
var. *binartulutriru* Gandil. ex Dorof. et al.	3		
var. *spontaneorubrum* Thum. ex Dorof. et al.	2		
***T. vavilovii* (Thum.) Jakubz.**		9+1	5
var. *vavilovii*	4		
***T. zhukovskyi* Menabde et Eriz.**		6+3	1
var. *zhukovskyi*	6		
***Triticum* sp.** (species not yet determined)		1828+1402	
***Triticum* species hybrids**		8+4	
Total		**17 669+17 798**	**526**

Table 2 lists the numbers of wheat accessions according to their countries of origin. Eight to six per cent of the accessions originate from Italy, Iran, the former Soviet Union, Austria, Ethiopia, Germany and India (in descending order).

Table 2. Countries of origin of the Gatersleben wheat collection. Only countries with more than 40 accessions are listed. It was not always possible to correctly assign accessions from countries which were recently divided into several new countries.

Accessions	Country of origin
1319	Italy
1252	Iran
1182	Former Soviet Union[1]
1134	Austria
1066	Ethiopia
909	Germany
880	India
741	China
630	Libya
621	Greece
508	United States of America
482	Former Czechoslovakia[2]
479	Turkey
395	France
389	Poland
310	Portugal
301	Afghanistan
263	Nepal
233	Pakistan
204	Bulgaria
196	Iraq
192	Romania
167	Albania
164	Sweden
161	Spain
155	Tunisia
137	Cyprus
136	Japan
123	Frmer Yugoslavia
112	Mexico
108	Hungary
102	Argentina
95	United Kingdom
86	Finland
84	Israel
75	Morocco
75	Kenya
66	Australia
64	Democratic People's Rep. of Korea
63	Lebanon
57	Netherlands
53	Canada
47	Switzerland
45	Chile
292	34 other countries
1508	Unknown[3]

[1] incl. 193 Georgia, 108 Russia, 107 Armenia, 66 Azerbaijan, 54 Uzbekistan, 46 Tajikistan, 42 Ukraine, and others

[2] incl. 367 Slovakia, 10 Czech Republic

[3] incl. 336 non-specified accessions from Europe

Acquisition of material

The wheat collection, like other collections of the genebank, has two main sources (cf. Hammer *et al.* 1993):

1. collecting activities, mainly of Gatersleben staff (e.g. Central Europe, Mediterranean, Near East, Caucasus, Central Asia, China, Korea, Ethiopia), but also historical collections from the first half of the 20th century (e.g. Turkey, Tibet, Nepal, Hindu-Kush, Ethiopia, Balkan);
2. breeders, botanical gardens, research institutions.

A large part of the collected material has to be considered as unique, especially the accessions collected by German researchers. The expeditions that contributed the largest number of accessions to the wheat collection are listed in Table 3. In total, more than 100 expeditions provided 9080 accessions to the genebank.

The most important donor institutions are listed in Table 4. In total, 9310 wheat accessions of the genebank were obtained from ca. 380 institutions and persons, among them 3219 accessions from Germany (110 donors), 1457 accessions from the former Soviet Union (10), 912 accessions from Italy (8), 677 accessions from the USA (12), and 422 accessions from 5 institutions in the Czech Republic.

Table 3. Collecting expeditions and collectors with the largest contributions of wheat accessions to the present genebank collection. Only expeditions yielding more than 100 accessions are listed.

Accessions	Expedition or collector	Collecting institution or country
1208	H. Kuckuck, FAO Collection in Iran 1952-54	FAO
874	E. Mayr, Alpine Landrace collection 1922-32	Austria
683	C. Lehmann, Collection in Ethiopia 1986	IPK
577	Univ. Bangor North India Expedition 1976	Univ. Bangor, UK
388	Libya 1983	IPK
354	H. Stubbe and others, Balkan 1941	IPK
316	German Expedition to Tibet 1938/39	Germany
249	German Hindukush Expedition 1935/36	Germany
221	H. Stubbe and others, Balkan 1942	IPK
214	A. Herrlich, India and Nepal 1937-38	Germany
199	S. Italy 1982	IPK
185	Czechoslovakia 1981	IPK
179	Univ. Bangor Pakistan Expedition 1974	Univ. Bangor, UK
174	Libya 1981	IPK
150	Univ. Bangor Nepal Expedition 1971	Univ. Bangor, UK
148	S Italy 1981	IPK
135	FAO Collection from Cyprus	FAO
131	R. Maly, Italy 1950	IPK
128	FAO Collection from Greece	FAO
117	S. Italy 1984	IPK
110	K.O. Müller, Anatolia, Turkey 1928-30	Germany
102	Italy 1989	IPK

Table 4. Donor institutions which contributed the largest number of accessions to the genebank wheat collection. Only institutions with more than 50 accessions are listed.

Accessions	Donor institute or person
1398	VIR, St. Petersburg, Russia
775	Genebank Bari, Italy
583	Biologische Bundesanstalt Braunschweig, Germany
525	Plant Breeding Station Halle, Germany
477	Plant Breeding Station Schlanstedt, Germany
557	USDA Beltsville, Maryland, USA
362	Genebank Prague-Ruzyne, Czech Republic
367	Agricultural Station Sacavem, Portugal
215	Plant Breeding Station Langenstein, Germany
205	Variety Testing, Nossen, Germany
175	Institute of Cereal Research Hadmersleben, Germany
162	Genebank Tápiószele, Hungary
149	USDA, National Small Grains Collection Aberdeen, Idaho, USA
126	INRA Versailles, France
116	INIA Londres, Mexico
110	Collection E. Schiemann, Berlin-Dahlem, Germany
105	Plant Breeding Station Njoro, Kenya
91	IHAR Genebank Radzików, Poland
96	Institute of Phytopathology Halle, Germany
86	Agricultural Research Institute Tolbuhin, Bulgaria
85	Agrobotanical Garden Szentes, Hungary
79	A. Blondeau, Bersée, France
74	Institute of Agriculture, Weihenstephan, Germany
73	Botanical Garden, University of Stuttgart-Hohenheim, Germany
74	Institute of Plant Breeding, Gülzow-Güstrow, Germany
68	Institute of Cereal Genetics, Rome, Italy
68	Institute of Ecology, Valdivia, Chile
64	National Institute of Agrobiological Resources, Tsukuba, Japan
63	Research Institute for Cereals and Technical Plants, Fundulea, Rumänien
54	Institute of Cereal Research, Bernburg-Strenzfeld, Germany
52	Institute of Tropical and Subtropical Agriculture, Exp. Station Oberholz/Leipzig, Germany

Reproduction and storage

The wheat accessions (about 1000/year) are multiplied in the field on plots of 2.5 m^2. The multiplication of wild species accessions is labour-intensive. In self-pollinating species such as wheat, populations of morphologically different types are being split up into lines which are maintained as separate accessions in order to reduce the risk of genetic change in accessions during multiplication (Mansfeld and Lehmann 1957; Knüpffer 2002). A herbarium or spike sample and a seed sample are taken from every accession for later reference, e.g. to check the identity after regeneration.

Seeds are stored in long-term storage at 0°C or -15°C.

Characterization and evaluation

The genebank collections have undergone intensive characterization and evaluation. The accessions are characterized routinely in the field during multiplication and rejuvenation. Morphological characterization includes the botanical determination of varieties and other infraspecific categories according to the system used, for example Mansfeld (1951) for *Triticum aestivum* and the Russian Wheat Flora[12] (Dorofeev *et al.* 1979) for other species. Every new accession is determined botanically during the first cultivation. The following descriptors are observed, among others: phenological data (such as days to flowering), 1000-grain weight, lodging, overwintering, susceptibility or resistance to naturally occurring diseases.

In cooperation with other groups of the Gatersleben institute, and with partners from other institutions, large parts of the collection have been extensively evaluated for resistance to diseases and abiotic stresses (cf. literature review). A seed protein screening of the cereal collections was carried out in the 1970s and 1980s. More recently, genetic studies and molecular marker analyses have been carried out.

Documentation

The traditional manual documentation is being carried out with a sophisticated system of cross-referenced card files and books. Passport, management, and increasingly also characterization and evaluation data are being registered in a database system, using the database management system Visual FoxPro in a local area network. The genebank's passport database for all crops is searchable on-line (http://fox-serv.ipk-gatersleben.de). For the united German Genebank, a new Genebank Information System (GBIS) will be developed under Oracle. The documentation system is being complemented by colour slides and digital images of wheat accessions under multiplication.

Passport data of the Gatersleben wheat collection have been included both in the East European Wheat Database developed in Radzików, Poland (Podyma 1992) and the ECP/GR Wheat Database maintained in Prague, Czech Republic (http://genbank.vurv.cz/ewdb/).

Review of literature on the basis of results from Gatersleben

Various research activities have been carried out on wheat genetic resources at Gatersleben. They include fields such as taxonomic research (classification of cultivated wheat species), genebank-specific questions of reproduction, genetics, morphology and anatomy, mutation research, or physiology. The wheat publications of the genebank staff and other researchers studying our material comprise ca. 100 research papers and other publications covering more than 50 years. Papers dealing with *Aegilops* or *Triticale* only are not included. A complete overview of relevant genebank literature covering the period from 1943 to 1993 was given by Hammer *et al.* (1994). The following topics have been selected:

[12] The Wheat Flora is being translated into English and will be published in 2003 or 2004 (cf. Knüppfer *et al.* 2002).

Taxonomy and evolution

Filatenko and Hammer 1997; Filatenko *et al.* 1999, 2001a, b, 2002; Hammer and Matzk 1993; Knüpffer *et al.* 2002; Korzun *et al.* 1998; Mansfeld 1951, 1955; Morrison *et al.* 2000; Padulosi *et al.* 1996; Perrino *et al.* 1996, 1998; Schultze-Motel 1987; Schultze-Motel and Meyer 1981; Szabó and Hammer 1996.

Morphology and anatomy

Filatenko *et al.* 2001b, 2002; Fritsch *et al.* 1997; Hammer and Specht 1998; Kruse 1973, 1980.

Resistance

Börner *et al.* 1998d, 2000b, 2001b; Frauenstein and Lehmann 1979; Hammer *et al.* 1996; Meinel *et al.* 1998; Nover 1962; Nover and Lehmann 1964, 1967, 1969, 1975; Nover *et al.* 1972.

Genetics

Ben Amer and Börner 1994, 1997a, b; Ben Amer *et al.* 1992a, b, 1995, 1996, 1997, 2001; Börner 1998, 1999; Börner and Korzun 2001a, b; Börner and Meinel 1993; Börner and Mettin 1988, 1989; Börner and Worland 1996; Börner *et al.* 1987, 1991, 1992a, b, 1993a, b, 1996, 1997a, b, 1998a, b, c, 2000a; Cadirgan *et al.* 1999; Flintham *et al.* 1997; Friebe *et al.* 1992; Khlestkina *et al.* 2001a, b; Korzun *et al.* 1996, 1997a, b, 1998, 1999; Mettin *et al.* 1991; Pestsova *et al.* 2000, 2001; Plaschke *et al.* 1996; Röder *et al.* 1995; Sagi *et al.* 1993; Salina *et al.* 2000; Schliephake *et al.* 2001; Schubert *et al.* 1996; Worland and Börner 1997; Worland *et al.* 1992, 1994, 1998.

Physiology

Apel and Lehmann 1967, 1970; Apel *et al.* 1975, 1981.

Quality characters

Lehmann *et al.* 1978; Müntz and Lehmann 1987; Müntz *et al.* 1974, 1979; Porsche *et al.* 1979; Rudolph *et al.* 1975.

Collecting missions

Hammer and Lehmann 1985; Hammer and Perrino 1984; Hammer *et al.* 1981, 1985a, 1994; Perrino and Hammer 1982, 1983, 1984; Perrino *et al.* 1984.

Genebank

Börner *et al.* 2001a; Hammer *et al.* 1994, 1996, 1998; Jaradat *et al.* 1996, Knüpffer 1999b, c; Lehmann 1963, 1977; Lehmann and Mansfeld 1957; Mansfeld 1955; Specht *et al.* 1997, 2000.

Work has been initiated by an international consortium to translate the Russian wheat monograph (Dorofeev *et al.* 1979) into English (cf. Morrison *et al.* 2000; Knüpffer *et al.* 2002).

Availability of material to users

The available accessions (i.e. those with enough seeds and germinability) are listed in the Index Seminum (e.g. Knüpffer 1999b, c). Material is freely available in small quantities, after signing a Material Transfer Agreement. Users may also interrogate the genebank's on-line database (http://fox-serv.ipk-gatersleben.de). Searches in the local database which contains more information are carried out on request.

International cooperation

The genebank contributed wheat passport data to the following Central Crop Databases: ECP/GR European Wheat Database (France/Czech Republic), East European (former COMECON) database of wheat (Radzików, Poland; catalogue printed in 1992), IPGRI database of wild *Triticum* and *Aegilops* species (Aleppo, Rome).

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The Greek national wheat collection

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Two institutions in Greece are responsible for the national wheat collection: the Cereal Institute and the Greek Genebank.

The Ceral Institute collection

The Cereal Institute holds nearly 20 old and 50 new cultivars (see list below) and a similar number of promising breeders' lines. The wheat collection is an active collection, duplicated every 3 years and conserved in cloth bags at 6-8°C and 60% humidity. Documentation and characterization are based on pedigree and some very important characteristics such as grain quality, lodging, yield stability and resistance to three rusts. This active collection is a source of very useful genetic variation in our continuous breeding programmes.

List of the wheat cultivars in the Cereal Institute collection

Bread wheat

Thermi	Lydia	Nestos-2
Niki	Melia	Aliakmon
Vitsi	Strymonas	Triton
Galini	Louros	Hyperion
Amydas	Pinios	Nireas
Ptolemais	Arahthos	Pigasus
Yenerozo-s	Loudias	Appolon
Yecora-s	Axios	Iapetos
S.Cerros-s	Thiamis	Orpheas
Aeges	Euros	Euridiki
Vergina	Eurotas	Elissavet
Dio	Alphios	Oropos
Dodoni	Aheloos	Danai
Gorgona	Aheron	Volvi
Xenia	Nestos-1	Doirani

Durum wheat

Mexicali-81	Samos	Aias
Capeiti-82	Syros	Rodos
Appulo-s	Sifnos	Papadakis
Selas	Smaragdi	Ilektra
Santa	Smili	Limnos
Sarti	Sunio	C-0365
Sapho	Stagira	C-0367

The Greek Genebank collection

The Greek Genebank holds 170 *Triticum* accessions distributed as follows: *T. aestivum* (67), *T. durum* (60) and *T. boeoticum* (43) and also 636 *Aegilops* accessions. The genebank wheat collection works partly as an active collection, duplicated every 10-15 years, and as a long-term collection, duplicated every 40-45 years. The active collection is conserved in cloth and paper bags in chambers at 0–4°C and 25-30% air humidity. The long-term collection is conserved in metal cans in chambers at a temperature of –21°C and nearly 0% humidity in cans. Documentation of the genebank collection is based on passport data.

The level of use is high in the case of the Cereal Institute collection and very low in the case of the Genebank collection. The very low use of the Genebank collection must be attributed to the lack of information about the basic characteristics that are very important in

breeding programmes. We think that evaluation, characterization and documentation of all collections must be done according to breeders' needs because breeders will be the most valuable customers of genebanks. But resources (staff, funds) and education are necessary to achieve the above target.

Status of the national wheat collections in Hungary

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Status at the national level

The institutions holding wheat genetic collections in Hungary are listed in Table 1.

Table 1. Current status of the state-funded wheat germplasm collections in Hungary

Institution	Location	No. of accessions
Institute for Agrobotany	Tápiószele	9869
Agricultural Research Institute of the Hungarian Academy of Science	Martonvásár	2410
Cereal Research Public Utility Company	Szeged	2963
Faculty of Husbandry and Agriculture, Saint Stephan University	Kompolt	200
Research Institute of Agricultural Sciences Centre, University of Debrecen	Karcag	194
Faculty of Agricultural Science, West-Hungarian University	Mosonmagyaróvár	25

Among these institutions the Institute for Agrobotany, Tápiószele (ABI) belongs directly to the Ministry of Agriculture and Rural Development. The others—mainly breeding organizations—also receive funding from the Ministry for the conservation, regeneration and characterization of those genebank accessions which are included into the National Genetic Resources Database (NGRD). A National Genebank Council has been established as a technical and scientific advisory body and a National Base Collection (NBC) created for the safety-duplication of seed-propagated accessions recorded in the NGRD.

Collection status at the Institute for Agrobotany (ABI)

ABI is responsible for the development and maintenance of the Hungarian field crop and vegetable genetic resources collection and for the operation of NGRD and NBC, beside its other genebank activities at the national and international level. The whole range of genebank activities therefore covers wheat as well as other crops.

History

The ABI wheat collection was started at Magyaróvár in the 1940s, and after 1953 it continued in the Agricultural Research Institute of the Hungarian Academy of Science in Martonvásár, which handed over the collection to Tápiószele in 1957. Since then it has developed continuously and in recent decades it has been managed in accordance with international genebank standards.

Storage

Today nearly 10 000 accessions of 21 *Triticum* species (Table 2) are stored in the active and base collection chambers of ABI. The storage temperature is 0ºC in the active collection and -20ºC in the base collection chambers, where 1150 accessions are kept. Another 2057 duplicates are kept in the NBC deep-freezers.

Table 2. *Triticum* species and respective number of accessions in the ABI wheat collection

Species	(2n)	Genomes	No. of accessions
T. boeoticum Boiss.			18
T. urartu Thum. ex Gandilyan	14	AA	1
T. sinskajae A.Filat. et Kurk.			2
T. monococcum L.			78
T. dicoccoides Koern. ex Schweinf.			13
T. dicoccon (Schrank) Schübl.			77
T. ispahanicum Heslot			6
T. karamyschevii Nevski			6
T. aethiopicum Jakubz.			3
T. durum Desf.	28	AABB	441
T. polonicum L.			1
T. carthlicum Nevski			25
T. turanicum Jakubz.			13
T. turgidum L.			43
T. araraticum Jakubz.		AAGG	1
T. timopheevii Zhuk.			21
T. spelta L.			102
T. macha Dekapr. et Menabde			6
T. vavilovii Jakubz.	42	AABBDD	1
T. petropavlovskyi Udacz. et Migusch.			4
T. aestivum L.			9007
Total			**9869**

Development

Table 3 illustrates the recent development of the collection. The increase in the number of stored accessions results mainly from introductions from abroad. Special attention has also been paid recently to the collection of ecotypes of *Aegilops cylindrica* Host; this species is the only close, but not very common wheat relative in the Hungarian native flora. Substantial areas of the country have been explored and 27 accessions of the species have been collected in 15 sites of occurrence.

Table 3. Number of wheat accessions involved in field multiplication, characterization, and volume of introductions between 1994 and 2000

Year	Multiplication	Characterization	New introductions
1994	503	486	167
1995	775	775	253
1996	503	503	170
1997	504	504	51
1998	867	741	165
1999	710	647	237
2000	444	183	2

Multiplication and regeneration

The volume of field multiplication and regeneration varies from year to year according to the changes due to newly introduced or collected material and to the regeneration needs of the genebank (Table 3). Despite the high level of yearly activity, 3665 wheat genebank accessions require urgent regeneration; the majority of these accessions were deposited for long-term storage in the 1970s.

Characterization

A list of 63 descriptors is used for characterization of the wheat accessions. About 500 accessions are characterized yearly, but the need for replication must be considered (Table 3).

Evaluation

The goals of the evaluation trials in the wheat collection are also changing, depending mainly on the interest of users. Recently the adaptive capability of so-called "underutilized" wheat species has often been studied in the field. Altogether 96 genebank populations of 17 *Triticum* species have been evaluated in this programme, with autumn and spring sowing, on loamy and sandy soil.

If required, ABI also undertakes more detailed laboratory evaluation (cytological, biochemical and other laboratory tests).

Documentation

Passport, characterization and genebank management data are fully computerized. The ABI wheat database can also be found on the Internet (www.rcat.hu) and is made available for the EWDB.

Future activities

Planned activities for the near future can be summarized as follows:

- Regeneration of the 3000 accessions identified;
- Broadening of the native *Aegilops* collection and determination of the intraspecific diversity of the ecotypes; and
- Compiling of characterization and evaluation data from various sources and making them more readily available to partners.

Ireland status report

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Background

A national advisory committee on plant genetic resources has been established. This committee is made up of representatives from the Department of Agriculture, Food and Rural Development (DAFRD); University College Dublin (UCD); Trinity College Dublin (TCD); Irish Genetic Resource Conservation Trust; Irish Seed Savers Association; and members of the Farming Organizations. The remit of this committee is to coordinate and fund activities at national level with the ultimate objective of achieving the following: to identify emergency needs in relation to the conservation of scarce genetic resource; to conserve and utilize these resources; to promote public awareness of plant genetic resources and participate in international networks, such as ECP/GR.

Wheat genetic resources

With reference to wheat genetic resources, the advisory committee has funded a number of projects to this end. The most important are: (i) evaluation of exotic germplasm as a potential resource for future breeding programmes; (ii) establishment of the Plant Genetic Resources Trust and (iii) establishment of the National Genebank.

Evaluation of exotic germplasm

This work is being carried out by UCD, where Ethiopian landrace material was collected in different regions of Ethiopia. This material was grown out as pure lines of spring wheat (durum wheat was excluded) and compared with randomly selected lines from a spring wheat breeding programme within UCD and commercially available varieties. It was found that this landrace material was a source of genetic material with a high level of diversity, and the presence of novel genes was indicated, particularly in relation to grain yield, grain protein and plant height. It is felt that it is worthwhile to conserve this material within the PGR programme.

Irish Genetic Resources Trust

This programme is a direct multiplication of old/superseded varieties that have been accumulated by the stakeholders of the programme, and is carried out by the Irish Genetic Resources Conservation Trust. This germplasm is available for inclusion in the National Genebank, or indeed to breeders/growers should they wish. This programme is ongoing, with accessions being accumulated, and stability of the accessions is currently being established.

Establishment of the National Genebank

Accessions have been obtained from UCD, TCD, DAFRD and other stakeholders. These accessions were of questionable use for inclusion in the National Genebank, so a programme was undertaken at UCD to produce viable seed stock under uniform conditions, undertake preliminary characterization of accessions and resolve duplication and identity issues. All accessions in this programme have increased the quantity of available viable seed stock and the material is now in a programme of morphological characterization to resolve a series of duplication issues. Also, some varieties are from breeding programmes where characterization has never taken place. The possibility of molecular characterization is also being examined.

The genebank is located at DAFRD, Backweston Farm, Leixlip, Co. Kildare, Ireland. Any queries relating to the genebank should be sent to this address.

Summary

To summarize, the infrastructure of a National Genebank has been put in place, with a National Database, cold storage facilities, etc. A National Committee has been established with all relevant stakeholders represented. Accessions are coming through the processes mentioned above for inclusion into this bank, with some very interesting inclusions, particularly relating to the exotic Ethiopian derived germplasm.

National collection status of the wheat group in Israel

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The holdings of the Israeli Genebank for Agricultural Crops (IGB) include some 4000 accessions of different *Triticum* species, most of them of worldwide origin. A special series contains local landraces of bread wheat (120 accessions) and durum wheat (80 accessions). All accessions are fully documented. Contact: Myra Manoah (Email: mmanoah@netvision.net.il).

At the present stage Israeli researchers maintain most collections of wheat and wheat relatives in their respective institutions. In addition to small research collections kept by different scientists and the Hazera Seed Company, the three main depositories are located in: (i) the Weizmann Institute of Science; (ii) the Institute of Evolution, Haifa University; and (iii) the Institute for Cereal Crops Improvement, Tel Aviv University.

1. Moshe Feldman, of the Department of Plant Genetics in the Weizmann Institute, maintains some 2000 wild diploid and tetraploid Middle Eastern *Triticum* and *Aegilops* spp., as well as accessions of *Agropyron*, *Eremopyrum*, *Heteranthelium*, *Crithopsis* and *Secale*. This collection also contains genetically manipulated mutants, amphiploid and autopolyploid wheats, alloplasmatic lines of durum and bread wheats, as well as complete series of aneuploid lines (e.g. monosomics, nullisomics, tetrasomics and ditelosomics) of bread wheat, mainly cv. 'Chinese Spring' but also of the Israeli cv. 'Bethlehem', and complete series of addition or substitution lines in which chromosomes or chromosome arms of several wild donors have been incorporated into the cultivar. Contact: M. Feldman (Email: lpfeld@wiccmail.weizmann.ac.il).
2. The Wild Cereals Genebank at the Institute of Evolution, Haifa University, managed by Eviatar Nevo, holds over 3800 *Triticum dicoccoides* lines from 33 Israeli populations and some 700 lines from neighbouring countries and some 2800 accessions of *Aegilops* species originating from 137 populations in Israel, Turkey, and Russia. All accessions are fully documented. (Home page: http://research.haifa.ac.il/nevolut/).
3. The Institute for Cereal Crops Improvement at Tel Aviv University maintains collections from Israel of about 4000 accessions of *Aegilops* sect. *Sitopsis* species and 5000 accessions of *Triticum turgidum* subsp. *dicoccoides* under the curatorship of Dr Manisterski. The venue and history of the accessions are fully documented. At present many of the accessions are used in phytopathological research. (Contact: cereal@post.tau.ac.il).

Status of the Bari wheat collection, Italy

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Introduction

In Italy, the management of plant genetic resources is performed in different places (research institutes, universities, regional genebanks, private companies, etc.) The Bari Germplasm Institute is the only research institution that is fully involved in plant genetic resources activities with special reference to the germplasm of the most agriculturally relevant plants in the Mediterranean region: cereals, grain legumes, forage legumes and various vegetable crops.

Since 1971, the activities of the Bari Germplasm Institute and other Italian institutions involved in PGR activities have been directed towards:

- increasing the existing plant germplasm collections which do not yet represent the full genetic diversity present in cultivated fields and in the wild (wild relatives and weed species), which is threatened by genetic erosion;
- extending the collaboration with national and international researchers in order to operate in a broader context;
- cooperating in the creation of national and international networks with the objective of improving wheat genetic resources and their utilization (Porceddu and Perrino 1998).

Wheat collection

Since 1971 the Germplasm Institute in Bari has maintained one of the largest wheat collections in the world. Collecting expeditions in the Mediterranean region and Ethiopia carried out in the 1970s served as the basis for the Bari wheat collection. Particular attention was devoted to North Africa and Sicily. Priority in Ethiopia was given to tetraploid wheats (Porceddu *et al.* 1973). In addition, during the last 30 years, several collecting missions and an intense worldwide exchange activity have added many new entries to the collection.

The wheat collection comprises about 28 000 accessions belonging to 27 different species. Most of the accessions belong to *T. aestivum* (8414), followed by *T. durum* (5663), *T. dicoccum* (371), *T. boeoticum* (321), *T. spelta* (310), *T. turgidum* (241), *T. dicoccoides* (173), *T. urartu* (140), *T. araraticum* (124), *T. monococcum* (86), *T. timopheevii* (34) and *T. polonicum* (24). Another 15 species are represented with less than 20 entries each. About 11 700 entries are not yet classified.

The geographical origin of the *Triticum* material is given in Table 1.

Table 1. Geographical origin of the wheat accessions held at the Germplasm Institute

Geographical origin	No. of accessions
North America	4089
Central/South America	589
North Africa	461
Central/South Africa	1360
Europe	4280
Eastern Europe	1745
Middle East	3396
Asia	6607
Oceania	686
Unknown	4531
Total	**27744**

Regeneration and characterization

Stored accessions with low germination rate or small amounts of seeds are subjected to a regeneration programme. The wheat collection was multiplied in suitable environments of the Apulia and Basilicata regions following original methodology designed to preserve genetic integrity and minimize selection and genetic drift to obtain sufficient seed for long-term conservation, distribution and characterization. During regeneration the accessions are characterized for heritable agromorphological traits. Special attention has also been paid to techniques such as protein electrophoresis, molecular markers, an image-based database for identification of lines, landraces and varieties in order to avoid duplications of samples in the wheat collection.

Conservation

The wheat collection is maintained under good storage conditions. Wheat is the main crop in the Bari collection. At harvest, after drying the seeds to a moisture content of approximately 5%, the seeds are packed in aluminium cans at –20°C for long-term storage, and in laminated aluminium bags under vacuum at 0°C and 30% air humidity for short- and medium-term storage.

Distribution and exchange

More than 52 013 wheat samples were distributed worldwide, mostly to European countries (27 980). Exchanges with genetic resources collections at other genebanks are also frequent.

Documentation

Data recorded during exploration, characterization and evaluation are all computerized to document diversity, to provide input for planning further collecting activities and contribute to the management of the wheat collection.

In particular, the 28 000 *Triticum* species accessions are all documented for passport data in SAS (Statistical Analysis System). Access to the wheat passport data will soon be available on the Internet at the Institute's Web site (http://www.ig.ba.cnr.it). A minimum of 13 descriptors is included with incomplete data for some accessions. Characterization data are also documented and available on request for 23 descriptors. Evaluation data exist for parts of the collection. Information is also available as a catalogue.

Safety-duplication

The Bari wheat collection has been duplicated at three genebanks abroad: Fort Collins (USA), Kyoto (Japan) and the Vavilov Institute (St. Petersburg, Russian Federation).

Future activities

- To complete the description of the genetic diversity with particular attention to the following aspects:
  - abiotic and biotic stress;
  - seed quality for nutritional and technological uses.
- To establish core collections for better management and prompt utilization of resources.
- To promote a routine utilization of repeatable molecular techniques for the description of genetic diversity.
- To contribute to and organize a coordinated management of the resources and their description.

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Status of wheat genetic resources conservation and utilization in Latvia

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In Latvia plant genetic resources (PGR) activity began after independence was achieved in 1991. Collection and evaluation of natural populations of wild relatives of cultivated plants of Latvian origin were recognized as a priority for the national programme (Rashal 1995).

There is no separate national programme for PGR in Latvia but all PGR-related activities take place under the framework of the National Programme for the implementation of the CBD. The structure of the national PGR activities is currently being discussed.

The Latvian Genebank was created in 1997 with support from the Nordic Gene Bank (NGB). It is located in Salaspils at the Institute of Biology, University of Latvia and has accepted responsibility for maintaining the Latvian Genebank accessions of Latvian origin (varieties, breeders' lines). In some cases accessions derived from foreign varieties which have been grown for a long time, have produced seed in Latvia and are likely to have undergone changes in their genetic structure, are also included in the collection. These are mostly heterogenous varieties. NGB's model for storage conditions was adopted in Latvia: seeds are kept in commercial freezers in aluminium bags. All seeds are divided between base and active collections and 5-10 distribution bags are prepared in advance (for the active collection).

Storage and documentation of accessions comply with internationally accepted standards. Safety-duplicates are kept at the NGB according to a bilateral agreement (Table).

Table 1. Number of seeds per accession in the Latvian Genebank

Priority group	Base collection	Active collection	Safety-duplicate collection (NGB)
1	10000	5000	2000
2	2500	2500	-
3	< 1000	< 1000	-

The Latvian Gene Bank operates as a centre for the Latvian PGR network. Multiplication, evaluation and characterization are carried out by experts in particular crops, mainly in the plant breeding stations. Complete evaluation of accessions is planned, according to the descriptors agreed by the Baltic Cereal Working Group (Rashal *et al.* 1998).

Wheat multiplication and evaluation/characterization, and maintenance of the working collection are carried out at the State Stende Plant Breeding Station, where the first trials with wheat were started in 1923. Local material and foreign wheat varieties were investigated there. During the Soviet period, working collections were created through the Vavilov Institute in St. Petersburg. When the national plant genetic resources programme was initiated an inventory was made of the existing wheat collection and it was found that advanced cultivars were available but all landraces had been lost.

The Latvian Gene Bank currently maintains 20 accessions of *Triticum aestivum* (Table 2). All 14 Latvian wheat varieties (including spring and winter) with available seeds are accepted for conservation in the Latvian Gene Bank with the highest priority. Seeds of these varieties are already prepared for long-term storage. The breeders' lines have been kept in the working collections for more than 10 years.

Table 2. *Triticum aestivum* accessions maintained at the Latvian Genebank

Type of material	No. of accessions
Spring wheat	
Varieties (1920s–1950s)*	2
Winter wheat	
Varieties (1920s–1940s)*	6
Varieties (1980s)*	2
Varieties (1990s)*	4
Landraces	0
Breeder's lines	4
Traditional varieties of foreign origin	2
Total	**20**

* (between brackets: date of creation of the varieties)

The Latvian Genebank is supported by the Nordic Gene Bank in the framework of the Nordic–Baltic cooperative programme on PGR (Rashal and Weibull 1997). In the Cereal Baltic Working Group, common wheat descriptors were elaborated. Other activities of the Latvian Genebank are connected with the EU-funded EPGRIS Project (European Plant Genetic Resources Information Infrastructure) (see Part I, page 17).

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The national Triticum *collection in Lithuania and its role in winter wheat improvement*

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Introduction

The Programme for National Plant Genetic Resources was launched in Lithuania in 1994. It is subsidized by the Lithuanian Science and Studies Foundation and coordinated by the Lithuanian Institute of Agriculture (LIA).

The Lithuanian Genebank is located at LIA, the chief national institution involved in plant breeding activities. LIA has a mandate to maintain cultivars and breeding material of cereal crops, forage grasses, legumes, potatoes and flax. Wheat breeding at LIA, the successor to the Dotnuva Plant Breeding Station, started in 1922 and is ongoing.

The winter wheat collection is kept at LIA (Table 1). The long-term storage collection includes 8 old Lithuanian varieties and 6 newly developed varieties, as well as 17 advanced breeding lines. Foreign commercial varieties and lines are kept in working collections and are not included in long-term storage.

Table 1. The Lithuanian wheat collection in 2001

Material	No. of accessions
Old Lithuanian varieties in long-term storage	8
Newly developed varieties in long-term storage	6
Advanced lines in long-term storage	17
Working collection	783
Investigation block	188
Introduction block	785
Lines of wide crosses	50
Total	**1837**

The key task of the present wheat breeding programme is to collect winter wheat germplasm from different geographical regions, test it in local conditions and select valuable genetic material which will be used for the development of new varieties. Results of studies conducted at LIA suggest that the greatest advantage of southern wheat germplasm is good grain quality and earliness, while its main shortcoming is susceptibility to diseases, especially powdery mildew. Therefore it is necessary to combine the germplasm of western and eastern origins for the breeding of new varieties adapted to Lithuanian conditions.

Status of the *Triticum* collection

The wheat collection is organized according to the following scheme: the newly obtained accessions (varieties or advanced breeding lines) are investigated under Lithuanian conditions for one or two years. The varieties that do not perform satisfactorily in local conditions, and in which valuable traits are not identified, are usually discarded. Varieties with some valuable traits are kept in the working collection, investigated for more detailed information and then included in the crossing block.

Varieties are selected for long-term storage if they are:

1. of Lithuanian origin, bred and registered in Lithuania;
2. Lithuanian varieties or breeding lines that have been submitted to the Official Variety Testing or have some valuable traits, e.g. grain quality, resistance to biotic or abiotic stresses, etc.;

3. exotic germplasm, foreign varieties with valuable traits; or
4. material from the base-broadening programme developed at LIA.

The Lithuanian wheat breeding programme included only winter wheat. It was started in 1922 but was discontinued in the period 1980-1990; therefore all material collected and evaluated before 1980 was lost.

During the former Soviet times Lithuanian plant breeders obtained germplasm for breeding purposes from the Vavilov Institute of Plant Industry (VIR) and did not keep the collection for a long time. When the National Plant Genetic Resources Programme started, the old Lithuanian winter wheat varieties were obtained from VIR with kind permission of Russian counterparts. The varieties were investigated according to the descriptors prepared by breeders (Puidokaitė 1968) and put in long-term storage at LIA. This material is of interest in terms of genetic resources and has historical value. The variety 'Akuotuotieji' was developed by D. Rudziskas from the old Russian local wheat 'Kalinovskaja'; 'Dotnuvos 458' includes in its pedigree the old variety 'Vysokolitewskaja' (Rudzinkis 1924); 'Pergalė' includes the old western European variety 'Nordost-Zigfrid' and a local variety from Russia; the variety 'Aidas' was developed by wheat/rye cross (Puidokaitė 1968; Liutkevičius and Ruzgas 1997) (Table 2). New varieties are listed in Table 3.

Table 2. Od Lithuanian winter wheat varieties in long-term storage

Denomination of the variety	No. of accessions in storage	Pedigree	Year of release
Raudonieji	1	Nordost-Zigfrid/Egipetskaja	1949
Pergalė	2	Nordost-Zigfrid/Egipetskaja	1949
Akuotuotieji	3	Selected from Kalinovskaja	1923
Širvinta 1	4	Miron808/Miron jubil50/2/Miron808/Bez1/3/Omar	1989
Dotnuvos 449	5	Nordost-Zigfrid/Breusted's squarehead	1937
Dotnuvos 458	6	Panser II/Vysokolitewskaja	1950
Mūras	7	Kronen/Lesosttepka 75	1958
Aidas	8	Carsten Dickopf/Dotnuvos aukštieji (rye)	1961

Evaluation and documentation

Accessions of Lithuanian origin are fully evaluated and characterized; all relevant information is available. The *Catalogue of Lithuanian Plant Genetic Resources* (Būdvytytė *et al.* 1997) includes 9 local winter wheats and 2 spring wheats, as well as 190 foreign varieties and lines. Data for accessions in long-term storage are available from the home page of the Lithuanian Institute of Agriculture (www.lzi.lt) subsection "Gene resources".

Descriptors included in the database are: Accession number; Accession name; Type of accession; Database number; Originator city; Common name; Status of accession; Genus; Species; Subtaxa; Year of release; Donor code.

Table 3. Newly developed Lithuanian winter wheat varieties and lines included in long-term storage

Denomination	Pedigree	No. in storage	Reason for conservation
Kena	Compal/Donia	932	Early ripening, tolerant to *Erysiphe graminis*
LIA 2903-77	Širvinta1/Lut.290	933	Tolerant to *Puccinia recondita, Tilletia tritici*
Ada	Širvinta/Lut. 290	934	Good bread-making quality, winter hardiness. Registered in Lithuania since 2001
LIA 2905-127	TAW5/ Kosack	935	Good winter hardiness, tolerant to *Puccinia recondita, Tilletia tritici*
OR 3890035		936	White hard type. Good winter hardiness, tolerant to *Puccinia recondita, Tilletia tritici*. USA origin
Seda	Nova/Marabu	937	High-yielding, tolerant to *Puccinia recondita.* Registered in Lithuania since 2001
Lina	TAW5/ Linija125	938	High-yielding, semi-dwarf, tolerant to *Tilletia tritici.*
Tauras	B.st.19149-88 /WW27314 (spring)	939	Good grain quality, tolerant to *Septoria tritici.* Registered in Lithuania since 2001
LIA 4518-12	Contra/Astron	940	Good grain quality, resistant to lodging
LIA 4522-10	Lone/ Inna	941	Tolerant to *Puccinia recondita, Septoria tritici, Tilletia tritici*
LIA 4526-24	Hussar/Konsul	942	Tolerant to *Puccinia recondita*
Milda	Bussard/Viginta	943	Excellent bread-making quality
LIA 3779-1	Širvinta/Lone	944	Good winter hardiness, tolerant to *Puccinia recondita*
Alma	Albatros odesskij /Kijanka	945	Early ripening, good winter hardiness, excellent grain quality
LIA 3756	Bussard//Sj833163/ Rendezvous	1040	High-yielding, resistant to *Tilletia tritici*
LIA 3948	Kijanka/Yacht DH	1041	High-yielding, good grain quality, tolerant to *Erysiphe graminis, Tilletia tritici*
LIA 3968-10	Kosack/Hereward	1042	High-yielding, good winter resistance, grain quality, flour output
LIA 4062-3	Vogogradskaja r84/ WDUYT 43 (durum)	1043	Good winter hardiness, 1000-grain weight
WDUYT 43		1044	Durum wheat, selected from the material of Oregon SU, tolerant to *Tilletia tritici*
LIA 4514-12	Pepital/Astron	1045	High-yielding, good grain quality
LIA 4537-16	Brigadier/Hamlet	1046	High-yielding, good winter hardiness, 1000-grain weight
LIA 4540-40	Apollo/Konsul	1047	High-yielding, tolerant to *Helmintosporium*, erect growth habit
LIA 4631-10	VSB28638/Astron	1048	High-yielding, good winter hardiness, high falling number index, tolerant to *Erysiphe graminis*

The role of plant genetic resources in wheat breeding programmes

The success of wheat breeding depends greatly on the parent material. Over 79 years of plant breeding activities Lithuanian wheat breeders have received and included in the working collections 2487 varieties from 25 countries. The varieties are included in the working collection after a short testing period (1-2 years) in local conditions to identify valuable traits for wheat breeding or research programmes.

The first Lithuanian winter wheat breeder D. Rudzinskas had only 67 varieties for breeding programmes in 1922. They included 15 varieties from Western Europe, 8 landrace varieties collected in various regions of Russia, and 44 lines derived by D. Rudzinskas in the Moscow Plant Breeding Station. Till 1935 Lithuanian breeders had collected 60 Lithuanian local winter wheat varieties such as 'Geltonieji' , 'Skujiniai' and 'Pukiai' (Rudzinkis 1924; Anonymous 1922-2001). In fact they were poor-yielding varieties and the new winter wheat lines with local parents in their pedigree were not registered in the Dotnuva Station

Catalogue. Today this genetic material would be interesting, but the local wheat varieties have not survived.

For successful winter wheat breeding it is necessary to involve varieties representing different ecotypes, bred in geographically distant regions, because the wider the cross, the greater the chance that segregation will disrupt favourable multilocus combination. To fulfil this task Lithuanian wheat breeders collect wheat germplasm from various sources, including the Facultative and Winter Wheat Observation Nursery Programme (FAWWON) initiated by CIMMYT (International Maize and Wheat Improvement Centre). CIMMYT's breeding methodology is tailored to develop widely adapted germplasm with stable yields across a wide range of environments (Braun *et al.* 1996). The germplasm for FAWWON is generally collected in countries with hot dry climates, quite different from that of Lithuania.

During the period 1995-2000, 923 varieties and lines from the FAWWON programme were tested under Lithuanian conditions. Analysis of the data suggests that 42% of the varieties tested were of satisfactory winter hardiness compared with the well-adapted local control variety 'Širvinta 1'. The main advantage of including southern germplasm in the Lithuanian winter wheat breeding programme is its high grain quality and early ripening. The disadvantages are the lower grain yield and susceptibility to the most widespread diseases in a wet climate, especially powdery mildew (Ruzgas and Liutkevičius 2001).

Therefore breeders are combining eastern and western type germplasms in the development of new winter wheat varieties in Lithuania. This method was and still is being used in present-day wheat breeding. The main task is to obtain genotypes with satisfactory winter hardiness, good grain quality and disease resistance. In order to meet these requirements it is necessary to collect a large amount of genetic resource material and conduct agronomic tests under local conditions.

Plans for the future

The following activities will be carried out on the *Triticum* collection:

- Continuation of the collecting, conservation, identification, characterization, evaluation and documentation of accessions;
- extension of cooperation and exchange of genetic material with other holders of plant genetic resources;
- transfer of a safety-duplicate collection of Lithuanian seed-propagated material to another site for storage.

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Status of wheat genetic resources in the Republic of Macedonia

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Introduction

Genebank activities in the Republic of Macedonia were previously organized by the headquarters in Belgrade, Former Yugoslavia. For the last ten years, i.e. since the independence of the Republic of Macedonia, the research community has been striving to reorganize these activities. However, for various reasons, mainly the inconsistency of governmental policy and instability in the region, very little has actually been achieved in the area of plant genetic resources for food and agriculture. Some activities were undertaken in several small genebank projects for various crops, financed by the Ministry of Agriculture and the Ministry of Science, but the records were not computerized and the seeds were not stored in cold chambers.

There is still no legal framework for genebank activities. Since 1996, funding is carried out through a Programme for Agricultural Development Support by the Ministry of Agriculture, Forestry and Water Economy. The national fund varies every year between 5000 to 50 000 US$, depending on the total budget of the Ministry and the prevailing policy. In 1998 funding was interrupted for one year owing to the Kosovo crisis.

Current status of PGR activities

Plant genetic resources activities in Macedonia are carried out by four institutes, each in charge of different crops. The wheat collection is maintained by the Institute of Agriculture in Skopje, Department for Field Crops, in collaboration with the Faculty of Agriculture, Department for Genetics and Plant Breeding. The Institute has experimental fields (300 ha) and a cold chamber (2-6°C) for medium-term storage of the active collections. Two additional rooms are currently under construction: a preparatory room for seed packaging and labelling and a cold chamber (-20°C) for long-term storage of base collections. The Faculty of Agriculture cooperates with the Institute, mainly for research activities.

Before 1996, conservation of the wheat collection was only part of the wheat breeding programme. Collections were characterized for the purposes of the programme only. During that period IPGRI descriptors were not used for the evaluation. Most of the accessions were released commercial varieties and introduced material (lines and varieties) for breeding purposes.

Starting in 1996, a 3-year genebank project was financed by the Programme for Agricultural Development Support. Conservation activities were undertaken for various crops, including cereals. As a result, the material listed in Table 1 was characterized.

Table 1. Wheat collection held at the Institute of Agriculture

Species	No. of accessions
Triticum aestivum	200
Triticum durum	265

After the project termination (1999), evaluation activities were continued by wheat breeders, resulting in the evaluation of approximately 60 foreign varieties (mostly Hungarian) during the last two years.

Storage conditions

Seeds are stored in plastic jars with double lids. Germination tests are carried out prior to placement in cold storage for most of the accessions. Evaluation for disease susceptibility is based only on morphological screening.

Evaluation

In order to evaluate the existing working collection properly and in a standardized way, IPGRI wheat descriptors have been obtained and translated. Evaluation data are currently recorded in Excel, as single layer tables. Data are still not fully computerized but additional data input is planned for the future. However the information is incomplete, especially for passport data. The wheat collection is currently evaluated according to the following IPGRI wheat descriptors:

Accession number	Quantity of sample	Glume colour
Scientific name	Growing habit	Seed colour
Variety name	Stem height	Seed vitrousness
Origin	Days to flower	Susceptibility to leaf rust
Year of last regeneration	Spike density	Susceptibility to mildew
1000-grain weight	Awnedness	

Most accessions are characterized for other morphological, biological and productivity traits, depending on the breeders' interests, but data are not computerized. Since 2000 the Faculty of Agriculture has equipped a laboratory for grain quality evaluation and accessions are currently tested for protein content, falling number, gluten content and sedimentation test.

Other activities

Repatriation of landraces from USDA

Contact has been established with the United States Department of Agriculture (USDA) National Seed Storage Laboratory, Fort Collins where a collection of wheat landraces originating from different regions in Macedonia is maintained (Table 2). Most of those landraces were collected by the Institute of Agriculture in Skopje and the Institute of Small Grains in Kragujevac (F.R. Yugoslavia) during 1969-1972. Repatriation of the collection will be possible when conditions for its maintenance will have been organized.

Table 2. Wheat collection held by USDA

Species	No. of accessions
Triticum aestivum subsp. *aestivum*	663
Triticum aestivum subsp. *spelta*	2
Triticum durum	47
Triticum turgidum	79
Total	**791**

Preparation of a national programme for genebank activities

Taking into consideration the importance of the protection of plant biodiversity, the Institute of Agriculture submitted a draft national programme both to the Ministry of Agriculture and to the Ministry of Education and Science. This proposal covers the following activities:

- Standardized inventory of existing working collections—all holding institutions would have appropriate software based on IPGRI descriptor lists for data input;
- Establishment of an Intranet connection between the six holding institutions with a centralized database in order to avoid storage of duplicates;

- Collecting landraces and wild relatives;
- On-farm conservation;
- Repatriation of the vegetables, cereals and fruit accessions stored in USDA, based on priorities for certain crops; some accessions that already hold passport data could be stored back in the Republic;
- Training of young researchers and appointment of curators for the priority crops.

At the beginning of 2000, a coordinating body was established under the auspices of the Ministry of Agriculture to prepare the National Programme and legislation for regular functioning and funding of genebank activities in Macedonia.

Current status of the CGN wheat collection

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Introduction

The wheat collection originates to a large extent from the former Foundation for Agricultural Plant Breeding (SVP) and the Department of Plant Breeding (IVP) of the Agricultural University Wageningen (van Soest *et al.* 1995). The previous SVP collection was a typical working collection used mainly in applied breeding research. The wheat collection (Wageningen Triticinae Collection, WTC) of the Department of Plant Breeding of the Agricultural University Wageningen (IVP) was established mainly by Dr A. Zeven and used intensively for the study on the distribution of necrosis genes (Zeven 1965; van Loosdrecht 1986).

Additional material was obtained from other institutions in Wageningen and private breeding companies in the Netherlands. Detailed information on the wheat collection has been published by van Soest and Boukema (1995).

The collection

The wheat collection, with 5475 accessions, is the largest collection of CGN. It is divided into 5051 accessions of cultivated *Triticum* species, 402 accessions of 17 wild species and 22 accessions of synthetic hybrids (Table 1). Besides the former working collection of the SVP, a substantial part of the collection originated from the former "Wageningen Triticinae Collection" (WTC) established between 1965 and 1985 by A. Zeven from the IVP (van Loosdrecht 1986). More recently new material from the CPRO-DLO, IPO-DLO and some private breeding firms from the Netherlands was included in the collection.

The classification of the wheat collection follows the system of Morris and Sears (1967).

Table 1. Overview of the wheat collection of CGN

Species/group	Wild/Cult.	No. of accessions
T. aestivum group *aestivum*	cult.	4430
T. aestivum group *spelta*	cult.	87
T. aestivum group *compactum*	cult.	33
T. aestivum group *sphaerococcum*	cult.	2
T. aestivum group *vavilovii*	cult.	3
T. turgidum group *durum*	cult.	311
T. turgidum group *carthlicum*	cult.	12
T. turgidum group *dicoccon*	cult.	84
T. turgidum group *polonicum*	cult.	19
T. turgidum group *turgidum*	cult.	34
T. turgidum var. *dicoccoides*	wild	198
T. timopheevi var. *timopheevi*	cult.	8
T. monococcum	cult./wild	40
T. longissimum	wild	17
T. ovatum	wild	17
T. speltoides	wild	28
T. squarrosum	wild	75
T. triunciale	wild	12
T. ventricosum	wild	16
Triticum (not known)	cult.	3
Triticum spp. (9 wild species)	wild	21
Triticum spp. (not known)	?	3
Synthetic hybrids	wild/cult.	22
Total		**5475**

Wild species

The collection includes 17 wild species and the majority of these species are diploid. The most important wild species and the number of accessions available are presented in Table 1. From the following 9 wild species only a few accessions are included in the collection: *T. kotschyi, T. columnare, T. lorentii, T. triaristatum, T. cylindricum, T. caudatum, T. bicorne, T. crassum* and *T. peregrinum.* The wild tetraploid emmer (*T. turgidum* var. *dicoccoides*) accessions are predominantly from Israel.

Cultivated wheat

The cultivated group comprises material of diploid *T. monococcum,* the tetraploids *T. turgidum* group, *T. timopheevi* var. *timopheevi* and the hexaploid *T. aestivum* group. The latter group includes the hexaploid 'spelt', 'compactum', 'sphaeroccocum' and 'aestivum' wheats, whereas the 'durum', 'dicoccon', 'carthlicum', 'turgidum' and 'polonicum' wheats belong to the tetraploid *T. turgidum* group.

Most cultivated wheats in the collection belong to the *T. aestivum* group and particularly to the *T. aestivum* group *aestivum.* This group includes 2225 accessions of spring wheat, 99 intermediate types and 2106 winter types. The intermediate types are predominantly from Pakistan, having been collected during two missions with Dutch participation in 1976 and 1980 (Hashmi *et al.* 1981).

The total *T. aestivum* group *aestivum* includes 50.8% landraces, 32.9% cultivars, 14.6% breeding lines and 1.7% of accessions for which the population type is not known. A large group of landraces, particularly of spring wheat, originates from the centres of diversity in Asia (Middle East) and Ethiopia. This material was collected in the period 1953 to 1981. The European landraces are predominantly from East, South and Central Europe. Only 3 old Dutch winter wheat landraces are present in the collection, namely 'Zeeuwse Witte', 'Limburgse Kleine Rode' and 'Gelderse Ris', indicating that most of the old landraces from the Netherlands have been lost. However, genes and properties of these landraces can certainly be found in the first generation of Dutch wheat varieties which were developed in the period 1890 to 1925. The CGN collection includes a number of these old varieties such as 'Wilhelmina' (1894), 'Mansholts Witte Dikkop I' (1924), 'Emma' (1927), 'Limburgse Kleine Rode no 1', 'Gelderse 42' and 'Mansholts Witte III'. Many of the cultivars of *T. aestivum* group *aestivum* are from Europe and North America, particularly from countries with a long history of wheat breeding, such as Russia, France, Germany, Sweden, USA, the Netherlands and Yugoslavia. The breeding lines in the *T. aestivum* group *aestivum* collection are from more than 25 different countries, mostly from those countries which had active breeding programmes for bread wheat.

The tetraploid cultivated *T. turgidum* group consists of 67% of durum wheat, mainly landraces from Mediterranean countries.

Regeneration and characterization

Most of the material included in the wheat collection has been regenerated and is stored under long-term storage conditions (-20°C) in the genebank facilities of CGN. Much of the cultivated material in the wheat collection was regenerated between 1986 and 1992, partly in cooperation with private cereal breeding firms in the Netherlands. The winter types are sown in October and the spring types in March at a density of 350-400 seeds per m² in plots of 1 m² with 20-25 cm between rows. The plots are separated by a 80-cm path. The seeds are harvested with a special combine.

During regeneration the accessions are characterized for a minimal set of agromorphological traits using a list of descriptors developed by CGN (van Loosdrecht 1985). Table 2 presents information on the available characterization and evaluation data of the wheat collection. Wild species are normally regenerated in glasshouses after initial vernalization in controlled environment chambers. Recently, several wild species have been rejuvenated in glasshouses, including several wild emmer species from Israel.

Table 2. Overview of observed characterization and evaluation traits of wheat accessions in GENIS

Trait	No. of methods	No. of experiments	No. of scores
Spike density	1	11	1203
Lodging susceptibility	1	21	2271
Growth height	3	24	2613
Seed color	2	16	1959
Seed shape	1	15	2032
Glume color	1	5	763
Seed size	1	10	1409
Spike emergence time	2	12	1455
Spike length	3	24	2607
Awn length	2	19	1486
Threshability	2	3	194
Stem brittleness	1	3	552
Seed shattering tendency	1	3	195
Annuality	1	11	1604
Winter susceptibility	2	5	336
Sprouting tendency	1	3	256
Glume hairiness	1	4	675
Heading time	1	2	127
Awnedness	1	23	2747
Rachis brittleness	1	1	102
Rachis hairiness	2	1	92
Erysiphe graminis	3	17	2124
Puccinia recondita	4	2	199
Puccinia striiformis	2	3	273
Fusarium culmorum	1	1	164

Evaluation

Evaluation data are available from scorings for susceptibility to some important wheat diseases such as *Erysiphe graminis*, *Puccinea striiformis*, *Puccinia recondita* and *Fusarium culmorum* (Table 2).

In the past three years 1290 accessions of winter wheat were evaluated under field conditions for resistance to the following diseases: *Erysiphe graminis* (mildew), *Septoria tritici*, *Puccinia recondita* (brown rust) and *Puccinia striiformis* (yellow rust). Testing took place at four private breeding companies in the Netherlands. Scoring was done on two different dates during the growing season. Some 750 more interesting accessions were tested at two different locations in the Netherlands, as the mildew pressure varies in the Netherlands and depends often on soil type. The standard varieties 'Vivant', 'Ritmo' and 'Residence' were used at all locations. The data of these scorings will be included in GENIS, the data information system of CGN (van Hintum 1989).

Documentation

All accessions in the wheat collection are documented for passport data in GENIS. The passport data of some accessions are not always complete. The country of origin and the population type of several accessions are missing. Furthermore the ancestor, the origin year and the breeder of several cultivars are not fully registered. Some of this information may be obtained from the literature, databases or other sources.

Data of the CGN wheat collection can be found on CGN's Web site (http://www.plant.wageningen-ur.nl/cgn/).

Since early 2001 passport data can be searched on-line and characterization and evaluation data can be downloaded via Internet.

Utilization

Since 1987 nearly 6000 accessions have been distributed to 78 different institutions all over the world. Approximately 67% of the accessions were requested from sources in the Netherlands.

Users are supplied with 100 seeds of cultivated material, but smaller amounts are distributed of the different wild *Triticum* species. Additional passport information on the material is supplied. However, since the inclusion of passport and evaluation data on the Web site of CGN, users can obtain the data from these sources themselves. Users have to sign the Material Transfer Agreement (MTA) of CGN before they can obtain material. More information on the MTA can be found on the Web site of CGN.

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Wheat genetic resources at the Nordic Gene Bank (NGB)

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The NGB wheat collection

The Nordic Gene Bank is responsible for the long-term preservation of the genetic resources of agricultural and horticultural crops in the Nordic region. Thus, the main Nordic wheat collection is located at the NGB. The other wheat collections in the area are mostly working collections at breeding stations or research material at the universities.

As of October 2001, the NGB wheat collection contained 1316 accessions. The most important part of the collection is represented by 339 accessions accepted for long-term preservation. However, there are also 914 accessions which are preserved only temporarily at the NGB. This part of the collection has a non-Nordic origin or is classified as breeding material (Table 1).

NGB's mandate is to preserve only material of Nordic origin. NGB has wheat accessions from all Nordic countries except Iceland. Forty percent of the material originates from Sweden (Table 2). In Table 3 the material is classified by the culton_type.

Storage and safety-duplication

Prior to storage the seeds are dried to a moisture content of 3-4% and packed in airtight containers (Al-foil bags and bottles). The temperature in the active and base collections is -20°C. The safety-base storage facility is located in a coal mine in Svalbard, Norway. The storage temperature in this permafrost varies between -3°C and -4°C. Almost 100% of all NGB's wheat accessions are stored in the safety-base collection.

Evaluation and characterization

Evaluation of the wheat collection is organized and carried out by the NGB´s working group on cereals. Wheat was evaluated frequently during the 1990s and 2000s. It was tested for agronomic, resistance and quality traits (Table 4). The aim is to publish these studies soon on the Internet (http://www.ngb.se/Databases/Activities/) in order to facilitate the use of the collection.

NGB also has older evaluation data resulting from the work carried out at cultivar level, i.e. the specific NGB accession numbers were not mentioned when reporting the results. Thus, this kind of evaluation data can be considered only as general cultivar descriptions. From the genebank point of view it is important that all characterization and evaluation data can be linked to a specific accession stored at the genebank. At the moment old evaluation data without accession numbers at the NGB are under revision and the possibility of re-assigning accession numbers is under study.

Table 1. Wheat accessions listed by conservation status (ACC = accepted for long-term conservation; TEM = temporary; PEN = pending, under consideration)

TAXNAM	ACC	TEM	PEN
Aegilops bicornis		1	
Aegilops crassa		1	
Aegilops geniculata		1	
Aegilops sharonensis		1	
Aegilops speltoides var. *speltoides*		2	
Aegilops tauschii		1	
Triticum aestivum subsp. *aestivum*	331	749	56
Triticum aestivum subsp. *compactum*		11	
Triticum aestivum subsp. *macha*		2	
Triticum aestivum subsp. *spelta*	3	13	2
Triticum aestivum subsp. *sphaerococcum*		4	
Triticum monococcum subsp. *aegilopoides*		6	
Triticum monococcum subsp. *monococcum*	3	55	
Triticum timopheevii subsp. *armeniacum*		1	
Triticum timopheevii subsp. *timopheevii*		8	2
Triticum turgidum subsp. *carthlicum*		3	
Triticum turgidum subsp. *dicoccoides*		8	
Triticum turgidum subsp. *dicoccon*	2	15	2
Triticum turgidum subsp. *durum*		12	1
Triticum turgidum subsp. *paleocolchicum*		1	
Triticum turgidum subsp. *polonicum*		4	
Triticum turgidum subsp. *turanicum*		1	
Triticum turgidum subsp. *turgidum*		14	
Total	**339**	**914**	**63**

Table 2. Wheat accessions (ACC, TEM or PEN) by country of origin (DNK = Denmark, FIN = Finland, NOR = Norway, SWE = Sweden, OTH = other)

TAXNAM	DNK	FIN	NOR	SWE	OTH
Aegilops bicornis					1
Aegilops crassa					1
Aegilops geniculata					1
Aegilops sharonensis					1
Aegilops speltoides var. *speltoides*					2
Aegilops tauschii					1
Triticum aestivum subsp. *aestivum*	127	122	34	507	346
Triticum aestivum subsp. *compactum*					11
Triticum aestivum subsp. *macha*					2
Triticum aestivum subsp. *spelta*	2			5	11
Triticum aestivum subsp. *sphaerococcum*	1				3
Triticum monococcum subsp. *aegilopoides*	1				5
Triticum monococcum subsp. *monococcum*	51			3	4
Triticum timopheevii subsp. *armeniacum*					1
Triticum timopheevii subsp. *timopheevii*	7			1	2
Triticum turgidum subsp. *carthlicum*	1				2
Triticum turgidum subsp. *dicoccoides*	4				4
Triticum turgidum subsp. *dicoccon*	10			2	7
Triticum turgidum subsp. *durum*	1				12
Triticum turgidum subsp. *paleocolchicum*					1
Triticum turgidum subsp. *polonicum*	1				3
Triticum turgidum subsp. *turanicum*	1				
Triticum turgidum subsp. *turgidum*	3			2	9
Total	**210**	**122**	**34**	**520**	**430**

Table 3. Wheat accessions (ACC, TEM or PEN) by culton (CUL = cultivar, LND = landrace, BRE = breeding line, WIL = wild, OTH = other)

TAXNAM	CUL	LND	BRE	WIL	OTH
Aegilops bicornis				1	
Aegilops crassa				1	
Aegilops geniculata				1	
Aegilops sharonensis				1	
Aegilops speltoides var. *speltoides*				2	
Aegilops tauschii				1	
Triticum aestivum subsp. *aestivum*	242	51	550		293
Triticum aestivum subsp. *compactum*		11			
Triticum aestivum subsp. *macha*		2			
Triticum aestivum subsp. *spelta*		16	1		1
Triticum aestivum subsp. *sphaerococcum*		3	1		
Triticum monococcum subsp. *aegilopoides*			4	2	
Triticum monococcum subsp. *monococcum*		5	53		
Triticum timopheevii subsp. *armeniacum*				1	
Triticum timopheevii subsp. *timopheevii*		2	8		
Triticum turgidum subsp. *carthlicum*		1	1		1
Triticum turgidum subsp. *dicoccoides*			7	1	
Triticum turgidum subsp. *dicoccon*		6	11		2
Triticum turgidum subsp. *durum*		6	2		5
Triticum turgidum subsp. *paleocolchicum*		1			
Triticum turgidum subsp. *polonicum*		3	1		
Triticum turgidum subsp. *turanicum*			1		
Triticum turgidum subsp. *turgidum*		10	4		
Total	**242**	**117**	**644**	**11**	**302**

Table 4. Evaluation of NGB's wheat collection

Year	Country	No. of accessions	No. of reference cultivars	Traits evaluated	Availbility on the Internet (Oct. 2001)
***Triticum aestivum* subsp. *aestivum* / spring**					
1996	DNK	183	6	Growth habit Ear emergence Ear density Awnedness Plant height Lodging *Erysiphe graminis*	NO
1996	SWE	183	6	Awnedness Plant heigth Lodging	NO
1996-1999	NOR	183	6	Maturity *Erysiphe graminis* *Septoria nodorum*	NO
1996	FIN	183	6	Ear emergence Ear density Awnedness Plant height Glume hairness Lodging Maturity *Erysiphe graminis* *Puccinia recondita* *Septoria nodorum*	NO
***Triticum aestivum* subsp. *aestivum* / winter**					
2000	NOR	82	1	Winter hardiness	YES
2000-2001	SWE	160	3	Baking quality (several factors)	NO

Wheat genetic resources at INIA, Portugal

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The National Institute for Agrarian Research (INIA) has the responsibility to conduct research and development activities for the Portuguese Ministry of Agriculture. Its main strategy is to promote rural development according to the agrarian policy followed by the Ministry. The current priorities for research and development activities are centred on five programmes:

- **Environment and production systems:** studies on environmental impacts and sustainable use of genetic resources are encouraged under this programme.
- **Crops and products:** viticulture and enology, olives and olive oil, horticulture and annual crops—pastures, forages and cereals (durum wheat).
- **Animal production and products:** landraces (cows, sheeps and pigs) and production systems.
- **Forests and products:** Mediterranean forests (oak and cork trees) and landscape.
- **Rural development:** agricultural systems and social impacts.

To pursue that strategy INIA is organized into National Stations that develop specific scientific activities:

- National Agricultural Research Station – Lisbon
- National Forestry Station – Lisbon
- National Research Station for Viticulture and Enology – Dois Portos
- National Plant Breeding Station – Elvas
- National Station for Animal Production - Santarém

Regarding agrarian genetic resources, each national station has responsibility for the species considered in its programme. The programmes are coordinated by the Agrarian Genetic Resources Committee. This committee aims to promote the sustainable use of genetic resources as well as their conservation, and is composed of delegates from the different stations.

Annual crops, cereals, pastures, forages and wild species are assigned to the National Plant Breeding Station. These species represent 83% (11844 accessions) of the total *ex situ* collections belonging to the INIA. Only a small part of that total is regenerated and characterized.

At the moment two main lines of work can be identified:

1. Genetic resource conservation
   - Germplasm prospecting to protect some species from genetic erosion
   - Repatriation of indigenous germplasm identified in international collections
   - Regeneration and characterization of collections *ex situ*
2. Promoting the use of genetic resources
   - Identification of landraces which can be used in breeding programmes to promote biodiversity in cropping systems
   - Promotion of on-farm conservation of traditional varieties.

As breeders we look at wheat genetic resources as a source of biodiversity. In recent decades wheat was bred by crossing only elite germplasm. Now we believe that we are reaching a limit and new approaches are needed. One of the most important steps in breeding, rarely used in the past, is germplasm development. This is not used by most private breeding companies since they need quick profit. ENMP is a public institution and

our programme is striving to obtain financial resources in order to pursue this objective. We have just repatriated 100 wheat accessions from the Genebank of IPK, Gatersleben, Germany. This was the oldest source of landraces from the beginning of the 20th century. It contains 53 tetraploid accessions, illustrating the importance of this species in our country.

This collection is also being characterized by molecular means in order to identify sources of *Erysiphe* resistance in the tetraploid groups. There is a great lack of resistance in our active crossing block, which currently includes 560 bread wheat entries and 190 durum wheats that are well characterized.

Old material can be a valuable source of traits (e.g. good rooting system) to be introduced into varieties suitable for organic farming, for which there is currently an important niche.

Status of the national Triticum *collection in Romania*

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The Romanian *Triticum* collection comprises 3088 accessions including the collection kept by the Suceava Genebank (1173 accessions), stored under standard conditions for the long and medium term.

Taxonomic composition of the wheat collections and respective holders

The collection status by species and holding institutions is given in Table 1. *Triticum aestivum* predominates; this species is the major species used in breeding programmes.

Table 1. The Romanian *Triticum* collection by species and holding institutions

Species	Institution	No. of accessions
T. aestivum	Suceava Genebank	1103
	Research Institute for Cereals and Industrial Crops Fundulea	15
	Agricultural Research Station Suceava	371
	Agricultural Research Station Turda	684
	Agricultural Research Station Simnic	487
	Agricultural Research Station Podu Iloaie	243
	Agricultural University Timisoara	22
T. monococcum	Research Institute for Cereals and Industrial Crops Fundulea	34
	Suceava Genebank	37
	Agricultural University Timisoara	9
T. turgidum	Research Institute for Cereals and Industrial Crops Fundulea	18
	Suceava Genebank	2
T. dicoccoides	Research Institute for Cereals and Industrial Crops Fundulea	10
	Suceava Genebank	6
T. timopheevii	Research Institute for Cereals and Industrial Crops Fundulea	9
	Suceava Genebank	4
T. dicoccum	Research Institute for Cereals and Industrial Crops Fundulea	8
	Suceava Genebank	5
T. durum	Suceava Genebank	4
	Agricultural Research Station Simnic	1
	Agricultural University Timisoara	1
T. spelta	Suceava Genebank	6
T. polonicum	Suceava Genebank	3
T. persicum	Suceava Genebank	1
T. carthlikum	Suceava Genebank	1
T. vavilovii	Suceava Genebank	1
T. urartu	Research Institute for Cereals and Industrial Crops Fundulea	1
T. ispahanicum	Research Institute for Cereals and Industrial Crops Fundulea	1
T. aethiopicum	Research Institute for Cereals and Industrial Crops Fundulea	1
Total		**3088**

Origin of wheat accessions

The collection is mostly made up of accessions from Romania (1271 accessions) and other European countries (1559 accessions) (Table 2).

Table 2. *Triticum* germplasm composition by country of origin

Country of origin	No. of accessions	Country of origin	No. of accessions
Armenia	3	Hungary	117
Bulgaria	59	Israel	18
Brazil	2	Kazakhstan	10
Canada	2	Moldova Republic	21
Switzerland	11	Mexico	38
China	14	Poland	1
Czechoslovakia	34	Romania	1271
Czech Republic	14	Russian Federation	63
Germany	38	Turkey	11
Spain	2	Ukraine	109
France	37	United States of America	198
United Kingdom	5	Uzbekistan	2
Georgia	8	Yugoslavia	14
Greece	2	South Africa	4
Georgia	2	Unknown	978

Status of samples

The collection structure in terms of sample status is shown in Fig. 1.

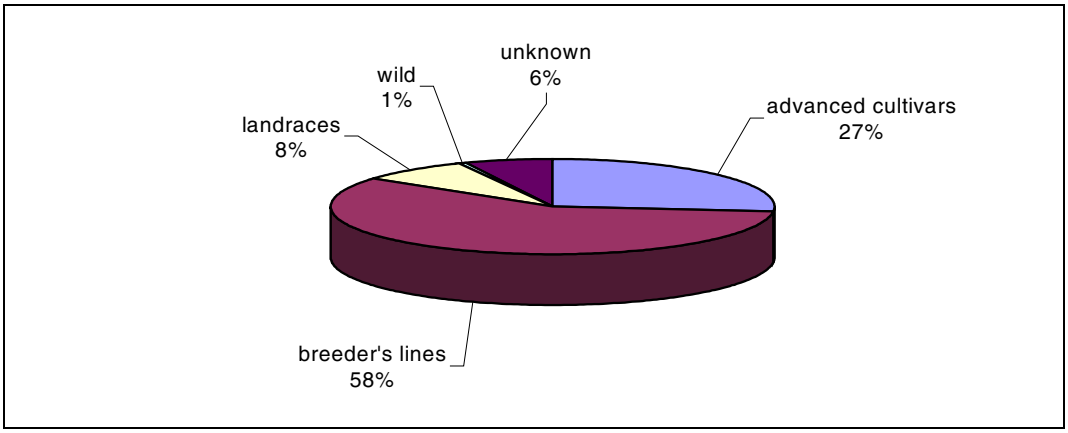

Fig. 1. Status of samples belonging to the Romanian *Triticum* collection.

Documentation

Passport data for the *Triticum* collection are included in the Romanian catalogue of plant genetic resources, Fascicle I, Cereals (Strãjeru *et al.* 2000).

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Current status of the ex situ *wheat collection at the Vavilov Institute, Russian Federation*

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The Vavilov Institute of Plant Industry (VIR) in Russia has been involved for more than a century in the collecting, preservation, study and utilization of genetic resources of cultivated plants and their wild relatives. VIR's Department of Wheat maintains the global diversity of genera *Triticum* L., *Aegilops* L. and of the synthetic crop *Triticale* Wittm.

Composition of the VIR wheat collection

The collection contains more than 44 000 accessions. Approximately two-thirds of the accessions (27 832) represent bread wheat germplasm. Spring and winter bread wheat are present in equal proportions. Durum wheat is represented by 5947 accessions (13%). Wild and primitive wheats have 2867 accessions, goat grass (*Aegilops*) 3847 and *Triticale* 3576 (i.e. each about 7-9% of all accessions).

Geographic origin

The wheat collection includes accessions from Europe, Asia, Africa, America and Australia (Table 1). Durum wheat accessions originate from more than 66 countries and those of bread wheat from 85 countries. A fair proportion of each crop is represented by accessions collected from 1907 to 1940. These accessions have particular value because they are mainly landraces or old varieties which were developed by selection from those landraces. Modern cultivars, breeding lines and genetic stocks are also included in the collection.

Table 1. Geographic diversity of durum and bread wheat accessions in VIR's collection (as of 1997)

Origin	Durum wheat				Bread wheat			
	No. of countries	No. of accessions	Accessions included in the collection before 1939		No. of countries	No. of accessions	Accessions included in the collection before 1940	
			No.	%			No.	%
Europe	20	1429	365	25.5	27	9304	2137	23.0
Asia	23	2629	1419	54.0	26	6387	3418	53.5
Africa	11	673	407	60.5	16	579	171	29.5
America	9	477	27	5.7	13	4219	569	13.5
Australia	2	15	7	46.7	2	511	134	26.2
Russia	1	674	372	55.2	1	5053	1887	37.3
Total	**66**	**5897**	**2597**	**44.0**	**85**	**26053**	**8316**	**31.9**

Taxonomic composition

The development of the collection was closely connected with the study of wheat on a global scale. Evolutionary and geographical principles formed the basis of this research. In the 1930s N.I. Vavilov formulated the concept of cultivated plants as Linnean species and gave the following definition: a Linnean species is a *"definite, discrete, dynamic system differentiated into geographical and ecological types and containing sometimes an enormous number of varieties"* (Vavilov 1931). The understanding of cultivated plants as species systems reached by Vavilov has not lost its scientific relevance and activities related to the development and study of the collection are based on this concept.

According to the wheat taxonomic system developed by Dorofeev and others and widely accepted in Russia, the genus *Triticum* L. consists of the subgenera *Triticum* and *Boeoticum* (Migusch. et Dorof.), each including three sections (Dorofeev *et al*. 1979). Within the sections there are 26 species which were collected in native conditions. This system also includes eight synthetic forms. Species and synthetic wheats are combined into four groups: wild, cultivated hulled, cultivated free threshing and synthetic forms (Table 2). Some of the wheat species are represented by a large number of botanical varieties. Wheat taxonomy is based on differences in the genomic composition of wheats and in the presence in their genomes of dominant or recessive mutations which control different morphological characters, including those that are connected with free threshing.

Table 2. Taxonomic composition of the genus *Triticum* L. in VIR's collection (Dorofeev *et al.* 1979)

Groups of species	Species	2n	Genome	No. of botanical varieties in VIR's collection
Wild	*boeoticum*	14	A^b	22
	urartu	14	A^u	5
	dicoccoides	28	A^bB	15
	araraticum	28	A^bG	5
Cultivated hulled	*monococcum*	14	A^b	11
	dicoccum	28	A^uB	23
	karamyschevii	28	A^uB	1
	ispahanicum	28	A^uB	1
	timopheevii	28	A^bG	2
	macha	42	A^uBD	5
	spelta	42	A^uBD	22
	vavilovii	42	A^uBD	3
	zhukovskyi	42	A^bA^bG	1
Cultivated with free threshing	*sinskajae*	14	A^b	1
	durum	28	A^uB	53
	aethiopicum	28	A^uB	43
	turgidum	28	A^uB	28
	jakubzineri	28	A^uB	1
	persicum	28	A^uB	3
	turanicum	28	A^uB	4
	polonicum	28	A^uB	13
	militinae	28	A^bG	1
	aestivum	42	A^uBD	121
	compactum	42	A^uBD	35
	sphaerococcum	42	A^uBD	8
	petropavlovskyi	42	A^uBD	4
Synthetic	*erebuni*	28	A^uD	1
	palmovae	28	A^bD	1
	timococcum	42	A^bA^bG	1
	miguschovae	42	A^bGD	1
	kihare	42	A^bGD	1
	fungicidum	56	A^uA^bBG	1
	timonovum	56	A^uA^bGG	1
	flaksbergeri	56	A^uA^bBG	1

Introduction

The enhancement of genetic diversity of the collection is one of the priority activities. In order to fill gaps in phenotypic and genotypic variability of collected species and to supply breeders with valuable sources, 875 wheat accessions have been introduced into the collection during the past five years.

Storage

For the preservation of the genetic integrity of accessions and high viability of their seed stocks three main types of collections have been formed. The base or long-term collection is kept at the State Seed Store situated in the Krasnodar Territory. Seeds are dried to 8-10%

moisture content, sealed in glass bottles and kept at 4°C. At present about 80% of the total number of accessions is included in the base collection. Access to this collection is restricted.

The active or short-term collection is kept at room temperature at VIR's Department of Wheat in St. Petersburg. Materials from the active collection are freely distributed to breeders and scientists and used for exchange with other genebanks.

In addition, collections for safety-storage are located at VIR's experimental stations. They are used for regular and urgent seed multiplication, and differ in their composition. Accessions are distributed among experimental stations according to their origin and to the suitability of the climatic conditions of experimental stations for their multiplication.

Documentation

Documentation of the wheat collection is one of the major priorities. Its objective is the development of an information retrieval system for effective management of the wheat collection, facilitation of routine work on the collection, and also for storage and standardization of information about accessions. This work is carried out in collaboration with the Department of Computer-Aided Information Systems of the VIR. Up to now the following databases have been developed:

- TRIT contains passport data for 36 589 accessions. The database is structured in 31 fields (21 passport and 10 additional). The version of the passport database which was transferred to the EWDB contains 34 808 records documented for 14 fields. This version is available on the Internet (http://genebank.vurv.cz/ewdb);
- TRIT_PV contains 456 records with information about 922 accessions which represent different populations. The structure of this database includes 68 fields (21 passport and 47 additional).

In addition, electronic botanical and geographical dictionaries containing information about the taxonomic system of genus *Triticum* L. according to Dorofeev *et al.* (1979) and codes of countries and territories have been developed. The following work is in progress: standardization of information about collecting sites, determination of their geographical coordinates and climatic characteristics.

An evaluation database has also been developed, containing the results of long-term (1972-1991) field studies of spring bread wheat accessions in the Krasnoyarsk Region. The database contains information about 4534 accessions.

The transcription of Chinese names is an important issue. VIR's collection contains 1033 accessions from China. For 323 of those, the names are transliterated using the Russian alphabet. For 93 accessions they are transliterated using the Latin alphabet (pin'yin). Finally, 53 accession names are given in the old English system. All names of accessions are phonetic transcriptions of Chinese hieroglyphs (Oshanin 1983).

For standardizing records, names had to be corrected. Considering all potential variants of the name of each accession, it appeared that in some cases an accession with the same name was already present in the collection (Table 3). More detailed comparison of all passport characteristics for such accessions, and also their identification by gliadin patterns have confirmed genetic identity for some of them (Table 4). Thus, standardization of records of accession names from China can contribute to the identification of duplicates. In order to decrease the number of duplicates in collections of different countries, it is expedient to transliterate the names of Chinese cultivars in pin'yin.

Table 3. More precise definition of the names of accessions from China

VIR's catalogue number	Name of accession according to passport database	Year of inclusion in the collection	Names of accessions in different transcriptions		
			In Russian	In Pin´yin – transliteration in latin letters	Old English system records
41656	Бай-са-май	1954	Бай-са-май	Bai-sa-mai	Pai-sa-mai
59351	Hsiang Yang 1	1981	Сян-ян 1	Xiang-yang 1	Hsiang yang 1
41664	[Зин?]-го-инь-сяо-май	1954	Цзин-го-инь-сяо-май	Jing-guo-yin-xiao-mai	Ching-ko-yin-hsiao-mai
41679	Хун-[цюан?]-ман	1954	Хун-цюань-ман	Hong- quan-mang	Hung- ch'üan-mang
41175	Нань-[Фун?]	1953	Нань-фан, Нань-фань, Нань-фэн(фын)**, Нань-фэнь(фынь) Нан-фан, Нан-фань, Нан-фэн(фын), Нан-фэнь(фынь)	Nan-fang, Nan-fan, Nan-feng(feng)**, Nan-fen(fen) Nan-fang, Nan-fan, Nan-feng(feng), Nan-fen(fen)	Nan-fang, Nan-fan, Nan-fêng(fêng)**, Nan-fên(fên) Nan-fang, Nan-fan, Nan-fêng(fêng), Nan-fên(fên)
40738	Нан-Фын	1952	Нан-фын(фэн), Нань-фын(фэн)**	Nang-feng(feng), Nan-feng(feng)**	Nang-fêng(fêng), Nan-fêng(fêng)**
41693	Юй-лин-бай	1954	Юй-лин-бай, Юй-линь-бай*	Yu-ling-bai Yu-lin-bai*	Yü-ling-pai Yü-lin-pai*
61286	Yu-Lin-Bai	1989	Юй-линь-бай*	Yu-lin-bai*	Yü-lin-pai*

*, ** - It is possible that accessions are genetically identical, […?] – the syllable is absent in the dictionary

Table 4. Identification of duplicates

VIR's catalogue number	Name of accession in passport database	Year of inclusion in the collection	Botanical varieties	Gliadin formulae				Name of accession after more precise definition
				α	β	γ	ω	
41175	Нань-[фун?]	1953	*erytrospermum*	5<u>6</u>7	$123_{2}45_{2}$	<u>3</u> <u>4</u>	234 <u>$6_{2}7_{2}8_{2}9_{2}$</u>	Nan-feng(feng)**
40738	Нан-фын	1952	*erytrospermum*	5<u>6</u>7	$123_{2}45_{2}$	<u>3</u> <u>4</u>	234 <u>$6_{2}7_{2}8_{2}9_{2}$</u>	Nan-feng(feng)**
41693	Юй-лин-бай	1954	*graecum*	$456_{1}\underline{7}_{1}$	$123_{2}45_{1}$	<u>2_{1}</u> 3 <u>5</u>	$4_{1}4_{3}6_{1}7_{1}8_{2}9_{2}$	Yu-lin-bai*
61286	Yu-Lin-Bai	1989	*graecum*	$456_{1}\underline{7}_{1}$	$123_{2}45_{1}$	<u>2_{1}</u> 3 <u>5</u>	$4_{1}4_{3}6_{1}7_{1}8_{2}9_{2}$	Yu-lin-bai*

*, ** - Genetically identical accessions

Characterization and evaluation

The main objective of the rationalization of the wheat collection is to maximize the amount of genetic diversity in the collection without increasing its size considerably. To achieve this task successfully, the characterization of the genetic diversity gathered in the collection and the determination of its structure are prerequisites.

RAPD markers were used to describe the structure of bread wheat genetic diversity and to elucidate polymorphism in relation to ecogeographical differentiation of the crop. The identification of a representative sample of accessions for the analysis was based on the agroecological classification developed by Vavilov. The classification was first published in 1964 in his posthumous book entitled "*Wheats*". When it spread from its primary centre of origin to other locations, wheat divided into a large number of forms adapted to specific environments. For example, according to the classification, the wide diversity of the hexaploid wheat complex was divided into a comparatively restricted number of species and subspecies, some of which are differentiated into agroecological groups. Each of those species (*T. macha* Dek. et Men., *T. vavilovianum* Jakubz. (=*T. vavilovii)* and *T. sphaerococcum* Perc.), being endemic, is represented by only one group. The species *T. compactum* Host contained three subspecies (subsp. *armeno-turkestanicum* Vav., *eurasiaticum* Vav. and *sinicum* Vav.) and 11 agroecological groups. *T. vulgare* Host (=*T. aestivum* L.) as the most widespread crop, consisted of five subspecies (subsp. *irano-turkestanicum* Vav., *indicum* Vav., *sinicum* Vav., *eurasiaticum* Vav. and *abyssinicum* Vav.) which were divided into 35 agroecological groups. Names of landraces and old breeding varieties which are typical forms for each agroecological group are also given in Vavilov's work. As the classification was based on the collection assembled by Vavilov and his co-workers and the main part of the collected material has been maintained at the present VIR's collection, it was possible to include in the representative sample of accessions the landraces and old breeding varieties which are mentioned by Vavilov.

A RAPD analysis of 148 landraces and old varieties of bread wheat (subsp. *eurasiaticum* Vav.) was carried out using 28 selected oligonucleotide primers (Mitrofanova *et al.* 2001). Three independent methods of multivariate statistics (principal component analysis, cluster and canonical discriminant analyses) were applied for classification of the investigated sample of accessions. This work was carried out in cooperation with VIR's Department of Biochemistry and Molecular Biology.

Results showed that each accession analyzed was unique in its RAPDs composition. Within the representative sample, genetic subgroups and groups of similar accessions were identified. Some of these subgroups coincided with the agroecological groups suggested by Vavilov. All 148 accessions were combined into 15 groups. Three of them were identified as major groups. They contained 71, 33 and 20 accessions respectively. The distinctions between both subgroups and groups of accessions identified were connected with quantitative changes of different RAPDs frequencies. Thus, the results obtained clearly demonstrated that the genetic structure of subsp. *eurasiaticum* is hierarchically more complex than had been supposed by Vavilov. Differences revealed between the major groups were obviously determined by genetic differences between their founders and by additional changes in the genomes of their descendants accumulated during adaptation to new environments.

Utilization of the collection

Genetic diversity is the most valuable factor for the development of new cultivars that will be able to withstand biotic and abiotic stresses and will have high grain yield and grain quality. Our work focuses on the evaluation of accessions and selection of the most potentially valuable forms for breeding. Usually the following scheme is used:

- Seed multiplication and preliminary evaluation of accessions. The latter includes the determination of growth habit (first year);

- Basic (ecogeographical) evaluation, which includes 2- or 3-year field trials according to VIR's descriptors;
- And finally, special evaluation of selected accessions by laboratory tests.

From 1996 to 2000 more than 5000 accessions from VIR's collection were involved in different evaluation experiments, resulting in the identification of 1030 new sources for breeding.

Various targeted specific sets of accessions have been formed within the active collection. These sets contain accessions which show resistance to leaf rust, yellow rust, powdery mildew, scab, tolerance to drought and saline soils, different reaction to photoperiod or possess other agronomic traits valuable for breeding. These sets of accessions might be recommended for use in breeding programmes. A genetic collection has also been constituted. Various series of near-isogenic lines have been developed at VIR's Department of Wheat. These lines carry mutations of morphological traits (33 identified mutations), Rht-mutations (12) and Ppd-mutations (6). All these mutations are introduced into genetic backgrounds of spring analogues of the cultivar 'Mironovskaya 808' or of the line 'FCHL 2'.

The Department of Wheat collaborates with several breeding centres and research institutes. More than 14 000 accessions were sent to breeders during the period 1996-2000.

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Status of the national wheat collection in the Slovak Republic

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Wheat growing in Slovakia is a longstanding tradition. Valuable traits with biological and economic value are present both in wild relatives and improved genetic material. The area under wheat in 2001 was 44 6526.5 ha, i.e. 30.1% of the arable land.

The Gene Bank in Piešťany, which started operating in 1996, is responsible for long-term genetic resource conservation in Slovakia.

The Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture is implemented in Slovakia by the National Programme on Plant Genetic Resources for Food and Agriculture.

Composition of the national wheat collection

The collection contains 3475 accessions including varieties (2058), breeders' material (1374) and local varieties (42). The list of species and status of samples are given in Table 1, and the countries of origin of accessions (448 Slovak and 3027 foreign) in Table 2.

Table 1. Taxonomic composition and status of samples in the Slovak wheat collection

Species	Total	Varieties	Breeders' material	Local varieties
T. aestivum	3303	1925	1344	34
T. aethiopicum	1		1	
T. araraticum	1		1	
T. boeoticum	2	1		1
T. carthlicum	4	2	1	1
T. compactum	5	3	2	
T. dicoccoides	1		1	
T. dicoccon	7	6	1	
T. dimococcum	1		1	
T. durum	77	66	5	6
T. karamyschevii	2	2		
T. ispahanicum	1	1		
T. militinae	1		1	
T. monococcum	15	13	2	
T. petropavlovskyi	1		1	
T. polonicum	13	11	1	
T. spelta	17	15	2	
T. sphaerococcum	4	2	2	
T. timopheevii	3		3	
T. turgidum	15	10	5	
T. vavilovii	1	1		
Total	**3475**	**2058**	**1374**	**42**

Evaluation and utilization of the collection

Studies carried out on the wheat germplasm include:

- collecting and conservation of the world collection: species, lines, breeding material, wild forms;
- evaluation according to the standard descriptor list;
- analysis of the biological material (testing for flour milling and baking characteristics);
- providing information and research results to breeders and other research workers, and implementation of research results;

- selection of suitable genotypes containing dwarfing genes (detection of *Rht* genes) mainly for cultivation of short-stalked varieties;
- computerization of data (Fox Pro).

The national database records 3475 accessions (323 winter and 3152 spring wheats). It contains passport data for all accessions and characterization data for 1025 accessions.

Table 2. Distribution of wheat accessions according to country of origin (3-letter ISO code)

Country	No. of accessions	Country	No. of accessions
ARG	2	ISR	6
ARM	1	ITA	64
AUS	31	JPN	18
AUT	63	KOR	6
BEL	14	LTU	1
BGR	214	MEX	71
BRA	2	NLD	28
CAN	26	NOR	9
CZE	134	NZL	55
DEU	432	PAK	1
ESP	2	POL	129
DNK	5	PRK	1
FIN	12	ROM	93
FRA	230	RUS	5
GBR	113	SRB	3
HUN	112	SUN	406
CHE	32	SVK	448
CHL	7	SWE	33
CHN	33	TUR	18
IND	10	TWN	2
IRN	1	UKR	25
		Others	7
Total	**3475**		

Collection development

Nine new samples belonging to the genus *Tritordeum* have been added to the collection. It is planned to put them in the container nursery to characterize them and to maintain them in the genebank for further breeding and research.

The collection is enriched by new accessions obtained through various channels:

- by ordering new varieties registered in foreign countries;
- by collecting expeditions organized by RIPP-Piešťany but also abroad;
- from colleagues, mainly from the Slovak Agricultural University in Nitra, the Botanic garden in Nitra, breeding stations, etc.;
- from private breeders;
- from foreign institutes.

In 2001 new accessions received from abroad (146) or from national breeders (6) have been included into our collection.

Five new Slovak varieties have passed through the state variety tests and were registered in 2001: 'Velta', 'Arida', 'Eva', 'Vanda' and 'Malyska'.

Characterization and evaluation

All samples are evaluated according to the descriptor list for the genus *Triticum* L. Newly obtained samples are put into the container nursery. The aims of this container nursery are as follows:

1. testing of new varieties received from abroad and comparison with the standard variety;
2. adaptation of species to prevalent agroclimatic conditions;
3. seed multiplication;
4. description of new genotypes;
5. selection of the best genotypes.

Characters evaluated according to the descriptor list include winter hardiness, earing, vining, plant height, resistance to diseases and pests (*Erysiphe graminis*, *Puccinia*, *Fusarium*, *Ustilago tritici* and others), number of spikes/m^2, date of ripeness, quality, etc. The number of spikelets/spike and the number of grains/spike are determined on a sample of 30 ears. Other characters such as grain mass/spike and spike length are recorded.

Technological and flour milling and baking quality analyses have begun in the Laboratory of Quality. The grain crude protein content and essential amino acids are analyzed. The flour is analyzed for wet gluten content, baking quality and by a sedimentation test. Gluten is evaluated for swelling, quality, tensibility and hardness of grain (glassing). The selected accessions were tested by gibberellic acid for the presence of *Rht* genes (short-stalked character). A total of 1113 genotypes of winter wheat have been tested. Analyses are carried out with the collaboration of institutes such as the Comenius University, Slovak Agricultural University Nitra and breeding stations. Results of all research are processed and recorded in the database.

Multiplication seed is stored in the genebank in RIPP-Piešťany and data are recorded in the database system running under FoxPro according to international standards.

Table 3 summarizes the evaluation and utilization of the Slovak wheat collections.

Table 3. Evaluation and utilization of wheat genetic resources in Slovakia

Collection holder	No. of accessions					
		evaluated			distributed	
Institute/breeding station*	obtained	preliminary	basic	multiplied	to users	maintained
RIPP Piešťany	178	411	348	531	1469	2920
ISTROPOL Solary	28	404	76		53	81
SAU Nitra	124	10				124
Total	**330**	**825**	**424**	**531**	**1522**	**3125**

* RIPP = Research Institute of Plant Production, Piešťany; SAU = Slovak Agricultural University, Nitra

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The wheat collection maintained at CRF-INIA (Spain)

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The Centre for Plant Genetic Resources (CRF), located in Alcalá de Henares (Madrid), comes under the National Institute of Food and Agrarian Research and Technology (INIA). The aims of the CRF-INIA are the conservation of the base collection (-18ºC, seed moisture <7%) of the Network of the National Plant Genetic Resources Programme, and the management and computerization of the Permanent Inventory of the Network. The aims of the CRF also include the conservation and regeneration of the active wheat collection (-4ºC, seed moisture <7%).

Other activities carried out by the CRF-INIA are prospecting for and collecting of seeds as well as multiplication, characterization and evaluation of the genetic material collected.

Wheat collection passport data

Information on wheat accessions at CRF is arranged in three groups: passport data, management data and characterization/evaluation data. The passport data are structured according to the descriptors agreed for European Central Crop Databases. They contain information about geographic origin, taxonomy, type of material, etc.

The wheat collection at CRF holds 2906 accessions, including 787 of unknown origin (Table 1). The majority of accessions are Spanish local varieties, coming from expeditions or breeder donations. Countries such as Portugal, USA, Italy and France, which have historically maintained material exchange with Spain, are well represented. Conversely, other countries such as South Africa, Sweden and Ethiopia are poorly represented in the collection.

Table 1. Numbers of accessions per country of origin

Country	Number	Country	Number
Unknown	787	Italy	95
Argentina	29	Japan	10
Australia	24	Morocco	2
Canada	9	Mexico	26
Czech Republic	1	Portugal	138
Chile	5	Romania	7
Algeria	9	Ex-Soviet Union	2
Egypt	3	Spain	1568
Ethiopia	1	Sweden	4
France	32	Tunisia	3
Great Britain	2	Turkey	20
Greece	5	Uruguay	3
Hungary	4	USA	108
India	8	South Africa	1

The distribution among species is as follows: 1773 accessions (Table 2) of *Triticum aestivum* (including 1524 of *T. aestivum vulgare*) and 1107 accessions of *Triticum turgidum* (including 779 of conv. *durum*). Other species are poorly represented.

Table 2. Taxonomic distribution of wheat accessions

Species	Subtaxon	Number
T. monococcum L.		16
T. monococcum L.	subsp. *boeoticum* (Boiss.) Mac Key conv. *aegilopoides*	2
T. monococcum L.	subsp. *monococcum*	1
T. turgidum L.		9
T. turgidum L.	subsp. *dicoccoides* (Korn.) Thell.	4
T. turgidum L.	subsp. *dicoccon* (Schrank) Thell.	82
T. turgidum L.	subsp. *carthlicum* (Nevski) MK.	7
T. turgidum L.	subsp. *turgidum* L.	2
T. turgidum L.	subsp. *turgidum* L. conv. *turgidum* L.	195
T. turgidum L.	subsp. *turgidum* L. conv. *durum* (Desfl.) MK.	779
T. turgidum L.	subsp. *turgidum* L. conv. *polonicum* (L.) MK.	29
T. timopheevi Zhuk.		6
T. aestivum (L.) Thell.		120
T. aestivum (L.) Thell.	subsp. *compactum* (Host) MK.	3
T. aestivum (L.) Thell.	subsp. *macha* (Dek. & Men.) MK.	4
T. aestivum (L.) Thell.	subsp. *spelta* (L.) Thell.	118
T. aestivum (L.) Thell.	subsp. *sphaerococcum* (Perc.) MK.	5
T. aestivum (L.) Thell.	subsp. *vulgare* (Vill.) MK.	1524
Total		**2906**

The first accessions were collected in 1929 (Table 3), the greatest number of accessions (164) being obtained during that year. Other years when large numbers of varieties were collected were 1945, 1939, 1977, 1979 and 1982.

Table 3. Number of accessions collected per year

Collecting year	No. of accessions
unknown	1776
1929	164
1930-34	149
1935-39	114
1940-44	48
1945-49	148
1950-54	70
1955-59	2
1960-64	0
1965-69	0
1970-74	0
1975-79	153
1980-84	123
1985-89	61
1990-94	7
1995-99	91
Total	**2906**

Nowadays, it is very difficult to find local wheat varieties since they have been replaced by modern cultivars. However, some local varieties, which we thought had disappeared, have been detected, e.g. 'Pichi' wheat found in an expedition in 1997 covering the Almería region in the south of Spain.

With respect to the regional distribution of the Spanish wheat accessions (Table 4) the majority come from the Castilla-La Mancha (south-central Spain) with 185 accessions of *T. aestivum*, 47 of *T. turgidum* and 4 of *T. monococcum*. Another 155 accessions of *T. turgidum*, 55 of *T. aestivum* and 5 of *T. monococcum* come from Andalucía (southern Spain) and 122 accessions of *T. aestivum* and 19 of *T. turgidum* come from Castilla-León (north-central Spain).

Table 4. Regional distribution (origin of accessions)

Region	*T. aestivum*	*T. monococcum*	*T. turgidum*
Unknown	135		176
Andalucía	55	5	155
Aragón	47		1
Asturias	131		47
Baleares	10		25
Canarias	11		10
Cantabria	13		3
Castilla-León	122		19
Castilla-La Mancha	185	4	47
Cataluña	48		29
Euskadi	23		2
Extremadura	49		41
Galicia	56		2
La Rioja	5		2
Madrid	4		
Murcia	14		38
Navarra	8		7
Valencia	16		16

With regard to the type of material (Table 5), the majority of accessions (2176) are local varieties (code 3), in particular for the species *T. aestivum* (1226 accessions) and *T. turgidum* (929 accessions). Commercial varieties (code 5) are present in the collection with 415 accessions, breeding material (code 4) with 166 accessions and wild relatives (code 1), with 5 accessions.

Table 5. Type of material

Species	Type of material*	No. of accessions
T. *monococcum* L.	1	2
	3	17
T. *turgidum* L.	unknown	17
	1	3
	3	929
	4	93
	5	65
T. *timopheevi* Zhuk.	3	4
	4	2
T. *aestivum* (L.) Thell.	unknown	126
	3	1226
	4	71
	5	350

* 1 = wild relatives; 3 = local varieties; 4 = breeding material; 5 = commercial varieties

Durum wheat collection

The durum wheat collection is being studied by different Spanish breeding groups. These groups are organized at national level, supported by INIA and coordinated by IRTA to encourage the breeding of the crop in our country.

For this reason, the study and rationalization of the collection is a priority activity at CRF. Characterization data are available for about 350 accessions and 13 agromorphological descriptors (INIA RF94-009 project). Furthermore, data coming from previous evaluations are also available (400 accessions evaluated for 9 morphological descriptors and 14 agronomic traits).

Moreover, for those accessions with similar agromorphology (potential duplicates) the gliadin protein patterns are being analyzed by electrophoresis.

The use of other molecular markers to identify varieties and to create the durum wheat core collection is being investigated.

Status of wheat genetic resources conservation in Switzerland

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Conservation of plant genetic resources is carried out in Switzerland by more than 25 public and private organizations. To coordinate work on conservation of genetic resources and strengthen collaboration between organizations, a commission for the conservation of cultivated plants (CPC) was created in 1991.

Three of these organizations deal with wheat: the Federal research station for plant production of Changins (RAC), the "Sortengarten Erschmatt" and the foundation Pro Specie Rara.

RAC holds the most important collection of 7148 accessions in the base collection and 1533 accessions in an introduction collection, of which a part will be put into the genebank. The number of accessions of the different *Triticum* species is given in Table 1.

Table 1. Number of accessions of different species of *Triticum*

Species	No. of accessions
T. aestivum	4508
T. boeoticum	17
T. carthlicum	4
T. dicoccoides	13
T. dicoccum	73
T. durum	158
T. macha	6
T. monococcum	19
T. plonicum	5
T. spelta	2252
T. timopheevi	9
T. turgidum	36
Triticum spp.	11
Aegilops sp.	37

Most of the accessions belong to *T. aestivum* and an important collection of *T. spelta* is also stored at RAC. About 74% of the accessions are winter wheat and 26% are spring-sown. Accessions of Swiss origin amount to 2388 and 4760 are from mostly European countries. The material consists of landraces (about 2700), old and modern varieties and breeding lines.

Except for the *T. spelta* and the *Aegilops* accessions, the material is well characterized and evaluated for heading date, plant height, maturity, lodging resistance, resistance to *Stagonospora nodorum*, leaf rust, stripe rust, stem rust and powdery mildew, 1000-kernel weight, protein content, grain hardness and Zeleny index.

About 80% of the accessions are kept in long-term storage at –20°C in aluminium foil bags. Security storage will be assured by IPK, Gatersleben, Germany.

All passport and evaluation data are computerized in a specific but Excel-compatible software system.

The "Sortengarten Erschmatt" holds 107 accessions. This organization promotes the cultivation of landraces in a region of Switzerland (Valais) where some 100 years ago many landraces were grown.

Pro Specie Rara, an organization specialized in on-farm conservation, holds 19 wheat accessions.

The accessions of both above-mentioned organizations originated partially from RAC's genebank. The other accessions are also stored in RAC's genebank for security reasons.

After the adoption of the Global Plan of Action in 1996 in Leipzig (Germany), the Swiss government prepared a national plan of action. Since 1999, projects are financed by the government, filling the gaps of the 20 priority actions of the Global Plan of Action with a total of 2 million Swiss francs available for 2001. Up to now 53 projects have been proposed by private and public organizations, of which 20 were totally or partially accepted. Seventeen projects concerned cereals, of which five were accepted. The three projects involving wheat deal with the on-farm conservation of the "Sortengarten Erschmatt", the establishment of demonstration plots with landraces in the eastern part of Switzerland, and the safe storage of an abandoned breeding programme of *T. spelta*.

One of the accepted projects is the elaboration of concepts for the conservation of genetic resources in Switzerland. These concepts consist of a central framework with specificities for different groups of crops (cereals, fruit trees, vegetables, grapevines, potatoes, forage crops and aromatic and medicinal plants). The idea is to integrate *ex situ*, on-farm and where possible *in situ* conservation, to define the procedures to follow when a new accession is found, with all the specifications to decide whether the variety is discarded, only put into *ex situ* conservation or also on-farm. These concepts are still under review and should be finalized in 2002.

The creation of a national database is also part of these concepts. This national database will be established in 2002, using the new FAO/IPGRI *Multi-crop Passport Descriptors* (MCPDs), including some relevant descriptors for each group of crops. As a second step, it is foreseen that the database will be extended to include characterization and evaluation data.

Activities and current status of the wheat genetic resources programme in Turkey

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Introduction

Plant genetic resources activities of Turkey started in 1964, and because of the importance of the country for plant genetic resources, these studies were implemented within the framework of the National Plant Genetic Resources/Diversity Research Programme (NPGRRP) in 1976. The Department of Plant Genetic Resources of the Aegean Agricultural Research Institute (AARI) has taken over all responsibility at national level on behalf of the Directorate of AARI as project centre. Cooperation with various institutions is organized according to the principles of the National Code of Conduct on Collection, Conservation and Utilization prepared in 1992. All joint programmes are conducted on a project basis within agreements (Tan 1998).

Turkey is also a member of several international programmes working on plant genetic resources such as the Commission on Genetic Resources for Food and Agriculture (CGRFA) of the Food and Agriculture Organization of the United Nations (FAO). Turkey adhered to the International Undertaking on plant genetic resources and is a member of the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR), the West Asia and North Africa Network on plant genetic resources (WANANET), the World Wheat Genetic Resources Networks and the World *Beta* Network (WBN).

The objectives of the NPGRRP are the survey, collecting, conservation (both *ex situ* and *in situ*), documentation and evaluation of existing plant genetic resources and plant diversity in Turkey. Survey/collecting, multiplication/regeneration and utilization activities are organized by crop groups, including cereals, food legumes, forages, industrial crops, vegetables, fruit trees, ornamental plants, medicinal and aromatic plants and endemic plants.

Turkey is one of the world's important centres for plant genetic resources and its flora displays a remarkable diversity. This is due to the following features of the country (Tan 1998, 2000):

- It overlaps the Near Eastern and Mediterranean Vavilovian centres of plant diversity;
- It is a meeting place of three phytogeographical regions, namely the Euro-Siberian, the Mediterranean and Irano–Turanian regions;
- It is a bridge between southern Europe and southwest Asia, and has apparently served as a migration route;
- It is a centre of diversity for many genera and sections;
- It is a centre of origin for many cultivated plants and weeds in Europe;
- And finally, it has a high level of species endemism.

Turkey is one of the origin and/or diversity centres for major cereals such as wheat, barley, rye and oat. These plant species have a wide range of variation as wild, cultivated landraces and primitive cultivars in Turkey. Diploid cultivated einkorn, *Triticum monococcum*, and tetraploid emmer wheat, *Triticum dicoccum* are now cultivated only on a small scale. Their wild ancestors, wild einkorn, *Triticum boeoticum*, and wild emmer, *Triticum dicoccoides* are also prevalent either in mixed population or in separate habitats (Firat and Tan 1998).

Wheat genetic resources activities

Wheat Genetic Resources activities are undertaken within the framework of General Groups of NPGRRP.

Ex situ conservation

Ex situ conservation activities have been undertaken since 1964 and are ongoing within the framework of NPGRRP. The first step of the project includes collecting (sampling the maximum variation) and determination of the interspecific, agroecological and phytogeographical distribution of plant species. Data of former surveys and expeditions are compiled and priorities regarding locations and plant species are defined to eliminate duplicate efforts when planning the collecting missions. Each year missions are planned to collect the existing plant genetic resources for eight plant groups, including cereals (Tan 1998).

The PGR material stored in the AARI Genebank was collected from different parts of Turkey in the last three decades. The facilities of the National Genebank at AARI for seed collections have been designed for long-term and medium-term storage of both base and active collections, respectively. Cold rooms work at -18°C for long-term and 0°C for medium-term storage. The collections are always kept safely in constant conditions. Humidity is not controlled in cold rooms. The seeds are dried to 5-6% moisture content and kept in sealed cans or aluminium containers for base and active collections. For temporary storage aluminium laminated foils are used. All conditions in the genebank comply with internationally recommended standards. For the safety-duplicates of base collections other storage facilities are available at the Central Research Institute for Field Crops (CRICF) in Ankara (Tan 1998, 2000).

The number of *Triticum* spp. accessions stored in the AARI genebank as of October 2001 is given in Table 1.

Table 1. *Triticum* spp. material stored in the AARI genebank (October 2001)

Species	No. of accessions
Triticum spp. (cultivated)	3435 (incl. 1685 *T. aestivum*, 1098 *T. turgidum durum*)
Triticum spp. (wild, including *Aegilops* spp.)	1930
Total	**5365**

As for other species, active collections of wheat are used for regeneration, multiplication, distribution, characterization and evaluation. All accessions are well documented (passport data, storage data, etc.). The conservation of herbarium specimens is also facilitated at the Plant Genetic Resources Department of the AARI. These herbarium specimens are used for further identification and kept as references of the maintained samples.

Multiplication/regeneration

Stored accessions with low germination rate or a small amount in active collections and insufficient collection material are subjected to a multiplication and regeneration programme. Over 3000 regenerated accessions have returned to the AARI National Genebank so far (Anonymous 2000).

Evaluation and characterization

Evaluation and characterization of *Triticum* species have been facilitated within the framework of the project. Until 2000, over 1000 *Triticum* accessions have been characterized at the AARI (Anonymous 2000).

A study on the evaluation of the cultivated hulled wheats which were collected in Turkey was completed in 2000. Results showed that the hulled wheats were lower yielding than the

bread and durum wheat control cultivars, but some of them had higher 1000-kernel weight and high protein content. Most hulled wheat accessions were highly resistant to leaf rust. They can be utilized as a source material in wheat breeding programmes to improve quality and leaf rust resistance (Begenc 2000).

A study has also been initiated to characterize the durum wheat accessions collected in different parts of Turkey.

In situ conservation

The "*In situ* Conservation of Plant Genetic Diversity Project" is an important part of the National Plant Genetic Resources Research Project, and was started in 1993 with wild relatives of crop species. Two areas of different ecosystems in south and southeast Anatolia (forest and marginal steppe ecosystems) were studied for wild relatives of wheat. Various sites were identified as Gene Management Zones (GMZs) for wild wheats and wild legumes (Tan 1998, 2000; Tan and Tan 2002). An atlas was published with various analyses by using GIS techniques (Anonymous 1998). In 1999, *in situ* (on-farm) conservation studies started in a selected pilot area in the northwestern transitional zone. The objective of the project is to identify the possibilities of *in situ*/on-farm conservation of landraces. Although cereals (hulled wheat) and legumes (chickpea, lentil, bean) have been selected as target species, the inventory of all landraces in the selected area is under study. A National Plan for *in situ* conservation of genetic diversity in Turkey was prepared and published (Tan 1998, 2000).

Status of central databases

The NPGRRP activity data are maintained in the databases created and managed under dBase 4, visual dBase and Excel. Passport/collecting and storage data have already been documented and computerized. Evaluation data are analyzed by multivariate analysis and a statistical program. The standard formats for each activity are used for easy recording and computerization. The Mapmaker package is also used for map production if the location of collection sites is recorded by the Global Positioning System (GPS). The recent application of Geographical Information System (GIS) technology has allowed geographic analysis of the data to begin (Tan and Tan 1998). The documentation unit is responsible for the centralized database of NPGRRP.

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Status of wheat genetic resources collections in Ukraine

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Structure of the collections

There are 15 research institutes, agricultural universities and experimental stations in Ukraine dealing with wheat breeding. Eleven cultivars are included in the Official State Register. Five institutions maintain wheat genetic resources collections (Table 1). The National Centre for Plant Genetic Resources of Ukraine (NCPGRU), based at the Yurjev Plant Production Institute (PPI), coordinates work on genetic resources and maintains bread wheat and spring durum wheat base collections. Other institutions duplicate in many respects the PPI collection. The Breeding and Genetics Institute traditionally has a large winter wheat collection (predominantly breeders' lines) since the time of the Council for Mutual Economic Assistance. The Institute maintains the winter durum wheat base collection. Ustymivka Experimental Station keeps many Ukrainian samples from the Russian VIR genebank.

Table 1. Composition of Ukrainian wheat genetic resources collections in 2001

Institution	Wheat	Total no. of accessions	Ukrainian cultivars	Other Ukrainian samples
Yurjev Plant ProductionInstitute	bread winter	5291	488	434
	durum winter	111	31	12
	bread spring	3111	59	42
	durum spring	1460	46	19
	obsolete species	272	0	0
	wild relatives	213	0	5
	amphidiploids	80	0	0
Breeding and Genetics Institute	bread winter	5170	335	-
	durum winter	227	37	-
Myronivka Wheat Institute	bread winter	544	61	-
	bread spring	218	10	-
	durum spring	110	7	-
South Region Agricultural Research Institute	bread winter	374	70	-
Ustymivka Experimental Station	bread winter	2251	388	-

Work on wheat genetic resources started at the Yurjev Plant Production Institute in 1956. Since then about 26 000 wheat cultivars and lines have been registered and tested. But many valuable samples were lost because the collection acquired national status only in 1992, with the founding of NCPGRU.

Germplasm introduction

It is now important to renew the old Ukrainian wheat accessions in the collection. Some were received from the VIR collection and from the Czech genebank. Another direction of germplasm introduction is to include in the collection new resources with traits valuable for breeding. NCPGRU receives many breeders' lines and cultivars from foreign institutes and testing nurseries through scientific collaboration. Most Ukrainian cultivars are received from breeders. Some wheat samples were collected by expeditions carried out by NCPGRU. Exchanges with other genebanks play an important role in the increase of the collection. After testing in a quarantine nursery, about 400 wheat accessions are registered for testing yearly.

Storage

The active collection is currently stored in Kraft paper bags and plastic boxes under non-controlled temperature and moisture conditions. The base collection is stored in hermetic glass bottles under non-controlled temperature and 6-7% moisture. Yurjev Plant Production Institute and Ustymivka Experimental Station use Munters air dryers. In 2001 NCPGRU purchased two freezing bins for long-term storage. As of November 2001, the National Depository contained about 4800 samples of bread wheat and over 700 of durum wheat. (Fig. 1). Fewer samples were put into storage due to bad weather conditions in 1999 and 2000, but about 1000 will be stored in 2001.

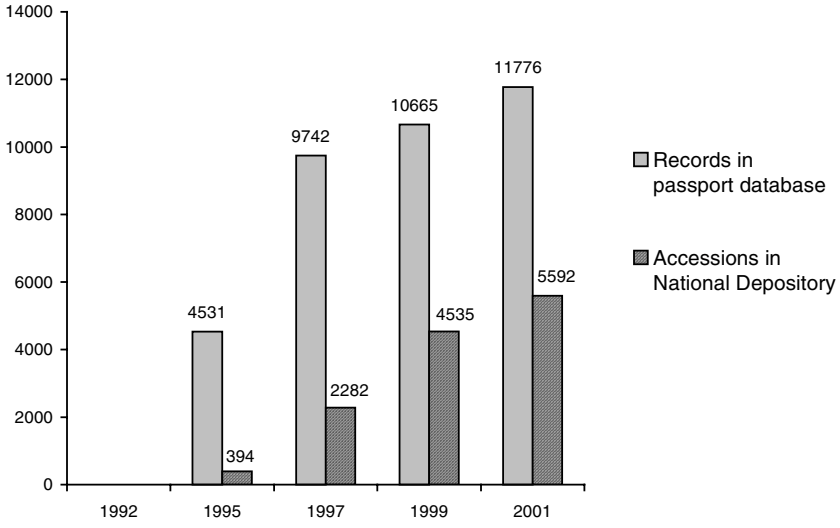

Fig. 1. Number of records of wheat accessions in the passport database and number of accessions in the National Depository of Ukraine.

Database

The passport and introduction database structure is common for all crops in NCPGRU. The wheat pedigree database is connected with the passport database. Parentage information with references is available for 3326 samples. Protein marker data are also included. The evaluation database records the results of trials. Yurjev Plant Production Institute and Ustymivka Experimental Station are the leading institutes for the wheat passport database. Wheat genetic resources groups in other institutions have fewer possibilities owing to lack of computer facilities. Most information is recorded in database format files (FoxPro 2.0). The database system needs to be improved with modern software; this work is ongoing.

Testing

The greater part of the work carried out on the wheat collection of NCPGRU is the testing of samples. Winter hardiness, drought resistance, lodging resistance, resistance to *Septoria*, powdery mildew, leaf rust and bunt, productivity elements, grain yield and bread-making quality are the most essential traits for Ukrainian conditions. The wheat genetic resources group collaborates with the Grain Quality Department, Genetics Department, Frost Resistance Group, Laboratory of Immunology and Institute of Plant Protection. Information about the testing of cultivars and lines has been recorded in the database since 1995.

Use

About 1500 wheat accessions are transferred yearly to research and educational institutions and genebanks. Some are used for hybridization or in genetic, immunology and other research programmes. Many samples are used for educational purposes. Private breeding firms are starting to show interest in the wheat evaluation collection.

Current status of wheat collections in Yugoslavia

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Introduction

Systematic and scientific work on wheat genetic resources began in the 1960s in Yugoslavia at the Institute of Field and Vegetable Crops in Novi Sad and at the Small Grains Centre in Kragujevac. Before that, there had been small grain collections in Novi Sad, Kragujevac, Zaječar, Podgorica and Belgrade.

During the period 1965-1970, the Small Grains Centre in Kragujevac established a collection of landraces and wild relatives of wheat, barley, oat and rye in central and southern Serbia, Kosovo, Metohija and Montenegro. Around 1000 samples were collected, classified and described. A major part of that material was sent to VIR, St. Petersburg. Unfortunately, most of this collection was gradually lost due to inadequate maintenance and infrequent use in breeding programmes. Efforts have recently been made to re-obtain the samples given to the Russian VIR collection more than 30 years ago.

The first small grains collection at the Institute of Field and Vegetable Crops in Novi Sad (IFVC) was established in 1939, although the first detailed written record for this collection dates back to 1942. The year 1957, in which Prof. S. Borojević became leader of IFVC's breeding team, marked the beginning of a new stage in the organization and utilization of the wheat collection. As a result of collaboration with many foreign universities and institutes, the IFVC received wheat samples from practically every wheat-growing country in the world. In 1965, the collection's organizational structure was given its final form, which has been maintained ever since (Denčić and Borojević 1991, 1995).

All the Yugoslavian small grains collections, except that of the Agricultural Institute in Podgorica, are located in institutions which work on the development of new cultivars and are therefore organized so as to be as useful as possible in current breeding work. Since the 1950s, our breeding programmes have produced over 300 wheat cultivars. They are highly diverse genetically with regard to a large number of traits, proving that they were developed using genetically different materials which can be found in the organizations involved in cultivar development. Some of our cultivars have been released in other countries (Russia, Hungary, the Czech Republic, Slovakia, Switzerland, Romania, Spain and Turkey) and the exchange of germplasm with foreign research centres continues. Many of our cultivars and lines are used in cultivar development in a number of countries. In Russia, for example, our cultivars 'Partizanka' and 'Balkan' are the parents of some of the new Russian cultivars such as 'Olimpia 2', 'Saratnica', and others (Pouchkov *et al.* 1997). In Hungary, the cultivars 'Sava', 'Posavka' and 'Novosadska rana 1' are the parents of a number of Hungarian cultivars, such as 'Kincso', 'Bence', 'Barna', 'Zombor', 'MV-21', 'MV-12', etc. (Balla 1991; Kertesz 1991).

Wheat collections in F.R. Yugoslavia

Wheat collections in Yugoslavia are currently maintained in six research centres and at the Ministry of Agriculture: Institute of Field and Vegetable Crops in Novi Sad (NS); Small Grains Centre in Kragujevac (KG); Centre for Agricultural and Technological Research in Zaječar (ZA); Agricultural Institute in Podgorica (PG); "INI Agroekonomik" PKB Beograd in Beograd (INI); Faculty of Agriculture in Zemun in affiliation with "PIK Agrounija" in Indija (IN); and Federal Department for Plant and Animal Genetic Resources (Dept.). All these are active collections that maintain a total of 6813 wheat genotypes. Among those, 2856 are of domestic origin and 3957 of foreign origin with around 22% and 10% of duplicates respectively (Table 1). The large number of duplicates is understandable, since almost all

institutions maintaining wheat collections also work on cultivar development; therefore, because of their importance in breeding, many genotypes can be found in more than one collection.

Table 1. Number of wheat accessions maintained by different research centres in Yugoslavia

								Domestic		Foreign	
IFVC	KG	ZA	PG	INI	Dept.	ZE-IN	Total	Total	Duplic.	Total	Duplic.
3557	1291	363	305	697	272	328	**6813**	2856	22%	3957	10%

IFVC = Institute of Field and Vegetable Crops, Novi Sad
KG = Small Grains Centre, Kragujevac
ZA = Centre for Agricultural and Technological Research, Zaječar
PG = Agricultural Institute, Podgorica
INI = "INI Agroekonomik" PKB Beograd, Belgrade
Dept. = Federal Department for Plant and Animal Genetic Resources, Belgrade
ZE-IN = Faculty of Agriculture, Zemun

The largest collection is kept at the Institute of Field and Vegetable Crops in Novi Sad, followed by the Small Grains Centre in Kragujevac, while the other centres have a considerably smaller number of accessions. The two centres mentioned above also have the most extensive exchange of accessions with other collections worldwide.

Taking into account all collections, the accessions can be divided into the following categories: current cultivars, advanced lines, obsolete cultivars, landraces and wheat relatives (Tables 2 and 3). Advanced lines and current cultivars are in the majority. This is logical since, except for the Federal Department for Plant and Animal Genetic Resources, all other collections are maintained in breeding centres.

Table 2. Status of accessions in the Yugoslav wheat collections

Category	%
Current cultivars	31.4
Advanced lines	56.0
Obsolete cultivars	0.8
Landraces	5.5
Relatives	6.3

Table 3. Number of diploid and tetraploid wheats in the Yugoslav collections

Species	Origin		Total
	Domestic	Foreign	
Diploids			
T. monococcum	5	118	123
T. boeoticum	-	5	5
Tetraploids			
T. durum	50	67	117
T. dicoccum	8	1	9
T. dicoccoides	3	14	46
T. polonicum	1	2	3

Evaluation

The methodology followed for the evaluation of accessions differs from one centre to another. The most detailed programme is carried out at the Novi Sad Institute. The collection is organized at three levels: world collection, genetic collection, and crossing collection (Denčić and Borojević 1991). Details are given in the next paper on "Organization of wheat germplasm collections at IFVC, Novi Sad".

In the collections of the other organizations, the most evaluated parameters are the following: winter hardiness, plant height, time of heading, resistance to prevalent diseases, spike length, resistance to lodging, and sometimes protein content and sedimentation value.

Documentation

Documentation systems play a major role in the management of genetic resources. Unfortunately, mostly due to the generally poor economic situation in the country as well as in research centres holding the collections, documentation and databases are maintained at a low level. The Institute of Field and Vegetable Crops in Novi Sad is the only one to computerize characterization and evaluation data. In the other collections, data are kept in field books.

The Federal Department for Plant and Animal Genetic Resources has recently tried to help the centres holding collections to establish joint databases and computerize all activities.

Priorities of work on wheat genetic resources

Given the importance of wheat, it is only natural that future priorities in the field of genetic resources should include further collecting, evaluation and maintenance of accessions in the existing collections. An analysis of the present situation in our collections has led to the conclusion that the following problems need to be addressed in the near future:

- All domestic collections should make use of identical descriptors proposed by an officially approved international organization such as ECP/GR or IPGRI;
- The collections should make use of databases that are compatible with and accessible in the international transfer of information (Internet);
- Field trips to collect more landraces should be organized in Yugoslavia. Previous expeditions have confirmed that Yugoslavia has more landraces of diploid and tetraploid wheat and, probably, *T. spelta* as well.
- Conditions should be created to enable the Federal Department for Plant and Animal Genetic Resources to operate as efficiently as possible and assume the leading role in the implementation of the overall policy in all the collections.
- All databases should be centralized at the Federal Department for Plant and Animal Genetic Resources. In this new scheme, we would have a single YUWDB (Yugoslav wheat database), a single YUBDB (Yugoslav barley database), and so on. Such unified national databases could then more easily integrate into the various information transfer systems, such as the Internet.
- It is necessary to establish facilities for long-term conservation at the federal level.
- Use of the new biotechnology methods, especially molecular markers, should be given more attention during sample evaluation, since they will undoubtedly have a significant role to play in the future as descriptors.
- Cooperation with other wheat collections on exchange of samples and data should be encouraged and expanded as much as possible, as should participation in all ECP/GR working groups, publication in national and foreign scientific journals of national research results in the field of genetic resources, etc.

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Utilization of the collections

Organization of wheat germplasm collections at IFCV, Novi Sad

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Introduction

Recognizing that the large size of germplasm collections may deter their use, Frankel (1984) introduced so-called "core collections" in order to prune a collection. The original concept of a core collection was put forward by Frankel and Brown (1984): *"A core collection consists of a limited set of accessions derived from an existing germplasm collection, chosen to represent the spectrum in the whole collection. The core should include as much as possible of its genetic diversity. The remaining accessions in the collection are called the reserve collection".*

So far several modifications to the core collection have been proposed (Knüpffer and van Hintum 1995; Mackay 1995).

In this paper we outline and discuss our approach in organizing wheat germplasm.

Organization of wheat collections

The wheat germplasm held at the Department for Small Grains of IFVC in Novi Sad was organized on three levels: world collection (whole collection), genetic collection (core collection) and crossing collection (breeders' collection) Denčić and Borojević 1991).

World collection

The world collection includes current cultivars (1102 = 48.1%), advanced lines (800 = 34.9%), obsolete cultivars (18 = 0.8%), landraces (309 = 13.5%) and relatives such as *T. monococcum*, *T. dicoccum*, etc. (62 = 2.7%). It comprises a total of 2291 accessions from 51 countries (Table 1), which are grown on each year.

Table 1. Countries of origin of the wheat germplasm held in the world collection

Continent	Country and no. of accessions
Europe	Yugoslavia (684), Croatia (69), Bosnia and Herzegovina (287), Macedonia (5), Austria (53), Belgium (7), Bulgaria (90), Czech Republic (97), Finland (2), France (17), United Kingdom (37), Germany (17), Hungary (86), Israel (11) Italy (73), Kyrgyzstan (1), Moldavia (17), The Netherlands (8), Poland (6), Romania (17), Slovakia (21), Spain (4), Sweden (5), Switzerland (5), Turkey (12), Ukraine (67), Russia (177)
North America	USA (114), Canada (8), Mexico (22)
South America	Argentina (31), Brazil (6), Chile (4), Colombia (3)
Asia	Afghanistan (3), South Korea (1), India (2), Israel (3), Japan (17), China (70), Pakistan (1)
Africa	Algeria (14), Angola (8), Egypt (7), South African Republic (3), Kenya (2), Lesotho (6), Nigeria (1), Tunisia (2)
Australia	Australia (34), New Zealand (33)

Evaluation

Two types of characters are evaluated in the world collection:

a) quantitative characters whose expression is dependent upon both genotype and environment such as winter hardiness, earliness, lodging, disease resistance, plant height and spike length. For each of these characters we calculate the mean every year, and as a measure of diversity the standard deviation (δ) and coefficient of variation (CV). The stability parameters (Eberhart and Russell 1966) are also calculated over a 4-5 year period.
b) characters which are under less environmental pressure such as growth habit, type of tillering, colour and position of leaves, spike colour and presence of awns or scurs. These characters are screened periodically.

The world collection is the "first look" at the germplasm collection for researchers to identify quickly the desired traits as well as to get a quick assessment of their variability.

Genetic collection

The next level of organization of the wheat germplasm is the genetic collection. The objectives of the genetic collection are to increase the efficiency of germplasm evaluation and to provide manageable and representative sets of wheat accessions to be used in breeding.

There were three main reasons leading to the decision to use the genetic collection instead of a core collection. First, when we established the genetic collection (1965), the concept of a core collection did not exist. Secondly, the basic postulate in developing a core collection is to capture as much diversity as possible from the whole collection. In our case this does not apply, since we focus on desirable gene(s)/trait(s) in the development of our genetic collection. Third, in the near future, molecular markers will enable us to identify genetic structures not only of "simple" traits but also of "complex" traits. In this context the concept of a genetic collection is more appropriate than that of a core collection.

On the basis of evaluation data from the world collection, data obtained from the owners of the germplasm, data from previous scientific research and published data, the genetic collection is grouped in sub-units according to the traits considered important for breeding (Table 2). For example in the sub-unit "winter hardiness", all genotypes possessing a high level of resistance to low temperatures are included. In this procedure we always try to include genotypes from different places of origin and as different as possible in the expression of other traits.

Table 2. The accessions grouped in sub-units of the genetic collection

Sub-unit	Example genotypes	Total no.
Winter hardiness	Mironovska.808, Bankut 1205, Centurk, Partizanka, MV-19...	20
Plant height	Norin 10, Aobakomughi, S. Cerros, Tum Thumb, Ai-bian...	120
Earliness	Norin 61, Tanori, Peking 11, Rusalka, Nizija	36
Resistance to leaf rust	Lee, Thatcher, Marquis, Bezostaja 1, Purdue 5392	47
Resistance to powdery mildew	Adder, Benni, Dina, Caldwell, NS 5-92...	22
Bread-making quality	Jubilejnaja 50, Bezostaja 1, Centurk, Elkorn, Atlas 66...	38
Leaf architecture	Sremica, Mexico 120, Resistante, Semilia Eligulata, Sadovo S..	45
High tillering capacity	Tanori 71, Magnif 41, NE 11, NS 46/98...	5
Low tillering capacity	ZG 238/82, L 154, Osprey (Tin), Bodalin (Tin)..	12
Spike architecture	Bolonjska, ZG-195, Mexico 3, Pesma, Intro 604..	107
Long leaf area duration	Red Coat, Partizanka, Purdue 5392, Szegedi 60, Buck Cin, Pobeda, Hersonska 90, ...	40
Glume size	NS 50-14, Mironovska 10, Raduša, S. Cerros ...	6
Resistance to insects	Vel, Bean, Harf, Ruler, Downy, Kharkof ...	35
Resistance to lodging	Novos. 100, Kratka, Ana, Fundulea 490, Recital, WLRGP-91-26	22
Leaf chlorose	Lira, Florida, Don.polupat. Caldwel, Centurk	23
Solidness of upper internode	GSN 17, UC 66206, W 53/86, Rogosija s.k.Z.P, Sun 25....	7
Genetic and cytogenetic stock	Mutations, Wheat-rye translocation, isogenic lines, etc.	103

In recent years attempts have been made whenever possible to establish sub-units according to genes which have been identified to control certain traits such as *Rht* genes for stem height (Table 3), *Vrn* genes for vernalization, etc. In the 17 sub-units of the genetic collection 750-800 genotypes are grown annually.

Table 3. The wheat genetic collection sub-unit "Plant height" arranged according to *Rht* genes

No.	Genotype	Gene(s)	Country of origin	Growth habit
19	Maris Hunts.	Rht 0	UK	W
25	Bank. 1205	Rht 0	Hungary	W
26	Siete Cerros	Rht B1b (4A)	Mexico	S
38	Banks	Rht B1b	Austria	S
39	Aobakomug.	Rht D1d (4D)	Japan	W
61	Durin	Rht D1d	UK	W
62	Norin 10	Rht B1b+Rht D1d	Japan	W
71	Cajeme 71	Rht B1b+Rht D1d	Japan	I
72	Tom Thumb	Rht B1c (4A)	Tibet	W
77	Min. Dwarf	Rht 3	Belgium	S
78	Akakomughi	Rht 8 (2D)	Japan	S
84	Sava	Rht 8	Yugoslavia	W
85	Ai-bian	Rht D1c (4D)	Japan	I
119	Burt M 860	Rht 20	USA	W

Evaluation

Evaluation in the genetic collection is highly intensive and includes 54 characters. Where available the international scoring scale is used; otherwise we use our own scale. Out of 54 characters 28 are periodically evaluated over 3-4 successive years because of their low dependance on the environment and 26 other characters are evaluated every season (Table 4).

Table 4. Traits evaluated in the wheat genetic collection in Novi Sad

Traits evaluated periodically (3-4 years)	Traits evaluated each year
1. Coleoptile coloration	1. Winter hardiness in the field
2. Coleoptile length	2. Number of leaves
3. Growth habit	3. Time of ear emergence
4. Tiller coloration	4. Vegetative period of flowering
5. Winter hardiness in cold chambers	5. Plant height
6. Coloration of auricules	6. Ear length
7. Coloration of leaves	7. Ear density
8. Leaves position in flowering	8. No. ears/m^2
9. Frequence of plants with recurved flag leaves	9. Lodging resistance
10. Flag leaf glaucosity	10. Resistance to leaf rust
11. Tillering capasity	11. Resistance to stem rust
12. Anther coloration	12. Resistance to powder mild.
13. Ear glaucosity	13. Resistance to fusarium
14. Culm glaucosity	14. No. of spikelets/ear
15. Straw-pith in cross section	15. No. of sterile spikes/ear
16. Ear coloration	16. Ear weight
17. Awns or scurs length	17. Biomass weight/m^2
18. Ear shape in profile	18. Harvest index
19. Apical rachis segment hairiness of convex surface	19. No. of grain/spike
20. Lower glume - shoulder width	20. Kernel weight/spike
21. Lower glume - shoulder shape	21. Spike index
22. Lower glume - beak length	22. 1000-kernel weight
23. Lower glume - beak shape	23. Grain yield
24. Lower glume - extent of internal hairs	24. Flour yield
25. Lowest lemma - beak shape	25. Sedimentation value
26. Grain coloration	26. Protein content
27. Grain coloration with phenol	
28. Seasonal type	

Besides the items mentioned a number of accessions are evaluated for special purposes such as: drought resistance under artificial conditions (mobile roofs and greenhouse); biochemical markers such as glutenin and gliadin sub-units; root characteristics at the seedling stage; presence of wheat/rye translocation (1B/1R); rate of photosynthesis, etc. All accessions in the genetic collection are grown in four replications. The first replication serves only for demonstrations to students, scientists, etc. The other three replications are used for evaluation and scientific research.

Crossing collection

The third level of organization of the wheat germplasm is the crossing collection. It is strictly connected with breeding and comprises potential parents intended for crossing. In principle, the crossing collection includes cultivars and advanced lines from the genetic collection whose genetic base is known to a certain degree. The basic criterion for genotypes to be included in the crossing collection is to posses desirable genes/traits intended to be recombined into new varieties. The crossing block usually consists of 300-350 genotypes.

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Research

Genetic and agronomic variability of durum wheat within the Mediterranean region

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Introduction

The genetic erosion of crops could lead to the extinction of genetic resources valuable for plant breeding. The protection of germplasm requires their conservation, evaluation and characterization (Esquinas-Alcazar 1987). Various DNA fingerprinting techniques have been successfully used to assess the genetic diversity in plant species. Among them, AFLP markers are able to detect non-specific but many independent loci, with reproducible amplification.

The objective of this study was to assess the genetic and agronomic variability existing in a set of local durum wheat varieties (*Triticum turgidum* L. var. *durum*) from the Mediterranean region, and to explore the variability existing within the Spanish collection.

Materials and methods

Plant material

This study included 42 durum wheat genotypes, 20 from the ICARDA gene bank and 22 from the INIA Centre for Plant Genetic Resources. These genotypes are considered to be a representative sample of the variability existing within durum wheat genetic resources in the Mediterranean region and within the Spanish collection (Table 1).

Table 1. Genotypes included in the study with their country of origin

Country of origin	No. of genotypes
Spain	22
Algeria	5
Italy	5
Cyprus	3
Greece	2
Lebanon	1
Syria	4

DNA isolation and AFLP analysis

DNA was extracted from a bulk of leaves from four plants from each genotype by the Doyle and Doyle (1990) method with some modifications.

AFLP assays were performed as described in Barrett and Kidwell (1998). Two restriction enzymes were used, PstI and MseI. PCR products were separated on 5 and 6% polyacrylamide denaturing sequencing gels and were detected by silver staining.

Bands clearly absent in at least one genotype were scored (1 when the band was present and 0 when it was absent) and entered into a data matrix. Nei's coefficient was selected to construct the dissimilarity matrix.

Agronomic characters

The 42 genotypes were grown at Gimenells, northeastern Spain (40º41′N, 0º20′E) during the 2000-2001 crop season. Sowing density was 250 germinable seeds/m^2. The experimental design was an alpha-lattice, with four replicates and plots of 9.6 m^2. The agronomic practices were those used in the region. Crop dry weight (g/m^2) and leaf area index (LAI) were determined at anthesis from a sample of 0.75 m^2 per plot. Yield components were assessed at ripening on a sample of 1.5 m^2 per plot. Plots were harvested mechanically and grain yield (t/ha) was determined for each plot and expressed at 10% moisture level.

Statistical analyses

In order to determine the genetic dissimilarity between genotypes, cluster analysis was performed by the unweighted pair-group method arithmetic average (UPGMA) (Sneath and Sokoal 1973) using the NTSYS-pc computer program (Rohlf 1995).

Analysis of variance (ANOVA) and principal component analysis (PCA) were performed on the agronomic data using the SAS/STAT statistical package (SAS Institute 1999).

Results and discussion

Cluster analysis of the AFLP data matrix was in agreement with the geographical distribution of the genotypes. Spanish genotypes were clustered in three different groups. Some North African entries were grouped jointly with some Spanish genotypes, suggesting that the migration of populations could have contributed to the introduction of durum wheat germplasm from North Africa to the Iberian Peninsula.

For agronomic traits, wide variability was observed between the durum wheat germplasm collected in different Mediterranean countries. Also, variability existed among the genotypes within most of the countries (Fig. 1).

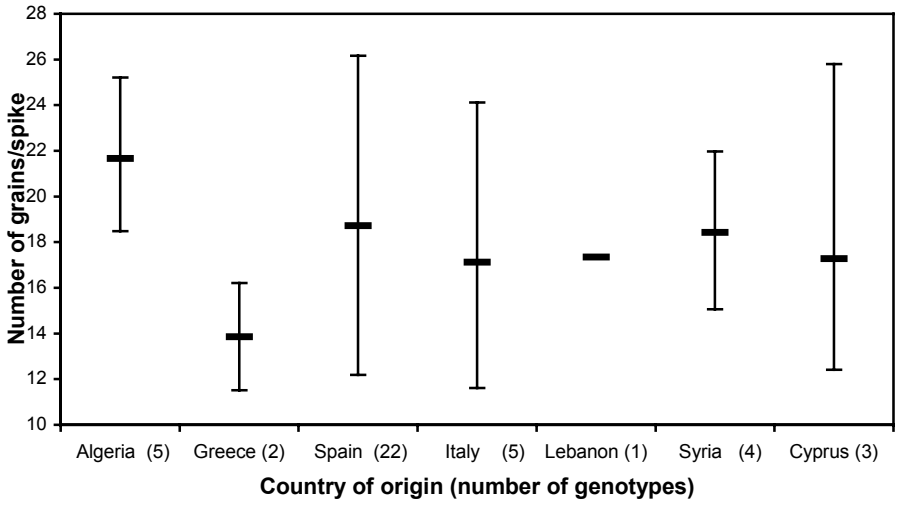

Fig. 1. Mean values and range of number of grains per spike (NGS).

Principal component analysis showed considerable variability in yield and yield components within the Spanish germplasm, but only moderate variability for biomass traits. Syrian and Algerian genotypes tended to have high yields, due partly to a large number of spikes per m^2.

These preliminary results suggest that AFLP markers used in this study are useful for variability studies in durum wheat. Most of the commercial durum wheat varieties released in recent decades, and extensively cultivated in the Mediterranean region, have a narrow

genetic background. The variability found in the local varieties studied could be exploited in breeding programmes in order to widen the genetic diversity of the species and for the introgression of desirable traits from local varieties.

Acknowledgements

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Wheat genetic resources research in Israel

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The main studies on wheat genetic resources are carried out in the same three institutions in which the largest collections of wheat and their relatives are kept (see national status report, this volume, p. 62).

In the **Department of Plant Genetics of the Weizmann Institute of Science**, Moshe Feldman and his co-workers are engaged in five main study projects:

1. In a series of chromosome-arm substitution lines, agronomically useful traits are being identified, mapped, and transferred into the Israeli bread wheat cultivar 'Bethlehem'.
2. A technology for the production of low-cost hybrid wheat is being developed.
3. In a study of variation and evolution in tetraploid wheat, DNA markers are used to screen wild tetraploid populations from Israel and Turkey (*Triticum turgidum* subsp. *dicoccoides* and *T. timopheevii* subsp. *armeniacum*) and diploid *Aegilops* sect. *Sitopsis* species. Evidence of introgression from *Ae. searsii* into the B genome of wheat has been obtained.
4. In a study of spike fragility in the *Aegilops-Triticum* group, two genes encoding this trait in wild emmer wheat have been identified and allocated to chromosome arms 3AS and 3BS.
5. The effects of allopolyploidization (interspecific or intergeneric hybridization followed by chromosome doubling) on genome evolution in the wheat group is under study.

Many of the numerous publications of Eviatar Nevo and his group at the **Institute of Evolution in the University of Haifa** deal with genetic and agronomic evaluations of the Institute's wild emmer wheat collection (e.g. Nevo 2001). The following traits have been investigated: amino acid composition; multiple disease resistance including powdery mildew, leaf rust, yellow rust, stem rust, and soil-borne wheat mosaic virus; drought tolerance and heat production; herbicide resistance; high and low molecular weight glutenins; high photosynthetic yield; uptake of Na^{22}; phenotypic variation in germination, biomass, earliness, and yield characters; grain protein content; salt tolerance; and vernalization. Other publications deal with wild emmer genes encoding resistance to chlorotoluron, yellow rust, and powdery mildew, which have been identified and allocated to chromosomes 6B, and chromosome arms 1BS and 5BS, respectively. A genome-wide map based on 549 molecular markers (SSR, AFLP, RAPD) has also been prepared for an ongoing qualitative trait loci analysis.

The research conducted at the **Institute for Cereal Crops Improvement at Tel Aviv University** is phytopathological. Both the wild wheat collection (5000 accessions) and the *Aegilops* species (4000 accessions) have been subjected to tests of responses to foliar fungal diseases of the wheat group (leaf rust of wheat; leaf rust of durum wheat; leaf rust of *Aegilops* spp., leaf rust of *Ae. speltoides*; yellow rust; stem rust; powdery mildew). All wild wheat accessions proved to be susceptible to leaf rust of wheat. Some accessions showed resistance to yellow rust and powdery mildew. Resistance to wheat powdery mildew was found at a high percentage in *Aegilops bicornis*, which is very susceptible to all rusts tested. Resistance to rusts was found in *Ae. longissima* and in a large number of accessions of *Ae. sharonensis*.

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The history of wheat landraces in Austria

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Cultivation of wheat in the Alps can be traced back to the end of Stone Age. When Mayr (1928) collected wheat landraces in the mountainous districts of western Austria, he distinguished between so-called *autochthonous* landraces, cultivated since ancient times, and *autochthogenous* landraces, cultivated over centuries and highly adapted. The theory of the centres of origin developed by Vavilov (1928) also highly influenced the studies carried out on these wheat landraces, and several scientists, including Schiemann (1939), proposed such a secondary centre in the Alps (Mayr 1928; Köck 1973).

The wheat landraces

In 1968, when the Federal Office of Agrobiology started collecting wheat landraces, these had already been replaced by commercial varieties. Nevertheless those landraces could still be found and allowed for a somewhat different and clearer picture than that we had in the past, also taking into account new evolutionary and genetic findings (Burggasser 1956; Schachl 1982, 1987).

Distribution of landraces

When studying the distribution of wheat varieties in the subalpine region, commercial varieties and landraces appeared scattered in a ring-shaped distribution, like waves in a pool, with the most recently bred varieties in the centre and the landraces on the periphery (Fig. 1).

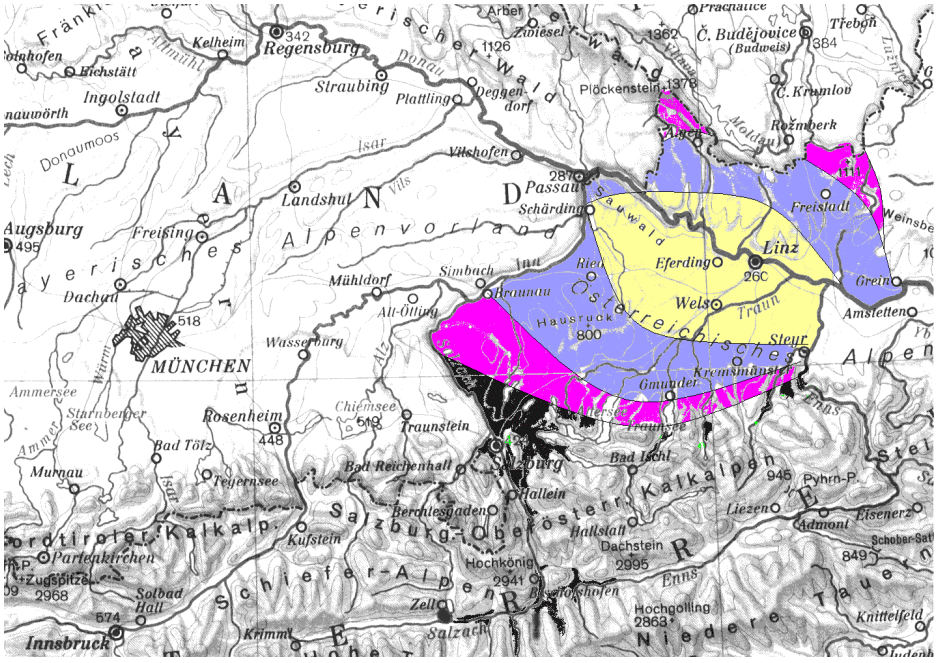

Fig. 1. Distribution of landraces in the subalpine region (yellow: commercial varieties; blue: older commercial varieties; red: Sipachzeller group; black: Alpine Bartweizengroup).

This idea of varietal replacement has often been criticized, as it has not been found so clearly elsewhere.

Geographically, the subalpine region of Upper Austria looks like a "soup-tureen" with an intensive cropping area in the centre along the Danube, surrounded by mountains. This provides the opportunity to study the process in a relatively small, easily surveyed, area. When a new variety appears, which always happens in the highly intensive cropping area where the farmers are more flexible and communications are good, the new variety pushes the older ones into the less intensive cropping area and finally to the extensive area higher up in the mountains. Thus the varieties become older and older from the centre to the periphery (Schachl 1981). In the case of wheat, two landraces were present, an older one called 'Alpine-Beard-Wheat' ('Alpiner Bartweizen') in the outermost ring, already collected by Mayr in the 1920s even further into the mountains, and a younger landrace called 'Sipachzeller Wheat' ('Sipachzeller Weizen').

Age of the landraces

Referring to the centre of Upper Austria, we have two very precise descriptions of the wheat landraces existing in the 19th century: the first is of a type which exactly fits the description of 'Alpine-Beard-Wheat' (Sailer 1841) and the second is of a type which identifies with 'Sipachzeller Wheat' (Brittinger 1862). In other words, there is clear evidence that the replacement of the older 'Alpine-Beard-Wheat' by the younger 'Sipachzeller Wheat' occurred between 1840 and 1860. This means (which seems very important to us) that landraces are much younger than is commonly believed. Therefore the terms *autochthonous* and *autochthogenous* seem to us to be no longer relevant (Burggasser 1956; Schachl 1981).

Genetic variation

Only two landraces were found (Schachl 1981; Zeven 1988). It might however be preferable to talk of groups of landraces, with each group comprising several local races differing in their prevailing genotypes, but being however clearly distinct.

Landraces collected in the past were criticized for being rather uniform when maintained by plant breeders, due to unintentional breeding by routine maintenance. Surprisingly, the material collected by Mayr is fairly uniform, though it was maintained with the utmost precautions to avoid reducing the variability within accessions: again, all the landraces collected by Mayr and Schachl show the same uniformity when planted under the same environmental conditions; this uniformity, however, stays within a limited range. The reason might be sought and found in human and natural selection (Schachl 1981, 1987; Zeven 1988):

- Human selection: landraces were permanently subjected to mass selection carried out by the farmers themselves. There is clear evidence of seed production and seed marketing of landraces by already highly skilled and specialized farmers, as was the case, for instance, in the area of Sipachzell from where the Sipachzeller Wheat originated.
- Natural selection: penetrating further into the mountains, the conditions for wheat cultivation become harsher with the increasing altitude, leading to increasingly stronger natural selection and thus greater uniformity.

In other words, the variability found in the early 1920s when wheat landraces were first collected was environmental rather than genetic variability and therefore Schiemann's (1939) suggestion that the Alps were a secondary gene centre for wheat, was mistaken. Furthermore, a gene centre is characterized by the fact that the number of genotypes appearing is greater than the number of genotypes lost by selection, which is not the case in the Alps (Schachl 1981). There are forms, however, that cannot be explained by the above, such as the locally very restricted occurrence of *Triticum compactum* in the Tyrol or of *T. dicoccum* in the centre of Upper Austria. But, especially in the case of *T. dicoccum*, the very

reliable information provided by Werneck (1935) explains the origin of this *T. dicoccum*: around 1905, farmers in the central area sowed *T. dicoccum* experimentally but not for very long as it did not fulfil their expectations. This might most probably also be true for those other forms which do not coincide with the big groups of landraces.

Spreading of the landraces

Landraces obviously migrated over long distances, as shown by the example of the 'Sipachzeller Wheat'. This one most probably originated from the Pannonian area, the eastern part of Central Europe. Along the main traffic lines, ox routes ("Ochsenstrassen") can still be found. The name signifies that oxen were brought along these lanes from poor mountainous areas to the lowland for fattening and later back for slaughter. These "ox routes" linked the settlements where agricultural goods in general, including landraces, were exchanged. Even during the early 20th century, seed of the 'Sipachzeller Wheat' was traded along these routes from the area of Sipachzell to the West up to Lower Bavaria (Werneck 1935). Landraces were always migrating along these trading routes; many appeared and disappeared, as was the case with *T. dicoccum* from 1905 onwards, but a few of them became well adapted and very popular.

Expectations of landraces for breeding

Several commercial varieties were bred from the local landraces, e.g. 'St. Johanner' in Tyrol, 'Record' in the eastern part of Austria, or 'Ritzlhofer', 'Achleitner', 'Wieselburger' and 'Otterbacher' selected from the 'Sipachzeller Wheat'. Crossings of the latter made by Nielson Ehle did not succeed due to unsuitable crossing partners, namely the Swedish varieties 'Ritter' and 'Panzer'. On the other hand, the Bavarian variety 'Tassilo', very popular over several decades, resulted from the crossing of a French landrace with a landrace from Lower Bavaria that can be traced back to an area near Sipachzell (Schachl 1987) (Fig. 3).

The oldest germinable wheat

The presentation of the Austrian wheat collection would not be complete without mention of the oldest still germinable wheat. It was found at the University of Agriculture and dates from the year 1877, and was induced to germinate by Prof. Ruckenbauer (1971) by applying low temperatures. This wheat is clearly distinct from the other two big groups of wheat landraces in the subalpine and alpine regions, and represents the typical landrace which is quite common and widely sown in the Pannonian part of eastern Austria and in neighbouring Hungary.

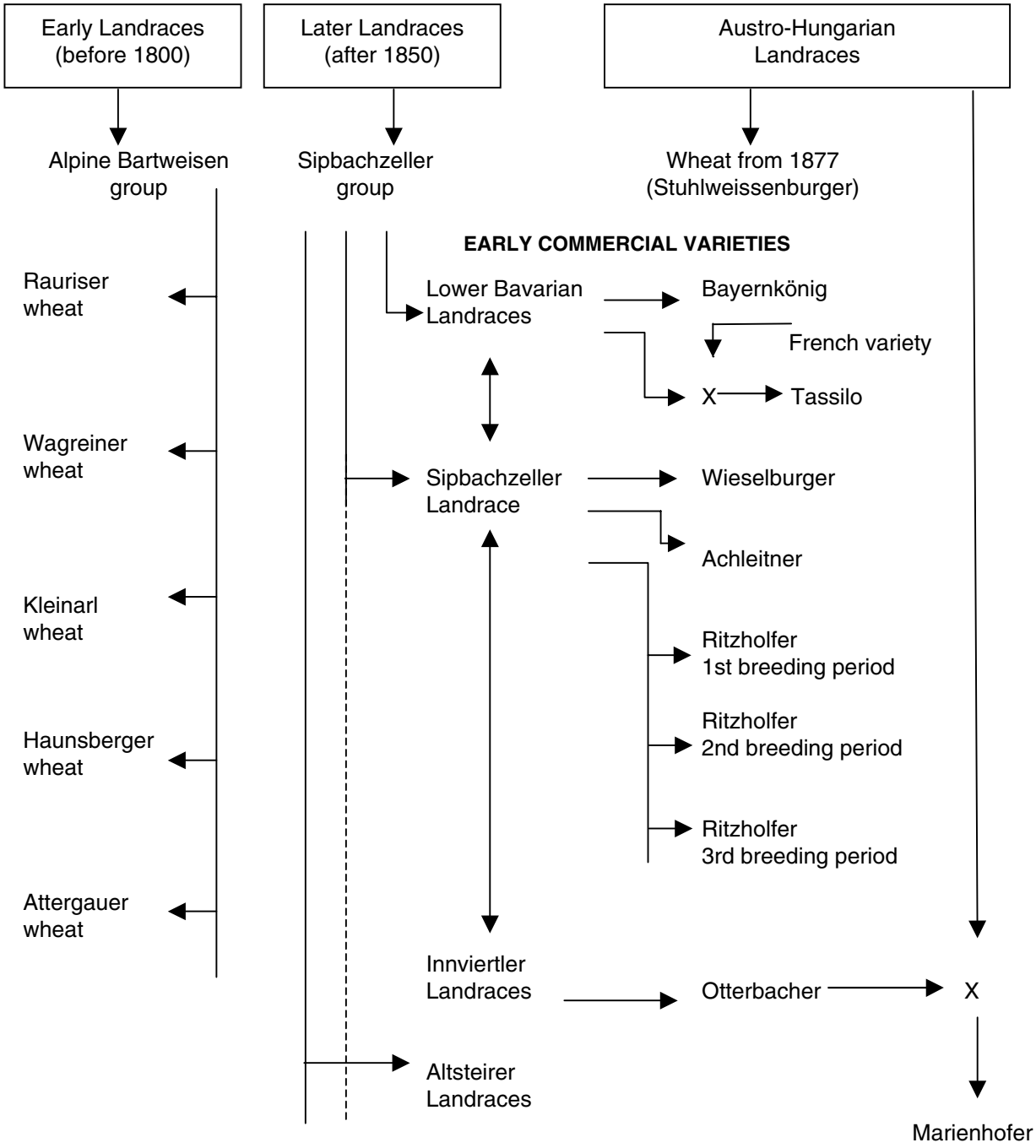

Fig. 3. Survey of Austrian wheat landrace groups (Schachl 1987).

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Evaluation of yield variability in the common winter wheat collection, based on harvest index

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Introduction

Most wheat breeding programmes rely on classical procedures for the improvement of new varieties. Every superior variety originates as a rare if not unique recombination arising as a result of hybridization between selected parent genotypes. Thus, providing the opportunity for the desired superior recombination to occur is the first step in a breeding programme. The second step is the selection process, which provides the means for identifying the desired superior recombination if it occurs in the hybrid segregating population. The number and value of hybrid combinations are strongly dependent on the diversity and value of wheat collections that are available for use to wheat breeders (Reitz and Craddock 1969). Therefore, the aim of wheat breeding collection is not to conserve all the genetic variation present in the species but only the usable portion of this genetic variability for the most important characters which represent breeding priorities. Thus, the main problem of a wheat breeding collection is to assure a maximum of diversity in a minimum number of accessions.

One of the main objectives of wheat breeding is to develop high-yielding varieties. One way of obtaining this is by using varieties with good combining ability for yield to develop suitable genetic recombination. This task is becoming more and more difficult and cannot be successful without a knowledge of the available useful variability for yield in the collections of common wheat under the environmental conditions at the breeding centre.

Evaluation of yield in the common wheat collection is difficult because of the large number of genotypes that must be tested, and on the other hand yield as a trait has a low heritability, due to the powerful influence of genotype × environment interactions. Yield of the wheat crop can be expressed as biological yield, i.e. total dry matter produced during a growing season, and economic, or grain yield. The ratio of grain yield to biological yield is known as the harvest index (Donald 1962). The product of growth rate and growth duration estimates biological yield while the product of biological yield and harvest index estimates grain yield. Harvest index integrates aspects of photosynthetic, translocatory, and storage processes. Therefore, in the distribution of the products of photosynthesis, harvest index is scarcely affected by population density and can be assessed on spaced plants or on microplots. Increasing the harvest index has played an important role in improving wheat yield. We previously studied some aspects of the genetics of the harvest index in winter wheat that may have implications in practical breeding procedures for the improvement of yielding ability (Moldovan *et al*. 1994). In breeding work, an increase in genetic yield potential can be expected by simultaneous improvement of the biological yield and of the harvest index. In this study we use the harvest index when analysing yield variability in the common wheat collection. We offer it as one approach for consideration and discussion.

Materials and methods

For this study, 937 genotypes of common winter wheat of both local and foreign origin and representing a wide range of agronomic types were grown in 1997 at the Agricultural Research Station (ARS), Turda, in a collection-screening nursery. These sources (varieties and lines) were sown in unreplicated plots (1.20 m^2) consisting of four rows, 1 m long, with 30 cm between rows. The local control variety 'Transilvania' was also included. In an unreplicated trial each of these 937 entries was grown in a single plot across the experimental site, except for the control variety ‘Transilvania’ that was planted systematically in every

tenth plot (i.e. 10, 20, 30, …, 1040), which resulted in 104 control plots uniformly distributed throughout the trial. At maturity, plants in all plots were cut with a sickle 5 cm above the ground. In this way, a small part of the straw is lost from the biological yield, resulting in an over-estimate of the harvest index. The harvested material was weighed to determine biological yield and threshed; the grain was then re-weighed for grain yield. Harvest index was determined as the ratio of grain yield to total plot yield (biological yield). Plant height was measured for each entry before harvest, because it can be related to the harvest index owing to the effects of the *Rht* genes on yield.

The large number of observations in this study necessitated computer analysis. Statistical analysis was carried out for the 937-line wheat collection compared with the 104 plots of the control variety 'Transilvania'. Mean, standard deviation, range and coefficient of variation (CV) were computed for harvest index (%), biological yield (g/plot), grain yield (g/plot) and plant height (cm). Simple correlation coefficients (r) were calculated to provide a measure of the degree of association of these traits with each other. A regression analysis was done to determine more precisely the relationship of harvest index to each studied trait. First, second, and third degree polynomial models were tested. The equations for these polynomials are as follows:

a) first degree or linear model: $y = a + b_1x$
b) second degree or quadratic model: $y = a + b_1x + b_2x^2$
c) third degree or cubic model: $y = a + b_1x + b_2x^2 + b_3x^3$

where b = regression coefficients; a = the intercept; x = the independent variable; and y = the dependent variable.

The regression model chosen to represent a particular relationship can be based on the coefficient of determination (r^2) values, which are the proportions of the sum of squares of the dependent variable that can be attributed to variation in the independent variables. A maximum value for the coefficient of determination provided the best fit for a particular regression equation relating any two variables.

Results and discussion

Mean, standard deviation, range and coefficient of variation values for harvest index, biological yield, grain yield and plant height of 937 common wheats, compared with 104 individual plots of the control variety 'Transilvania' are shown in Table 1.

Table 1. Mean, standard deviation, range and coefficient of variation (CV) for four quantitative characters of the collection of 937 common wheat accessions and 104 sites of the control variety 'Transilvania' (Agricultural Research Station, Turda, 1997)

Character	Statistical population	Mean	Standard deviation	Range		CV
				Minimum	Maximum	
Harvest index (%)	937 wheat accessions	41.16	4.89	24.1	62.9	10.59
	104 control plots	49.31	2.39	42.4	53.6	4.85
Biological yield (g/plot)	937 wheat accessions	2132.91	442.82	240	3320	20.76
	104 control plots	2319.61	265.04	1140	2750	11.42
Grain yield (g/plot)	937 wheat accessions	986.65	216.22	90	1600	21.91
	104 control plots	1147.59	127.33	530	1330	11.09
Plant height (cm)	937 wheat accessions	91.71	9.17	59	133	9.89
	104 control plots	89.86	4.61	78	103	5.13

These results indicate considerable variability between the 937 genotypes in the common wheat collection for all four characters studied. The values obtained in this study are the results of phenotypic expression of the characters analyzed. The phenotypic expression of a trait such as those presented can be considered as a linear function of the genotype and the environment in which the genotype was grown. With only one measurement made on each entry, the genotypic effect cannot be separated from the environment and the genotype × environment interaction effects. Thus, part of the variability in the common wheat collection presented here is non-genetic in origin. The parameters of variability of the 104 sites of the control variety 'Transilvania' reflected this non-genetic variability due to the microenvironmental effects plus random error of measurement. Therefore, comparison of the variability of the 937 lines of common wheat with the variability in the 104 sites of 'Transilvania' would indicate that the winter wheat lines studied contain a significant amount of genetic variability for harvest index, biological yield, grain yield and plant height. The magnitude of this variability can be illustrated by comparing the wide range of values for the winter wheat collection with the smaller range obtained for the tester. Coefficients of variation were also higher in the case of the common wheat collection compared with the control for all characters studied, revealing the expression of large genetic variability for yield in the collection of winter wheats. Useful genetic variability in the yield characters in the collection is located between the mean values of characters and the upper limits of range values.

The frequency distribution of 937 winter wheat collection genotypes according to grain yield and harvest index is illustrated in Figs. 1 and 2.

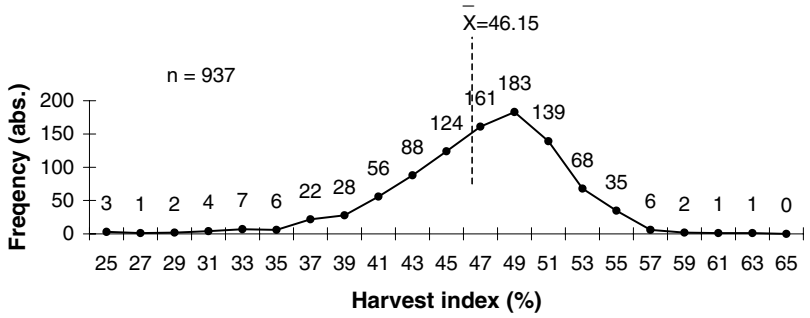

Fig. 1. Distribution of the genotypes from the winter wheat collection for harvest index (Turda, 1997)

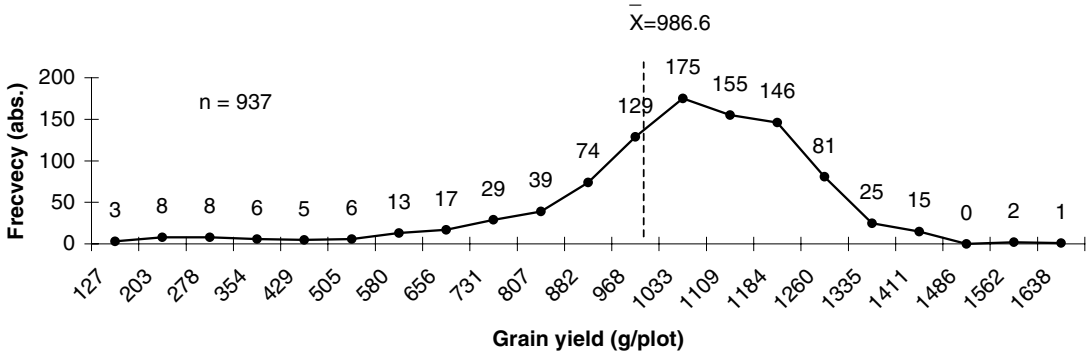

Fig. 2. Distribution of the genotypes from the winter wheat collection for grain yield (Turda, 1997)

The frequency distribution of genotypes for harvest index is nearer to normal than that for grain yield, which makes it a useful criterion for the evaluation of yield variability.

The results of this study allow tentative identification of wheats likely to be genetically superior in their ability to produce high yield and for use in breeding of high-yielding varieties.

Yielding ability is the most complex breeding character, influenced by the many other morphological and physiological traits that are related to yield potential. Correlation coefficients (r) between harvest index, biological yield, grain yield and plant height are listed in Table 2.

Table 2. Correlation coefficients (r) between harvest index, biological yield, grain yield and plant height in the collection of 937 common wheats (ARS Turda, 1997)

Variable	Biological yield	Grain yield	Plant height
Harvest index (%)	0.038^{NS}	0.466**	-0.291**
Biological yield (g/plot)	-	0.884**	0.429**
Grain yield (g/plot)	-	-	0.246**

** = significant at P = 0.01; NS = not significant.

Many of these relationships have been reported previously, but not for wheats representing such a wide range of agronomic types, all grown at the same location in the same year. The results indicate that a significant and complex relationship does exist between the characters analyzed. The low correlation in this study between harvest index and biological yield indicates that these two traits are largely independent of each other. Some researchers have reported a negative correlation between them. There was also a significant and negative correlation between harvest index and plant height, suggesting the role of *Rht* genes for improving yield potential. Biological yield is strongly correlated with grain yield. Therefore selecting for high biological yield together with high harvest index can be useful to obtain high grain yielding ability. The harvest index is correlated positively with grain yield, which makes it a useful selection criterion in breeding for improved yield potential.

In order to explain more precisely the relationships between harvest index and the other traits studied, a regression analysis was made.

The relationship between biological yield and grain yield is presented in Fig. 3. It shows that grain yield is heavily dependent on biological yield (r^2=0.7823). The closest relationship is that between harvest index and grain yield (Fig. 4). It offers the opportunity to identify wheats with the largest positive deviation of their grain yield values from yield values predicted by the regression equation, which are the most likely sources of genes for yielding ability. All types of regression analyzed are summarized in Table 3.

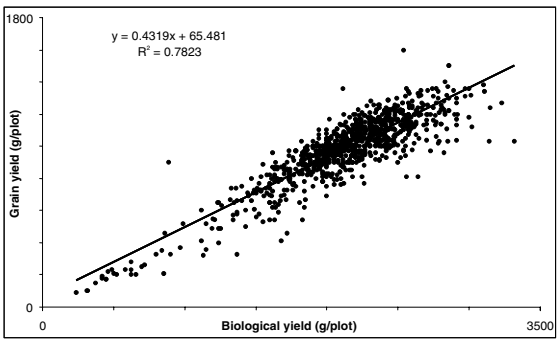

Fig. 3. Relationship between biological yield and grain yield of the 937 winter wheat genotypes (Turda, 1997)

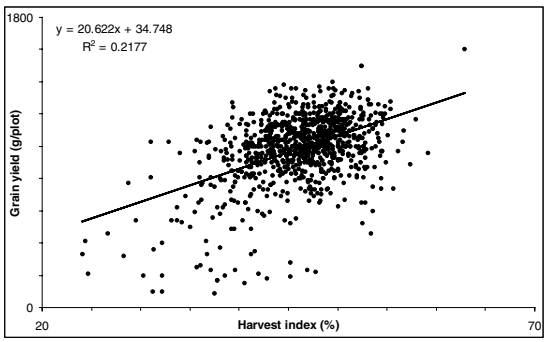

Fig. 4. Relationship between harvest index and grain yield of the 937 winter wheat genotypes (Turda, 1997)

Table 3. Summary of regression models tested for the 937-line collection of common wheats grown at Turda in 1997

Independent variable (x)	Dependent variable (y)	Regression model	Regression coefficient b_1	b_2	b_3	Intercept (a)	Coefficient of determination (r^2)
Harvest index	Biological yield	linear	3.4595	-	-	1973.2	0.0015
		quadratic	234.51	-2.6168	-	-3053.8	0.0627
		cubic	319.18	-4.6366	0.0157	-4209.5	0.0629
Harvest index	Grain yield	linear	20.622	-		34.748	0.2177
		quadratic	109.27	-1.0039	-	-1893.9	0.2555
		cubic	68.01	-0.0198	-0.0077	-1330.7	0.2557
Harvest index	Plant height	linear	-0.5453	-	-	117.88	0.0847
		quadratic	2.9181	-0.0392	-	42.529	0.1168
		cubic	13.883	-0.3008	0.002	-107.15	0.1264

Results of the regression analysis indicate that quadratic and cubic polynomial models gave the best fit for the regression of biological yield, grain yield and plant height on harvest index. The coefficients of determination for the linear regressions were low, except those between harvest index and grain yield, which had values nearer to those for the quadratic and cubic models. Even in this case, non-linear models better explain the existing relationship, because wheats with the highest harvest index do not necessarily have the highest grain yield. In fact, the opposite can be true. The magnitude of the coefficient of determination (r^2) for the regression of biological yield, grain yield and plant height on harvest index indicates that approximately 6% of the total variation of biological yield, 25% of the total variation of grain yield and 12% of the total variation of plant height can be attributed to variation in the harvest index of the wheats analyzed. Wheats with the largest positive deviation of their grain yield values from yield values predicted by the regression equations are the most likely sources of genes for yielding ability.

We concluded from this study that the useful genetic variability for yield in common wheat has not been exhausted. As long as usable variation for yield exists, there will continue to be opportunities to increase genetic potential for yield through classical breeding methods. The identification of wheats genetically superior for yield and yield components is the first step in any such programme.

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APPENDICES

Appendix I. Wheat Working Group Progress

Iva Faberová and Annick Le Blanc (WWG co-chairpersons and EWDB co-managers)

Status*	Activities	Progress as of 14 September 2001 (*WWG establishment in July 1998)*
	Conservation regular	
M	Uniform standards for regeneration, multiplication and conservation adopted	*Yes, used genebank standards for cereals conservation and regeneration, no specific requirements*
M	Duplicates and synonyms identified based on available information	*Yes, the result will be presented in the First WWG meeting in November 2001 in Prague*
M	Unique material identified	*Yes, the result will be presented in the First WWG meeting in November 2001 in Prague*
M	Most appropriate methods of conservation determined	*Long-term storage –20°C; medium-term storage +5°C (wheat seeds keep viability very good for a long time)*
A	Appropriate alternative/complementary *ex situ* conservation strategies implemented	*Not necessary, usual wheat seed conservation is sufficient, species with high viability, no specific requirements*
	Conservation emergency	
M	Regeneration needs identified	*Partly, by identification of unique material within collections*
M	Procedures for emergency regeneration established	*Not yet, it should follow the results of identification of unique material*
M	Safety-duplication implemented	*Partly, between some genebanks*
M	Emergency regeneration carried out	*Partly, regenerations are carried out within usual genebanks activities*
	Documentation	
M	European database established	*Yes, at the end of 1996*
M	Database manager nominated	*Yes, joint database management by Iva Faberová (CZE) and Annick Le Blanc (FRA)*
M	Passport data included	*Yes*
M	Protocol for updating data elaborated	*Not yet, expected results of EPGRIS will be used as a model* *Up to now first data version was included from each partner*
U	Database accessible through Internet	*Yes (since June 1998) <http://genebank.vurv.cz/ewdb/>* *Present status 108 229 passport records*
A	Characterization data included	*Not yet*
A	Evaluation data included	*Not yet*
A	Crop-specific links with other programmes/networks/databases established	*Collaboration within Cereals Network*
	Collecting	
M	Genetic diversity of crops inventoried based on available data	*Main part are cultivated accessions, collecting activities mainly in the regions rich to wild relatives*
M	Gaps and potential needs for collecting identified	
A	Collecting activities, where needed, carried out	

*Status: M = Minimum, U = Undecided; A = Additional

Wheat Working Group Progress (continued)

Status*	Activities	Progress as of 14 September 2001 (*WWG establishment in July 1998)*
	Characterization/Evaluation	
M	Descriptor lists for (preliminary) characterization and evaluation agreed	*Yes, 20 descriptors*
U	Descriptor lists for (further) characterization and evaluation finalized	*Not yet, necessary revision of wheat descriptor list from 1985*
U	Core collection established	*Not yet centrally*
A	Characterization of collection carried out	*Not yet centrally, separately in holding institutions according to different descriptor lists*
A	Evaluation of collection experiments carried out	*Not yet centrally, separately in holding institutions according to different descriptor lists*
A	Pre-breeding (base broadening) undertaken	*Function of wheat collections is obvious in pre-breeding phase*
	Collaboration	
M	Priorities for complementary activities identified in collaboration with other relevant actors	*Item will be discussed in WWG meeting in November*
A	Above priorities implemented	*Not yet*
A	Collaboration with other regions established	*Not yet*
	***In situ* conservation**	
	Appropriate *in situ* strategies identified	*Not yet*
	Appropriate *in situ* strategies implemented	*Not yet*
	Sharing of responsibilities	
	Mechanisms identified	*Item will be discussed in WWG meeting in November*
	Mechanisms implemented	*Not yet*

*Status: M = Minimum, U = Undecided; A = Additional

Appendix II. First set of characterization descriptors for wheat

Descriptor number	Descriptor		
	Scale (score)		Reference values*
1	**Awnedness**		
	1	awnless (upper part of spike)	< 10 mm
	3	awnletted (upper part of spike)	10 - 40 mm
	5	long awnletted (upper part of spike)	41 - 60 mm
	7	awned (whole spike)	≤ length of spike
	9	long awned (whole spike)	> length of spike
2	**Grain colour** (colour of mature caryopsis)		
	1	white yellow	
	2	amber yellow	
	3	light brown	
	4	brown	
	5	dark brown	
	6	purple	
	7	other	
3	**Glume colour** (observed on the outer glume)		
	1	white yellow	
	2	brown	
	3	grey	
	4	black	
	5	other	
4	**Glume hairiness** (observed on outer side of sterile glume)		
	0	absent	
	3	sparse	
	5	medium	
	7	dense	
5	**Spike density** (the average number of spikelets per 10 cm length of spike)		
	1	very lax	< 16
	3	lax	16.0 - 25.0
	5	intermediate	25.1 - 30.0
	7	dense	30.1 - 40.0
	9	compact	> 40.0
6	**Plant height** [cm] (measured from ground to top of spike, excluding awns)		
	1	dwarf	< 35 cm
	2	dwarf to short	35 - 50 cm
	3	short	51 - 65 cm
	4	short to intermediate	66 - 80 cm
	5	intermediate	81 - 95 cm
	6	intermediate to high	96 - 110 cm
	7	high	111 - 125 cm
	8	high to very high	126 - 140 cm
	9	very high	> 140 cm

* Reference values: given for orientation; in case of plant height in comparison to the medium high standard

Appendix III. Abbreviations and acronyms

AARI	Aegean Agricultural Research Institute, Izmir, Turkey
AAS	Academy of Agricultural Sciences, Zhodino-Minsk, Belarus
ABI	Institute for Agrobotany, Tápiószele, Hungary
AFLP	Amplified fragment length polymorphism
ARC	Agricultural Research Centre, Lushnje, Albania
ARI	Agricultural Research Institute, Martonvasar, Hungary
ARI PGRH	Agricultural Research Institute Plant Genetic Resources and Herbarium, Nicosia, Cyprus
ARS	Agricultural Research Station, Turda, Romania
ASSINSEL	Association internationale des sélectionneurs pour la protection des obtentions végétales (International Association of Plant Breeders for the Protection of Plant Varieties), Nyon, Switzerland
ATRC	Agricultural and Technological Research Centre, Zaječar, Yugoslavia F.R.
BAZ	Bundesanstalt für Züchtungsforschung an Kulturpflanzen (Federal Centre for Breeding Research on Cultivated Plants), Braunschweig, Germany
BRG	Bureau des ressources génétiques, France
BVAL	Federal Office of Agrobiology, Linz, Austria
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CGN	Centre for Genetic Resources, Wageningen, The Netherlands
CIMMYT	International Maize and Wheat Improvement Center (CGIAR)
CRAE	Centre de Recherches Agronomiques de l'Etat, Gembloux, Belgium
CRF	Centro de Recursos Fitogenéticos (INIA), Alcalá de Henares, Spain
DAFRD	Department of Agriculture, Food and Rural Development, Leixlip, Ireland
ECCDB	European Central Crop Database
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
ENMP	Estação Nacional de Melhoramento de Plantas, Elvas, Portugal
EPGRIS	European Plant Genetic Resources Information Infrastructure
EU	European Union
EURISCO	European Internet Search Catalogue (EPGRIS project)
EWDB	European Wheat Database
FAO	Food and Agriculture Organization of the United Nations, Rome, Italy
FVC	Department of Field and Vegetables Crops , Faculty of Agriculture, Hebrew University of Jerusalem, Rehovot, Israel
GEVES	Groupe d'étude et de contrôle des variétés et des semences (Varieties and Seeds Study and Control Group), France
GRIN	Genetic Resources Information System (USA)
IA	Institute for Agrobotany (=ABI), Tápiószele, Hungary
ICARDA	International Center for Agricultural Research in the Dry Areas (CGIAR)
IDG	Istituto del Germoplasma, Bari, Italy
IFVC	Institute of Field and Vegetable Crops, Novi Sad, Yugoslavia F.R.
IGB	Israeli Gene Bank for Agricultural Crops, Bet-Dagan, Israel
IIGR	see IPGR
IHAR	Plant Breeding and Acclimatization Institute, Radzików, Poland
INIA	Instituto Nacional de Investigação Agrária (National Institute for Agrarian Research), Portugal
INIA	Instituto de Investigación Agraria (Agricultural Research Institute), Spain
INRA	Institut national de la recherche agronomique (National Agronomic Research Institute), France

IPBPP	Institute of Plant Breeding and Production, Zagreb, Croatia
IPGR	Institute for Plant Genetic Resources, Sadovo, Bulgaria
IPK	Institut für Pflanzengenetik und Kulturpflanzenforschung (Institute for Genetics and Plant Breeding), Gatersleben, Germany
IRTA	Institut de Recerca i Tecnologia Agroalimentàries, Lleida, Spain
IU	International Undertaking
JIC	John Innes Centre, Norwich, United Kingdom
JPBI	Jõgeva Plant Breeding Institute, Jõgeva, Estonia
LGB	Lieberman Germplasm Bank, Tel Aviv, Israel
LIA	Lithuanian Institute of Agriculture, Dotnuva, Lithuania
MCPDs	Multicrop passport descriptors (FAO/IPGRI)
MTA	Material Transfer Agreement
NAGREF	National Agricultural Research Foundation, Greece
NCPGRU	National Centre for Plant Genetic Resources of Ukraine
NGB	Nordic Gene Bank, Alnarp, Sweden
NGO	Non-governmental organization
PCR	Polymerase chain reaction
PGLIB	Plant Genetics Laboratory, Institute of Biology, Salaspils, Latvia
PGR	Plant genetic resources
PPI	(Yurjev) Plant Production Institute, Ukraine
RAC	Federal Research Station for Plant Production of Changins, Switzerland
RAPD	Random amplified polymorphic DNA
RICIC	Research Institute for Cereals and Industrial Crops, Fundulea, Romania
RICP	Research Institute of Crop Production, Prague, Czech Republic
RIPP	Research Institute of Plant Production (RIPP), Piešťany, Slovak Republic
SFRAC	(=RAC) Station fédérale de recherches agronomiques de Changins, Switzerland
SINGER	System-wide Information Network for Genetic Resources (CGIAR)
SSR	Single sequence repeat
TCD	Trinity College Dublin, Ireland
UCD	University College Dublin, Ireland
USDA	United States Department of Agriculture
VIR	N.I. Vavilov Research Institute of Plant Industry, St. Petersburg, Russian Federation
WIS	Weizmann Institute of Science, Rehovot, Israel
YIPB	(=PPI) Yurjev Institute of Plant Production, Kharkiv, Ukraine

Appendix IV. Agenda

First Meeting of the ECP/GR Working Group on Wheat
Prague, Czech Republic, 8-10 November 2001

Wednesday 7 November
Arrivals

Thursday 8 November
8:30 Departure from the hotel

Time	Topics
9:00 – 9:10	• Opening of the meeting, welcome (*Vice-Director RICP)*
	• Brief self-introduction of the participants
9:10 - 9:30	• Approval of the agenda
	• ECP/GR briefing and outcome of the Mid-term Steering Committee meeting (*L. Maggioni)*
9:30 – 10.00	• Networking activity on wheat and the European Wheat Database (*A. Le Blanc and I. Faberová)*
10:00 – 11.00	***Discussion***
11:00 – 11:30	Coffee break
11.30 – 13:00	• National collections status report *(10 minutes)* ➢ Austria (*P. Freudenthaler)* ➢ Croatia (*D. Novoselović)* ➢ Czech Republic (*Z. Stehno)* ➢ France (*A. Le Blanc)* ➢ Greece (*D. Gogas)* ➢ Germany (*H. Walther)* ➢ Hungary (*L. Horváth)* ➢ Ireland (*R. Hackett)* ➢ Israel (*Y. Anikster)*
13:00 – 14:30	Lunch
14:30 - 15:30	• National collections status report *(continued)* ➢ Italy (*G. Polignano)* ➢ Latvia (*V. Stradziņa)* ➢ Lithuania (*V. Ruzgas)* ➢ Macedonia (*S. Ivanovska)* ➢ The Netherlands (*L. van Soest)* ➢ Nordic countries (NGB) (*J.A. Dieseth and M. Veteläinen)* ➢ Portugal (*B. Maças)*
15:30 – 16:00	Coffee break
16:00 – 17:30	• National collections status report *(continued)* ➢ Romania (*L. Vasilescu)* ➢ Russia (*O. Mitrofanova)* ➢ Slovakia (*I. Čičová)* ➢ Spain (*D. Villegas)* ➢ Switzerland (*G. Kleijer)* ➢ Turkey (*A. Aydin)* ➢ Ukraine (*O. Leonov)* ➢ Yugoslavia (*S. Denčić)*
17:30	Departure from the institute
18:30	Departure from the hotel
19:00 – 22:00	Social dinner

Friday 9 November
8:30 Departure from the hotel

Time	Topics
9:00 – 11:00	• Update on the International Treaty on PGR *(G. Kleijer)* • Briefing on the EPGRIS project *(L. Maggioni)* • Establishing a workplan for the Wheat Working Group *(introduced by I. Faberová and A. Le Blanc)* Development of the Wheat Database Rationalization of the collections Core collections ***Discussion and recommendations***
11:00 – 11:30	Coffee break
11:30 – 13:00	• Utilization of the collections ➢ Organization of wheat germplasm in collections *(S. Denčić)*
13:00 – 14:30	Lunch
14:30 - 15:30	• *In situ* and on-farm conservation ➢ *In situ* conservation and research on wheat genetic resources in Israel (*Y. Anikster)*
15:30 – 16:00	Coffee break
16:00 – 17:30	• Scientific research on wheat genetic resources ➢ The variability of durum wheat across the Mediterranean region (*D. Villegas)* ➢ New model for selecting on quantitative traits in Wheat (*H. Walther)* ➢ History of landraces in Austria (*P. Freudenthaler*)
17:30	Departure from the institute

Saturday 10 November
8:30 Departure from the hotel

Time	Topics
9:00 –10:30	• Visit to the Gene Bank RICP
10:30 – 11:00	Coffee break
11:00 – 12:30	Drafting of the report (free time for delegates not involved in the drafting)
12:30 – 14:00	Lunch
14:00 – 15:00	• Presentation of the draft report and adoption of recommendations
15:00 – 15:30	Coffee break
15:30 – 16:30	• Election of the Chair and Vice-Chair • Other business • Closing of meeting
16:30	Departure from the institute

Sunday 11 November
Departures

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