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

Report of a Working Group on Forages

Fifth meeting
31 March-2 April 1995
Hissar, Bulgaria

T. Gass, R. Sackville-Hamilton, K. Kolshus and E. Frison, *editors*

International Plant Genetic Resources Institute
IPGRI

Roma, 24 October 1996

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The European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) is a collaborative programme among most European countries aimed at ensuring the long-term conservation and facilitating the increased utilization of plant genetic resources in Europe. The Programme, which is entirely financed by the participating countries and is coordinated by IPGRI, operates through crop-specific working groups in which curators and breeders work together to analyze the needs and set priorities for the crop concerned. Working group members and other scientists from participating countries carry out an agreed workplan with their own resources as inputs in kind to the Programme. The Programme is overseen by the Technical Consultative Committee (TCC) composed of National Coordinators nominated by the participating countries.

The International Plant Genetic Resources Institute (IPGRI) is an autonomous international scientific organization operating under the aegis of the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to advance the conservation and use of plant genetic resources for the benefit of present and future generations. IPGRI works in partnership with other organizations, undertaking research, training, and the provision of scientific and technical advice and information.

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Summary of the introductory session

The fifth meeting of the ECP/GR forages working group was held from 31 March to 2 April 1995 in Hissar, Bulgaria. The local organization of the meeting was provided by the Institute of Plant Genetic Resources (IPGR), Sadovo, Bulgaria, as a contribution in kind to ECP/GR.

The meeting was opened by Dr Rada Koeva, Director, IPGR, Sadovo, who welcomed the participants to Bulgaria. She pointed out that in a context of increased international involvement and collaboration regarding plant genetic resources, meetings such as this one had an important role to play. Dr Koeva thanked IPGRI for choosing to convene the meeting in Bulgaria and highlighted the role IPGRI was playing in fostering collaboration in Europe in the framework of ECP/GR and also in facilitating bilateral collaboration between European countries. She gave as examples the Swiss-Bulgarian project on forages and the project on documentation coordinated by CGN, the Netherlands. After a short overview of the activities carried out with forage genetic resources in Bulgaria, Dr Koeva concluded by wishing success for the meeting and stating that she and her staff would do their best to provide a good working environment during the meeting.

Dr Thomas Gass, ECP/GR coordinator, welcomed the participants on behalf of IPGRI and thanked Dr Koeva and her staff for the excellent organization of the meeting. He transmitted the apologies of Dr B. Cagas from the Czech Republic, Dr A. Dovrat from Israel and representatives of Austria and FAO. Dr Gass also informed the participants that Dr Dovrat had retired and that in future Dr Avi Perevolotsky from the Volcani Centre, Bet Dagan, will take over his responsibilities with regard to ECP/GR. The list of participants is given in Appendix 1.

Dr Emile Frison, Director for Europe, IPGRI, presented the steps which led to Phase V of ECP/GR. He reminded the meeting that it was in Bulgaria, in August 1993, that the programme of Phase V was unanimously adopted by the National Coordinators of ECP/GR during the meeting of the Technical Consultative Committee (TCC). At that meeting, the need for a full-time coordinator was stressed, in order to facilitate the activities of the working groups and to ensure the necessary follow-up between meetings of the different working groups. Dr Frison stressed that the working groups are at the heart of the programme and that its *modus operandi* is based on activities carried out in participating countries as contributions in kind to the programme. The enthusiasm and commitment of the participants are therefore of utmost importance to the success of the programme. The TCC also stressed the importance of information exchange and public awareness and recommended that more attention be paid to these aspects during Phase V. Since the appointment of Dr Gass, several new initiatives have been started. A grain legume working group will hold its first meeting in July 1995 and a meeting to propose that activities on *Malus* be included in ECP/GR will take place in the UK in June 1995. The creation of new databases without the establishment of a working group is also envisaged. The level of information exchange has greatly increased, partly through the publication of an IPGRI Newsletter for Europe.

Dr Frison further mentioned that ECP/GR working groups are more and more cited as examples of successful regional collaboration and are being taken as models for similar initiatives in other regions. He concluded by stressing the importance of developing an agreed workplan for the group in which responsible persons and deadlines are specified.

Dr Charmet, who was elected Chairman of the working group at the end of the last

meeting, also thanked the Bulgarian programme for hosting the meeting, and invited each participant to briefly introduce himself or herself. Dr Charmet then gave a rapid overview of the main activities of the working group since the last meeting. While it was noted that some activities foreseen in the report of the last meeting had not been carried out, it was recognized that the lack of a full-time coordinator has prevented the necessary follow-up. It was noted that significant progress had been made in the development of a core collection for *Lolium*.

Dr Charmet informed the participants that he had been invited to present a paper on the activities of the working group and the *Lolium* core collection at the forthcoming Grassland Conference in Canada. He also mentioned that the working groups are also good mechanisms to develop joint project proposals for submission to funding agencies such as EU programmes. For forages, three such projects are being developed: one on grasses, coordinated by Dr Sackville Hamilton; one on *Medicago*, coordinated by GEVES, France; one on *Lathyrus* and *Vicia*, coordinated by Southampton.

Chairperson's report

Gilles Charmet, INRA, Station d'Amelioration des Plantes, Clermont Ferrand, France

Since the fourth meeting of the working group held in Budapest in October 1991, the following points of the established workplan have been developed:

Updating databases

This activity is now done routinely. Most curators provided diskettes or catalogues in 1993/94. Following the recommendations of the Group, some preliminary contacts have been established with the main forage databases in the world, namely the USDA, AgResearch (New Zealand) and ICARDA.

Geographic Information Systems (GIS) softwares are now available in the UK (I. Thomas) and France (F. Balfourier), which allow mapping of ecotype locations or any characteristics such as agronomic trait, enzyme frequency, etc.

Collecting and conservation

Joint collecting missions of grasses and legumes were done in 1992 in Czechoslovakia and in 1993 in Bulgaria by IGER and host countries. Other collecting missions are made regularly in Central Europe by breeding companies, but the material is generally poorly documented and its distribution is severely restricted.

Little advance has been made regarding *in situ* conservation. An EU-funded project with Germany, Italy and UK is intended to compare stability and genetic drift in both *in situ* and *ex situ* conservation of natural populations of *Lolium perenne*.

Implementation and evaluation of core collections

It was decided at the fourth meeting to start a pilot programme on perennial ryegrass, which should be followed as soon as possible by a similar project on *Medicago*.

For perennial ryegrass, a first informal disccussion was organized in February 1992, during an EEC-funded workshop on ryegrass genetics held in Amsterdam, with the financial support of IPGRI for non-EEC countries. Guidelines for sampling a representative subset and advice for ensuring genetically conforming multiplication have been proposed.

Among the European genebanks that participated in the Budapest meeting or which were contacted by mail later on, 20 answered. Some of them may represent several countries, e.g. the Nordic Gene Bank (Denmark, Finland, Iceland, Norway, Sweden) or the Vavilov Institute (countries from former USSR). Most of them agreed to participate in this programme, i.e. to establish a representative subset from their native populations,

to multiply them in order to provide seeds to every participant and to evaluate the full pan-European subset in 1995 (with some exceptions if there is no specific funding). In discussing the situation with Ian D. Thomas, curator of the *Lolium* database in November 1992 in Aberystwyth, we noted that some countries wished to participate, but found the delay too short to be able to multiply under good conditions. Other countries lack multiplication facilities and asked other genebanks to do that work, which also takes time. Therefore it was decided to postpone the evaluation phase to 1995, to give one more year to every participant to multiply the material, and to any other country that may be interested in joining this programme. A circular letter was sent to every European genebank or forage scientist in summer 1994, and seeds were exchanged among the 16 participants in early 1995.

Concerning the way to evaluate the material, some considerations are in the report of the Fourth Meeting. However, we need to be more precise and to organize the network, the management of data, statistical analyses, evaluation in controlled environment, biochemical or molecular studies, etc. This will need to be done during the present meeting. An informal round-table was organized during the EUCARPIA meeting of the genetic resources section in Clermont-Ferrand, March 1994. However, most time was spent discussing a reply to an EU call on genetic resources, and little time was given to the evaluation protocol itself. This proposal in now being finalized, in the form of two separate projects: one on forage grasses (*Lolium* and *Festuca*), coordinated by IGER, UK, which includes core collection evaluation and non-EU countries, and one on *Medicago*, coordinated by GEVES, France.

In the case of a core collection project on *Medicago*, it appears that two databases are concerned: France for perennial *Medicago* and Spain for annual medics. Moreover, this group of legumes is of particular interest for Mediterranean countries which are outside the ECP/GR working group, e.g. in West Asia and North Africa. Therefore it should be recommended that contacts be established with these countries in order to coordinate their efforts, and eventually to plan a common project on a core collection for *Medicago*, for example within the framework of the "Mediterranean network on *Medicago*", which recently met in Zaragoza, Spain. Different working groups from several IPGRI geographic regions may be associated within this network.

The future

The new chairman elected in Budapest is a grass specialist. It may be one reason why the programme on ryegrass is going ahead while the one on *Medicago* is still being discussed. Therefore, I tried to find a legume specialist, interested in the concept of core collection, to coordinate the project on *Medicago*. As chairman, I have been called to move from forages to cereals, and therefore a new chairperson must be elected at the end of the present meeting in Bulgaria.

The present meeting will play an important role in maintaining the cohesion of the Working Group. Also, although the Group agreed to be self-sustained, the guidance and coordination by a permanent staff of IPGRI is felt to be irreplaceable. The recent nomination of Thomas Gass as ECP/GR coordinator is therefore welcome.

The European Forage Databases

Representatives from the countries hosting the ECP/GR Forage databases presented an update of the status of these databases. Since the last meeting of the Working Group updating has been initiated for several of these.

RAC, Changins, Switzerland

A. Schori reported on the *Trifolium pratense* database maintained at the Federal Agricultural Research Station (RAC), Changins, Switzerland. This database has been updated since the beginning of 1995, a process which will be completed by 30 June 1995. A. Schori informed the group that RAC wishes to pass the responsibility for this database to another European institution. L. Horvath informed the group that the Institute for Agrobotany, Tapioszele, Hungary, is prepared to assume the continued responsibility for the *T. pratense* database in future. Considering the expertise of the Institute of Agrobotany in *T. pratense* breeding, and the presence at that institute of a collection of over 800 accessions, the group recommended that the database be transferred to Tapioszele. A. Schori and L. Horvath agreed to complete this transfer by 1 September 1995. On behalf of the group the Chairman thanked RAC and particularly Dr Kleijer for the efficient management of the database since its establishment.

INIA, Badajoz, Spain

G. Lopez reported on the databases for *Trifolium subterraneum* and *Medicago*, maintained at the Servicio de Investigacion y Desariollo Tecnologico (SIA), Badajoz, Spain. The databases were last updated in 1988. There are plans to include collections from the following institutes: Badajoz (Spain), Elvas (Portugal) and Cagliari (Italy). Dr Lopez will update the databases by December 1996, based on a survey to be initiated in October 1995. Dr Perrino wil provide the name of the curator of the Cagliari collection to G. Lopez by 30 April 1995

Hebrew University of Jerusalem, Rehovot, Israel

T. Gass reported on the databases for *Trifolium alexandrinum* and *Trifolium resupinatum* on behalf of Prof. A. Dovrat at Hebrew University of Jerusalem, Rehovot, Israel and informed the group that from now on Israel would be represented by Mr Avi Perevolotsky. The Working Group welcomed A. Perevolotsky as a corresponding member and looks forward to continued collaboration with Israel. It was recommended that the databases be updated and that this should be envisaged by December 1996. The Group also expressed its appreciation to Prof. A. Dovrat for his contributions to the activities of ECP/GR and wished him a pleasant retirement.

INRA-Geves, Guyancourt, France

G. Charmet reported on the database for perennial *Medicago* spp. maintained at INRA-Geves, Guyancourt, France. He thanked contributors of information and announced that the catalogue is being edited. Additional information will be sent from the IPK Branch Station at Malchow, Germany (500 accessions) and from IPGR, Sadovo, Bulgaria, who had not received the request for updates. Both institutions agreed to send the information by 30 April 1995. G. Charmet will ask to delay the printing of the catalogue to include the two institutions above. Information from VIR could not be included directly in the catalogue owing to formatting difficulties. The Working Group recommended that the data from VIR be included as an appendix.

IBEAS, Pau, France

G. Charmet also reported on the database for *Lathyrus latifolius, L. tuberosus, L. heterophyllus* and *L. sylvestris*, maintained by IBEAS, Pau, France. Dr Charmet will ask Dr Guy to send more detailed information to T. Gass by 30 April. P. Perrino agreed to send passport data and F. Lopez will contact the National Centre in Madrid, both by 30 April 1995.

University of Southampton, UK

R. Sackville-Hamilton reported on the database for other *Lathyrus* spp. in the University of Southampton. Taking note of the existence of an EU project proposal, coordinated by Frank Bisby and submitted jointly with IBEAS, Pau and CNR, Bari, it was recommended that a European Vicieae database be established and managed jointly by the University of Southampton, IBEAS and CNR. The responsibility for updating the database will be shared between the three institutes on the basis of species groups as follows:

- *Vicia* spp. (CNR, Bari)
- *Lathyrus latifolius, L. tuberosus, L. heterophyllus, L. sylvestrisis, L. sativus* and *L. cicera* (IBEAS, Pau)
- Other Vicieae, excepting the grain crops (University of Southampton).

The *Vicia* and both *Lathyrus* databases may be involved in the projected European Vicieae database discussed in the recommendation above.

Grassland Research Station, Zubri, Czech Republic

The information on the *Arrhenatherum elatius* and *Trisetum flavescens* database (B. Cagas, Grassland Research Station, Zubri, Czech Republic) was not presented during the meeting but is included in this report.

Institute for Agrobotany (RCA), Tapioszele, Hungary

L. Horvath reported on the database for *Bromus*, maintained by the Institute for Agrobotany (RCA), Tapioszele, Hungary. The last update was in 1988, and the catalogue is available on diskette (dBASE IV). There are gaps from the former USSR, Romania and Bulgaria. An update will be introduced in September 1995 and should be concluded by December 1996.

IHAR, Radzikow, Poland

W. Majtkowski reported on the databases for *Dactylis* and *Festuca*, maintained at IHAR, Radzikow, Poland. They have not been updated since 1985. Catalogues were published by J. Serwinski in 1985 and in 1987. Since then no work has been done on the databases. The Botanical Garden of IHAR at Bydgoszcz is prepared to do the update but requires new hardware. If hardware is provided the database could be transferred to Bydgoszcz and the update could be done by the end of 1996. The database will include all *Festuca* spp. maintained in Europe.

FAL, Braunschweig, Germany

E. Willner reported on the *Poa* spp. database, maintained by Dr Seidewitz at FAL, Braunschweig, Germany. The IPK Branch Station at Malchow will be included in the database. Dr Seidewitz will update the database before retiring later this year and will write a letter to the Chair announcing his retirement, the ongoing update and the possible transfer of the database to IPK. The Working Group thanked Dr Seidewitz for the efficient management of the database from its establishment.

Nordic Gene Bank, Alnarp, Sweden

K. Kolshus reported on the *Phleum* database, maintained by the Nordic Gene Bank, Alnarp, Sweden. The last update took place in 1991, and the last catalogue was published in October 1991. NGB will be conducting an update of the database this summer, and the update should be complete by October 1995. The database will only be distributed by diskette and via Internet.

IGER, Aberystwyth, UK

R. Sackville-Hamilton reported on the databases on *Lolium perenne, L. multiflorum* and *Trifolium repens,* maintained by IGER, Aberystwyth, UK. The last update was in 1991. IPGRI will send a database printout to R. Sackville-Hamilton and a formal letter asking for the databases to be updated (by July 1995). IGER will then start a survey for a new update. The proposal currently being prepared for submission to the EU should support the updating process, which should be concluded by December 1996.

CNR, Bari, Italy

P. Perrino reported on the databases for *Lolium* spp., *Phalaris* and *Vicia,* maintained by CNR, Bari, Italy. The *Lolium* database (only annuals) and *Phalaris* database were last updated in 1991. The *Vicia* database needs to be updated. The information is distributed by printouts. Internet access is foreseen by the end of 1996. The Working Group recommended that the *Lolium* database be transferred to IGER at Aberystwyth. It further recommended that the *Phalaris* database be transferred from Bari to NGB, Sweden and that it should include all *Phalaris* spp. NGB will update the *Phalaris* database by October 1995. Concerning the *Vicia* database, refer to the recommendation made under University of Southampton (see above).

Recommendations

The Working Group agreed on the following regarding the databases in general:

— IPGRI will send a letter to all the European Forages Database Managers by 30 April 1995, officially requesting them to start the updating process with the institutes already included in the database. By the end of June 1995, IPGRI will then send printouts of the upcoming European directory to all database managers so that any institutes not yet included in the databases can also be contacted.

— IPGRI will circulate a standard list of acronyms to all the members.

— it was recommended that IPGRI include instructions on how to access WWW and Gopher in the final Report of the present meeting. (*In view of the diversity of Email systems being used and the rapid development of new, user-friendlier software, IPGRI advises interested users, however, to obtain these procedures from their local Email provider.*)

— the Working Group agreed that the databases should remain close to the users, i.e. decentralized.

— the Working Group agreed upon the establishment of a European *Agrostis* database at NGB, Sweden. The information will be called for at the same time as the update of the *Phleum* database and the *Phalaris* database.

— the Working Group agreed upon the establishment of a European *Agropyron* spp. database at IPGR, Bulgaria.

— the Working Group agreed upon the establishment of a European database for

perennial legume forage species (other than *Trifolium repens*, perennial *Lathyrus* and perennial *Vicia*) at the Institute of Agrobotany, Tapioszele, Hungary.

— the Working Group recommends that special emphasis be placed on the completeness of the passport data during the upcoming updates. More information should be sent to the databases, particularly data on latitude and longitude. The information should be provided in the form requested by the database manager.

Searching the databases for duplicates:

— The Working Group agreed that the search for duplicates is a second priority. The first priority is to identify unduplicated material so that each country can take responsibility for conserving its unduplicated material.

— The database managers will check the databases for unduplicated material using the passport data and report back to the next meeting of the Working Group. A subgroup, consisting of R. Sackville-Hamilton, P. Perrino and E. Willner and led by E. Willner, will collaborate on a protocol which will be circulated to the database managers by 31 October 1995.

National collections

The status of the national collections was presented to the group, including the number of accessions, the needs for regeneration, the degree of characterization and evaluation and the level of documentation.

Austria

The group was presented the report sent by the corresponding member of Austria, stating that the only collection in the country was maintained at the Federal Research Institute at Gumpenstein. This collection holds material from different origins of *Lolium* × *boucheanum, Dactylis glomerata, Poa pratense* and other species. Single forage samples are also maintained at the Federal Institute for Agrobiology in Linz.

The Austrian material is primarily used in the country's breeding programme and no efforts have yet been undertaken to establish a comprehensive forages collection. The group welcomed the participation of Austria in the ECP/GR Forages Working Group and recommended that the conservation of this country's valuable forage genetic resources be given due attention.

Belgium

D. Reheul presented the Belgian collection of grasses maintained at RvP, Merelbeke. He pointed out that this collection's principal purpose is to serve the breeding programme of the Institute. The material stored is young and in good condition but none of it has yet been duplicated. The group recommended that this be done in the near future and RAC, Changins offered to host the safety duplicates from Belgium. D. Reheul agreed to send the duplicates of the collection to RAC by 30 September 1995. A limited capacity for long-term storage is available at RvP and D. Reheul offered to receive some safety duplicates from other collections.

Bulgaria

S. Angelova presented the status of the collection which is maintained at IPGR, Sadovo. She mentioned that there was a need for further documentation of the material of Bulgarian origin and that difficulties had been encountered in regeneration of wild species. S. Angelova also pointed out that none of the Bulgarian material was safety duplicated yet. The group recommended that this be done as soon as possible when sufficient material is present. It is expected that this could be done at RAC, Changins, within the framework of the collaborative project between Bulgaria and Switzerland.

France

G. Charmet presented the status of the forage collections maintained by GEVES - Le Magneraud (varieties) and INRA (three locations: landraces and ecotypes). The general principle followed is to declare as genetic resources only the accessions which have been multiplied, and store the rest of the collection for the long term. A network is being established comprising GEVES as active bank and national database; INRA as being responsible for collection, regeneration and evaluation; private companies which have agreed to maintain the old French cultivars. INRA will carry out the multiplication of grass accessions collected in North Africa (40 by the end of 1997). Passport data for old collections of *Festuca arundinacea* and *Dactylis* spp. have not yet been computerized. This should be done by the end of 1996 and the data transferred to the ECP/GR databases. As INRA is discontinuing its *Trifolium pratense* breeding programme, G. Charmet asked whether another institute would accept the responsibility of maintaining the most valuable part of the genetic material. He agreed to do an inventory of this material before the end of 1995. L. Horvath informed the group that the Institute for Agrobotany

in Tapioszele would probably take the responsibility for this material. He will contact his director and then contact G. Charmet directly.

Germany

E. Willner reviewed the forage *ex situ* conservation activities in Germany. She explained that the inventory of the forages collection in Malchow was currently being made and should be concluded by the end of 1997. This inventory includes passport data and preliminary characterization data as well as an assessment of the quality of the stored material. Whether this objective is achieved depends, however, on the possibility of renewing the contracts of the complementary staff currently working on this task and whose contracts are due to end on 31 May 1995. E. Willner explained that in the collection in Malchow, some manually recorded data still need to be computerized. She agreed to conclude this by December 1997 in cooperation with the genebank in Gatersleben and the Information Centre for Genetic Resources (IGR) of ZADI in Bonn.

E. Willner informed the group of her intention to establish agreements with German breeding and seed production institutes to better distribute the responsibility for the characterization and evaluation of the German collections.

Greece

T. Vaitsis reported on the Greek forages collections. The responsible institute within Greece is the Agricultural Research Centre of Central Greece (CGARC/FCPI) in Larissa. The material obtained through national and international collecting missions is mainly maintained at the Greek genebank in Thessaloniki, while clones, breeders' lines and bred varieties are maintained in Larissa. The passport data of the material in the genebank in Thessaloniki are fully computerized but this is not the case for the collection in Larissa. Also, there is a need to regenerate, characterize and do primary evaluation of most of the indigenous forage accessions (about 600) maintained in Larissa. The group recommended that this be given high priority. T. Vaitsis agreed to regenerate and test 300 accessions before 1 September 1997. He also agreed to send samples of all indigenous material held in Larissa which are not yet duplicated in Thessaloniki to the Greek genebank by the same date. Computerization of the passport data of the accessions in Larissa will be concluded by the end of 1996. Characterization data for *Dactylis glomerata* accessions distributed by T. Vaitsis to Australian scientists have been requested.

Hungary

L. Horvath discussed the new organization of genetic resources conservation activities in Hungary. He explained that the Institute of Agrobotany in Tapioszele is permanently funded for conservation activities. It also has the responsibility for coordinating all plant genetic resources activities in Hungary. Additionally, private and public breeders can receive grants from the ministry for regeneration and evaluation of material on the condition that a subsample be deposited in the base collection at the Agrobotany Institute. The group commended this approach and recommends that the efforts to regenerate and evaluate material and at the same time duplicate it in the base collection be continued.

The material in Tapioszele is stored in active and base collections, according to international genebank standards. Viability testing and regeneration are done routinely. Regeneration of forages is also carried out in the "backyard" system throughout Hungary. An isolation garden will be established in Tapioszele before the 1996 growing season. The group noted the necessity to safety duplicate the Hungarian collections of *Bromus* and other indigenous grasses in other collections. L. Horvath informed the group that half of the collection will be duplicated by the end of September 1997.

Ireland

V. Connolly discussed the Irish forages collection and informed the group that the principal need for regeneration concerned old *Trifolium repens* material. He agreed to undertake this task after a thorough revision of the accessions to eliminate less valuable material such as highly similar breeders' lines. Completion of this work should be by September 1997. A high percentage of the indigenous material is duplicated in other collections within ECP/GR.

Italy

P. Perrino gave a review of the principal Italian collections. He mentioned that in Bari activities concerned mainly *Vicia*. The Group noted the urgent need to complete the passport data related to the *Vicia* collection. Such information was noted to be missing for material collected by Erna Bennett in Turkey. P. Perrino agreed to contact E. Bennett by the end of April 1995, copying the correspondence to the ECP/GR coordinator. C. Sabanci agreed to check whether the Turkish National Program is in possession of the missing passport data. P. Perrino also agreed to contact the Italian breeding institutions and ensure that their collections are safety duplicated in Bari.

Nordic Gene Bank

K. Kolshus briefly explained the functioning of the NGB and the Working Group for Forages (Chair: P. Marum), which has the responsibility for regeneration of the forage collections maintained at NGB. She pointed out that these collections consist only of material from the five Nordic countries (Denmark, Finland, Iceland, Norway and Sweden). The problem needing attention as a priority is the material collected in 1979–81, which comprises the largest part of the collection. About 400 of these accessions are presently stored in only small seed quantities and/or have a relatively low viability. The regeneration/multiplication of half of this material will be completed by September 1997. There are also further needs for characterization/evaluation. This is dealt with in individual NGB projects such as an ongoing evaluation of the *Phleum* collection at NGB, to be concluded by the end of 1996. All safety duplication is taken care of and is conducted in Svalbard.

Poland

W. Majtkowski informed the group of the status of Polish forages collections. The long-term storage is done at the Polish Gene Bank (Plant Breeding and Acclimatization Institute - IHAR) in Radzikow near Warsaw. Active collections of Forage Leguminosae maintained at the Laboratory of Grasses and Papilionaceous Plants (IHAR) in Krakow and large field collections are maintained at the Botanical Gardens (IHAR) in Bydgoszcz. The primary need identified is the documentation of the collections at Bydgoszcz. W. Majtkowski agreed to initiate an inventory in collaboration with M. Gorski in Radzikow. He will submit a funding request to IPGRI in the framework of an EU-project proposal and, if provided with allocation of funds to cover the computer hardware requirements, will complete this inventory by September 1997.

Portugal

M. Tavares de Sousa presented a report on the status of forages collections in Portugal. These collections were constituted as a result of countrywide collecting missions conducted between 1945 and 1993 and already have been used intensively in creating new varieties. The collections are documented manually in most cases. A part of the collection was lost because of lack of staff to conduct the regeneration. The lost material is no longer documented in the ECP/GR databases. M. Tavares de Sousa said that a large effort will be made to conclude the computerization of the documentation by September 1997. Regeneration will be continued at rate of 100 accessions per year. He

will also request Portuguese breeders to send duplicates to the Portuguese Plant Germplasm Centre in Braga and to standardize their characterization/evaluation.

Russia

V. Chapurin reported on the Russian forages collections, informing the Group that 80% of the collection at N.I. Vavilov Institute (VIR) is stored in Kuban in a medium-term cold store which is currently being renovated. He explained that in order to devote more resources to conservation, VIR is reducing its intensive evaluation activities and increasing the multiplication for long-term storage.

Spain

F. Gonzáles López presented the Spanish forages resources activities. He informed the Group that the genebank in Badajoz was applying the international standards to identify regeneration needs. He agreed to review the collection of *Trifolium subteraneum* and complete passport data where necessary by December 1996. He will also send duplicates to the genebank in Madrid. He informed the group that the *Medicago* collection in Badajoz would be characterized and complete passport data sent to the database managers by July 1997.

Switzerland

A. Schori informed the Group of the forages collection of RAC, Changins in Switzerland. He informed the Group of his wish to find an institute which could host a safety duplication of these collections. D. Reheul said that RvP would be prepared to do this. A. Schori agreed to regenerate the Swiss *Dactylis glomerata* ecotypes at the rate of 10 per year and would send safety duplicates of the regenerated material to Belgium.

Turkey

C. Sabancí gave a review of the Turkish forages collections. The Aegean Agricultural Research Institute (AARI) has the national responsibility for these collections and provides short-, medium- and long-term storage for them. Between 1991 and 1994, a multiplication programme for 1500 accessions was undertaken. C. Sabanci informed the group that AARI is giving priority to regeneration over evaluation and that material needed by breeders is also given priority.

UK

R. Sackville Hamilton presented a report on the UK forages genetic resources collections. IGER is presently the only government institute dealing with forages genetic resources in the UK. All collected material is safety duplicated at RGB, Wakehurst Place. There is a need to regenerate approximately 200 accessions which are older than 20 years. Also some intensely used accessions need multiplication. R. Sackville Hamilton agreed to regenerate these accessions at a rate of 150 per year. R. Sackville Hamilton also agreed to send all data on IGER's forages to the corresponding ECP/GR databases.

Collecting activities

Collecting since 1991

Bulgaria

During 1991-94 national collecting missions have been carried out for *Lolium, Festuca, Trifolium, Medicago* and *Vicia*. In 1993, IPGR Bulgaria and IGER UK collaborated in a joint collecting mission in the mountains of south-central and southwestern Bulgaria, collecting *Lolium, Festuca* and *Trifolium*.

Czech Republic and Slovakia

In 1992 a collaborative collection with IGER UK was conducted in Czechoslovakia (as it then was called), collecting mainly *Lolium, Festuca* and *Trifolium*.

France

Collections of ryegrass were made in the Sierra Nevada, Spain in 1992 in collaboration with Dr A. Oliveira, CIAM, Mabegondo Galice. In 1994 ryegrass and *Festuca* were collected in Morocco in collaboration with D. Bounejmate of INRA Morocco.

Germany

In 1991, 52 accessions of grasses including 26 of *Lolium perenne* were collected on the coast of the Baltic sea in collaboration with Dutch breeders. A further 134 grass populations including 82 of *L. perenne* were collected in north, south and central Germany in collaboration with a German research project (A. Oetmann).

In 1993, a collecting trip was made to Romania in collaboration with a German breeding company. The collected material (455 *L. perenne* accessions) will be evaluated in two different locations and then multiplied at Malchow to generate sufficient stocks for storage and distribution. In collaboration with a Dutch breeding company, 238 accessions of grasses (including *L. perenne, Dactylis glomerata, Festuca* spp. and *Phleum* spp.) were collected on 40 sites of old pastures in northeast Poland.

Greece

No specific forage collecting trips were undertaken but a few forage accessions have been collected since 1991 in the context of other collecting projects. In addition, 30 samples of the fodder shrub *Medicago arborea* have been collected.

Hungary

In 1992, the Institute of Agrobotany and DSW, Germany conducted a joint collecting mission in the village pastures and meadows in Hungary; 423 forages accessions were collected.

Italy

IDG Italy undertook several unoriented collections in 1991-94 jointly with IPK Gatersleben, Germany, during which 124 accessions from 15 genera were collected. Three such missions in Albania were supported by IPGRI. SIA Extremadura collected annual legumes from Sardinia in 1992.

Poland

IHAR Kraków collected *Trifolium pratense* in 1993 and *Trifolium* and *Festuca* in 1994 from several regions of Poland. IHAR Bydgoszcz sampled populations of 24 species of grass from eastern Poland in 1993, and 20 species of grass from southern Poland in 1994. The Polish Gene Bank of IHAR Radzików collected 5 species of forage legumes from southeastern Poland in 1994.

Russia
In 1992 VIR collected 488 samples of forage legumes and grasses in Kazakhstan (jointly with US scientists) and in the Volga region and northern Caucasus (jointly with Japanese scientists), and in 1993, 146 samples in Canada.

Spain
SIA Extremadura collected annual legumes from two provinces in Spain in 1991 and 1994.

Switzerland
In western Switzerland, 64 accessions of *Poa pratensis* were collected in 1994.

Turkey
In 1991, AARI Turkey collected 387 accessions of forages.

Collecting planned for 1995

Bulgaria
Perennial legumes and grasses from mountain regions and annual legumes and grasses from the coastal region.

Germany
Grass collection is planned in the Altmark region (former East Germany).

Greece
No specific forage collecting trips, but forages will be collected as part of a more general trip to southern Greece and adjacent islands.

Hungary
The Institute of Agrobotany will continue the collecting of forage legumes and grasses in abandoned village pastures.

Italy
No specific forage collecting trips, but forages will be collected as part of a more general trip to southern Italy and islands.

Poland
Collecting is planned in the southern region of Poland and Slovakia (Tatra Mountains).

Portugal
Annual *Medicago* spp. will be collected in June, mainly in central Portugal, to form the base of a breeding project.

Russia
In the north of the Leningrad region and Karelia for *Trifolium pratense, Poa pratensis* and other grasses.

Turkey
The following collecting activities are planned in Turkey:

1. A joint expedition with the Co-operative Research Centre for Legumes in Mediterranean Agriculture (CLIMA);
2. Collecting in the context of a project submitted to the FAO Regional Office for the

Near East (FAO/RNEA);
3. Collecting in the gene management zones in Kazdag;
4. A joint expedition has been envisaged with ICARDA and the University of Birmingham.

UK

IGER has planned the following collecting activities:

1. Joint collecting in Uruguay with INIA Tacuarembó, Uruguay, for *Trifolium repens* and *T. polymorphum;*
2. Joint collecting in Turkey involving IGER, University of Birmingham, ICARDA, and Ankara for *Trifolium* species;
3. Joint collecting in Portugal for *Dactylis*, with Prof. V. Carnide, UTAD as the principal collaborator/co-organizer and collector in the north; other collectors will join for collecting in central and southern Portugal.

Remaining gaps

Cyprus

IPGRI has received a letter from Dr Clark, University of Leeds, UK, identifying potentially valuable material from uncultivated lands in northern Cyprus.

France

INRA France has identified Crete and the former Yugoslavia as representing gaps in *Medicago* and other Mediterranean legumes.

Greece

Wild and semiwild ecotypes of *Medicago sativa* need to be collected from all over Greece.

Hungary

Previously overgrazed and now undergrazed village pastures in Hungary are considered as urgently requiring collecting.

Ireland

Several isolated sites have been identified needing collecting. Collecting of forage species other than *Lolium* and *Trifolium repens* is desirable.

Nordic countries

Parts of southern Finland, southern Sweden and Denmark still need to be covered.

Poland

There is still a need to collect rare and endemic species throughout the country.

UK (IGER)

In consideration of the genetic erosion and to fulfill UK responsibilities under the Rio Convention, large gaps in coverage of the UK need to be filled. For genetic novelty, high-altitude equatorial temperate pastures (e.g. Ecuador) are considered high priority.

Discussion of further collecting needs

P. Perrino, noting the difficulties being experienced by most delegates with maintaining existing collections, queried the wisdom of continuing collecting and suggested that greater priority should now be attached to maintaining existing collections rather than to additional collecting. The importance of conserving adequately what has already been collected was agreed upon. Three general reasons for continuing to collect were identified.

First, genetic erosion is a continuing problem. Collecting must continue in areas that have been identified as being endangered. Where there is no danger of genetic erosion, collectors should be very careful to verify that adding a new collection is justifiable relative to the need for maintaining what is already collected.

Second, breeders are dependent on new material, new variability and new species. Having evaluated a collection, breeders would often eliminate population samples that they have rejected for breeding purposes, rather than store them. Breeders' priority may therefore be to continue collecting regardless of any problems a genebank might have in maintaining a collection.

Third, there is a need to distinguish breeder-oriented collecting trips from conservation-oriented collecting trips. The former are targeted at material with high probable immediate value for meeting the breeder's current objectives, such as improving drought tolerance or cold tolerance, and often at material with high immediate general agronomic value. In contrast, conservation collections are targeted at maximizing the genetic diversity sampled within an area. A properly trained genetic resources collector can collect much more diverse material. Although having lower immediate value for specific current breeding objectives, a conservation collection has greater long-term value for breeders, is more efficient both in terms of conserving maximum diversity with minimum size of collection and in terms of combating genetic erosion, and contains genes absent from breeder-oriented collections. Where accessions held by a genebank are primarily from breeder-oriented collections, there is a greater need to augment the diversity in the genebank with new conservation-oriented collections.

Research activities

Comparison of *in situ* and *ex situ* conservation

(E. Willner, IPK, Germany)

A project coordinated by Prof. E. Weber (University of Halle, Germany) and including Perugia (Italy) and IGER (UK) has been submitted to the EU under the framework of IV DGVI Agriculture and Environment.

Under the project it is proposed to return to sites that have previously been sampled and accessed into the *ex situ* collections of the three partners (*ex situ* material) and identify 25 sites in each participating country that have not disappeared through habitat destruction, resowing, etc. Repeat samples will be collected from those 25 sites during the project (*in situ* material). The accessions will be multiplied, morphologically and biochemically characterized and evaluated in a common trial to determine the extent to which the *in situ* and *ex situ* material differs both between and within populations.

Regeneration methodology

(R. Sackville Hamilton, IGER, UK)

Results were presented of research on regeneration methodology of *Lolium perenne* at IGER, UK, suggesting a need to redefine regeneration protocols and leading to a proposal for a project for submission to the second round of EU Framework IV.

In a seed regeneration island a few plants contribute most of the seed, and often some plants yield no seed. The problem tends to be worse with native UK accessions. When the same mother plants are used to generate more seed in successive years, differences between plants are largely consistent between years. Thus selection is a far more important problem than drift in regeneration, at least for outbreeding perennial forages under these conditions. Regeneration protocols must therefore take relatively more account of selection. Since selection is important, and is likely to be the same unidirectional selection for all accessions, the acceptable level of cross-contamination between islands is zero, as the combination of unidirectional selection with introgression leads to the most rapid loss of genetic diversity between accessions.

To minimize the problem, IGER creates a "balanced bulk" for medium-term storage, using an equal number of seeds from each mother plant that produced sufficient seed; and for long-term storage a separate foil pack is used for each mother plant that produced any seed. However, this addresses only unequal maternal contributions of each plant. Further research is needed on paternal contribution, and on the potential value of changing location and methodology for regeneration. To this end a Framework IV project is proposed involving paternity analysis by DNA fingerprinting to determine pollen contribution, and a factorial combination of accessions from each participating country, regenerated in all participating countries, under two regimes. Expressions of interest in participation were received from Belgium, Italy and Norway.

Standardization of isozyme analysis in ryegrass

(G. Charmet, INRA, France)

In a follow-up to the 4th ECP/GR workshop at Budapest, a meeting on *Lolium* was held in 1992 in Amsterdam. Participants identified a need to standardize the protocol for isozyme analysis of ryegrass. A subcommittee was set up to do so, chaired by Prof. M.D. Hayward (IGER, UK).

The protocol has been finalized, and is detailed in a refereed paper[1]. Briefly, the protocol includes:

1. Standards for gels and buffers, to eliminate variation due to different electrophoresis conditions;
2. Standards for naming bands. An entirely new system of nomenclature has been established, which permits the logical naming of new bands as they are discovered without resort to the illogical and inconsistent subcategories previously used. The system is based on a numerical score of the position of the band;
3. Standard reference clones. A set of 30 clones has been identified which include homozygotes for most known alleles of all isozyme systems. Different subsets of the 30 clones are appropriate for different isozyme systems. All isozyme assays should include the appropriate subset as controls. The 30 clones are available on request from Dr F. Balfourier (INRA Clermont-Ferrand, France).

The group expressed appreciation for the efficiency with which the subcommittee has satisfied this need.

Description of Nordic timothy varieties and local populations stored in the Nordic Gene Bank

(P. Marum, Norway)

This 3-year project, funded by the NGB, began in 1994. The objective is to describe the 370 accessions of *Phleum* stored in the NGB. Each population/variety is tested as spaced plants (7 plants in a 1.5-m row) in two replicates. The varieties Engmo and Bilbo are used as control varieties; each was planted 21 times in each replicate. Accessions are being scored as rows using IBPGR descriptors as a basis with some minor modifications.

Genetic resources of coexisting native and introduced *Trifolium* in Uruguay

In January 1995, IGER UK and INIA Tacuarembó, Uruguay, began a collaborative project to collect, characterize and evaluate Uruguayan genetic resources of *Trifolium repens* (introduced) and *T. polymorphum* (native) occurring in the same pastures. Emphasis will be given to collecting from sites differing widely in soil moisture status and evaluating adaptation to drought.

Ecogeography of *Trifolium* species in Turkey

IGER UK, University of Birmingham UK, ICARDA Syria and AARI Izmir Turkey have begun a collaborative project on the ecogeography of *Trifolium* in Turkey. The project will involve detailed environmental analysis of collection sites and ecogeographical analysis of the distribution of different species and the distribution of genetic variation within species.

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[1] Hayward, M.D., G.H. Degenaars, F. Balfourier and F. Eickmeyer. 1995. Isozyme procedures for the characterisation of genetic resources of the *Lolium* genus. Genetic Resources and Crop Evolution (in press).

In situ conservation

Turkey

C. Sabancí described a World Bank funded *in situ* conservation project integrated in the National Plant Genetic Resources Research Project. The project covers wild and weedy relatives and landraces of cultivated crops such as cereals, forages, food legumes, industrial crops, vegetables, ornamental plants, fruits, nuts, grapes, medicinal and aromatic plants, and endemic species. The objectives are:

1. To identify and establish *in situ* conservation areas in Turkey;
2. To test and develop a new approach for conservation of genetic diversity;
3. To provide sustainable *in situ* conservation of wild genetic resources.

The proposed zones are: northwest, southeast, and south and central Turkey. The project components are: site surveys and inventories; gene management zones; data management; national plan for *in situ* conservation.

Italy

P. Perrino reported that in Italy there are several protected areas (National Parks, reserves, biospheres, oases, etc.). He also outlined plans for starting, in collaboration with other Mediteranean countries, an international *in situ* conservation project. The principal contact in Italy for this project is the University of Tuscia, Viterbo, Italy.

Bulgaria

S. Angelova described a Bulgarian 5-year project begun in 1992 according to the methodology of A. Dovrat (Rehovot, Israel) and Dr N. Maxted (Univ. of Birmingham, UK). Five sites in the mountains and Mediterranean areas are being documented and the species identified.

Hungary

L. Horváth described three National Parks situated mainly on grasslands. Within these National Parks, important forage species are preserved. The areas are exploited using traditional grazing systems which are favourable to the preservation of genetic diversity. Seed from these areas has been collected and can be found in the Hungarian genebank.

UK

R. Sackville Hamilton briefly described the UK system of National Parks, Environmentally Sensitive Areas (ESAs) and Sites of Special Scientific Interest (SSSIs). Full details were presented by Dr R. Smith (Royal Botanic Gardens, Wakehurst, UK) at the International Symposium on Plant Genetic Resources at IPK in Gatersleben. Numerous universities, research institutes and NGOs around the UK are involved in a diverse range of solo or collaborative projects, monitoring species and/or genetic diversity *in situ*, and/or seeking optimum management regimes for conservation.

Core collections

Dr Charmet introduced the subject by reminding the participants of the discussions which took place during the fourth meeting of the Working Group in Budapest in 1991. The Group then expressed the view that ideally all existing forage accessions should be evaluated in depth but that, mainly for financial reasons, this is not possible in the short term. It was decided that a *Lolium* core collection consisting of approximately 10% of the total holdings should be developed and evaluated as a pilot study and that this experience should be extended as soon as possible by additional projects. It was agreed that each country would be responsible for the selection of the indigenous ecotypes to be included in the core collection. The number of accessions per country would be proportional to the diversity present in the country with a maximum of 10% of the total holdings in the country or 25 accessions.

The Group then divided into two subgroups, one dealing with the *Lolium* core collection and the other dealing with legume core collections.

Progress with the *Lolium* core collection

Each country participating in the project selected the accessions for inclusion in the core collection and multiplied them during 1993 and 1994. The total number of accessions is 162. The number for each country and the person responsible for providing the seeds are given in Table 1.

Table 1. Seed samples for the *Lolium* core collection

Country of origin	Number of seed samples	Responsible person
Belgium	5	D. Reheul
Bulgaria	7	S. Shamov
Czech Republic	2	I. Thomas
Denmark	2	K.Kolshus
France	25	F. Balfourier
Germany	14	E. Willner
Greece	6	T. Vaitsis
Hungary	12	L. Horvath
Ireland	7	V. Connolly
Italy	6	V. Negri
Netherlands	7	T. van Hintum
Norway	1	K. Kolshus
Poland	15	W. Majtkowski
Romania	15	G. Dologa
Spain	10	A. Oliveira
Sweden	1	K. Kolshus
Switzerland	4	I. Thomas
United Kingdom	23	I. Thomas

A total of 20 sites have been identified for the evaluation of the core collection and the seeds of the selected accessions were sent in February 1995 to the respective countries for evaluation (Table 2). In some countries, the accessions have already been sown in the greenhouse.

Table 2. Countries and sites for evaluation of the core collection

Country	Locations for evaluation trials
Belgium	Merelbeke
Bulgaria	Plovdiv
Czech Republic	Zubri
Denmark	Store Heddinge
France	Bourg-Lastic + Le Pin au Haras
Germany	Hohenheim + Malchow
Greece	Larissa
Hungary	Tapioszele
Ireland	Carlow
Italy	Perugia
Norway	Fure
Poland	Bydgoszcz
Romania	Brasov
Russia	St Petersburg
Spain	Mabegondo
Switzerland	Zurich
United Kingdom	Aberystwyth + SASA (Scotland)

The group then discussed in detail the protocol for the evaluation of the core collection and the following was agreed upon.

- At each site the 162 accessions will be planted in 4 replicates, in 1.5-m long rows with seven plants at 25-cm intervals and 50 cm between the rows in a split-plot design.
- Two replicates will be subject to conservation management with a cut when the last accession has 50% anthesis. The other two replicates will be subject to a frequent cutting regime, simulating periodic grazing with cuts every 3 to 5 weeks, as appropriate for the site.
- The varieties Arion, Francis, Talbull and Vigor will be used as controls. Additional controls may be included if necessary.

The group also discussed the descriptors which will be used for evaluation. It was agreed to use the IBPGR/IPGRI descriptors for forage grasses as a basis with only some minor modifications. Two descriptors will not be evaluated in all countries. Digestibility will be evaluated in Belgium and Germany and possibly also in Ireland, Switzerland and UK. Isozyme studies will be performed in France and possibly in the UK.

Regarding data collection and analysis, R. Sackville Hamilton will coordinate a task force to develop a proposal which will be submitted to the participants by the end of

1995. P. Marum will, with the help of R. Sackville Hamilton and G. Charmet, finalize the full protocol for the evaluation, including the modified list of descriptors and distribute it to the participants.

Core collections for forage legumes

The subgroup discussing possible core collection projects for legumes noted that GEVES, Le Magneraud is preparing a project to be submitted to the EU Programme on Genetic Resources. This project ultimately aims at the creation of a *Medicago* Core Collection. The representatives from Bulgaria, Greece, Hungary, Portugal and Russia expressed interest in participating in this project.

P. Perrino informed the subgroup that, within the framework of the same EU Programme, the University of Southhampton was preparing a project on the rationalization of *Vicia* and *Lathyrus* collections in Europe. The representatives from Bulgaria, Hungary, Russia and Spain expressed their interest in being associated with this initiative.

The subgroup agreed that for the time being and apart from the two abovementioned initiatives, no further activities would be planned in view of establishing forage legumes core collections.

Lists of standard varieties

Introduction

(G. Charmet, INRA, Station d'Amélioration des Plantes, 63039 Clermont Ferrand CEDEX, France)

Most genebanks and users of genetic resources (breeders, research institutes, etc.) who carry out evaluation for agronomic traits usually include improved material such as commercial cultivars for comparison. Frequently each institute uses its "own" check varieties, mostly those which are widely grown in the particular country or the newest ones.

In order to allow comprison of evaluation data over countries and over years, the ECP/GR Forages Working Group, meeting informally in Lusignan, France in 1987, recommended that a common list of standard varieties be established and that these varieties should be used as much as possible in any further evaluation trials of genetic resources material.

The principles which served as guidelines for the initial choice in 1987 were:

- The variety should be well known by most participants and easily available on the market.
- The variety should be grown over a wide range of countries and be representative of the current set of varieties (not necessarily the best or the newest one).
- The variety should be registered in several national lists and possibly in the European catalogue.

According to these principles, a preliminary list was issued in 1987, then completed in 1989. During the fourth meeting of the ECP/GR Forages Working Group in Budapest in 1991, it was suggested and accepted that the institute which is responsible for a species database must also keep available a seed stock of the standard varieties for distribution to any user who may have difficulties in finding them. Meanwhile, some amendments were made to the list, particularly to replace varieties which had become difficult to find.

It appears now in 1995 that the initial list needs revision for the following reasons:

- Some varieties have become difficult to find.
- Some other varieties are more widely used.
- Some standard varieties have been taken off the official lists.
- The original list does not cover the whole ecogeographic spectrum of Europe.

Therefore the national representatives were asked to contact breeders and other users in their countries and make proposals for new standard varieties. While giving due consideration to any new suggestions it should, however, be noted that:

- To allow comparison over years, not all standard varieties of a given species should be replaced at the same time (necessity of overlapping).
- Representatives should not only take into account the wish of their country's breeders, but also the general principles cited above.

Considering the guidelines given above, the group agreed to establish three lists — one for southern (Table 3), one for central (Table 4) and one for northern (Table 5) Europe. In order to extend the ecogeographic coverage of these lists, M. Tavares de Sousa agreed to coordinate the establishment of a standard variety list of grasses for southern Europe in consultation with Italy, Greece, Portugal and Spain and to send the final list to IPGRI by the end of April 1995 for inclusion in the Report. P. Marum agreed to coordinate the establishment of a standard variety list for northern Europe in consultation with Russia and send the final list to IPGRI by the end of April 1995 for inclusion in the Report.

Table 3. Standard varieties for forages in southern Europe

Species	Varieties	Country of origin	Registration	
			EU	OECD
Grasses				
Dactylis glomerata	Cesarina	ITA	—	—
	Currie (very susceptible to rusts)	AUS	—	—
Festuca arundinacea	Tima	ESP	—	—
	Tanic	ITA	—	—
	Sibilla	ITA	—	—
Lolium multiflorum	Caramba (annual)	NLD	—	—
	Billion (westerwoldicum	NLD	—	—
	Bragelim (italicum)	PRT	yes	—
Lolium perenne	Vejo	—	—	—
	Victorian	AUS	—	—
Lolium hybridum	Asso	—	—	—
Legumes				
Hedysarum coronarium	Grimaldi	ITA	—	—

Species	Varieties	Country of origin	Registration	
			EU	OECD
Lotus corniculatus	Franco	ITA	yes	yes
	Oberhaunstädter	DEU	yes	yes
Onobrychis sativa	Fakir	FRA	—	yes
Medicago litoralis	Harbinger	AUS	—	—
Medicago polymorpha	Circle Valley	AUS	—	—
	Serena	AUS	—	—
Medicago rugosa	Paragosa	AUS	—	—
Medicago sativa	Magali* (semidormant)	FRA	yes	yes
	Aragon* (dormant)	ESP	—	yes
	Moapa* (nondormant)	USA	—	yes
	Hyliki** (semidormant)	GRC	yes	yes
	* grown under irrigation ** grown with or without irrigation			
Medicago scutellata	Robinson	AUS	—	—
Medicago truncatula	Sephi	AUS	—	—
	Jemalong	AUS	—	—
Trifolium alexandrinum	Sacromonte	ITA	—	yes
	Lito	GRC	yes	yes
Trifolium hybridum	Hytra	DEU	—	—
Trifolium pratense	Nesson	GRC	yes	yes
Trifolium subterraneum	Cubillana (very early)	ESP	—	—
	Dalkeith (early)	AUS	—	—
	Areces (intermediate)	ESP	—	—
	Junee (late)	AUS	—	—
	Rosedale (late)	AUS	—	—
Trifolium resupinatum	Demet	TUR	—	—
	Ossa	GRC	yes	yes
Vicia benghalensis	Fontainhas	PRT	yes	yes
Vicia sativa	Alexandros (early)	GRC	yes	yes
	Kubilay (early)	TUR	—	yes
	Idice (intermediate)	ITA	—	yes
	Piedade (intermediate)	PRT	yes	yes
	Septimane (intermediate)	FRA	—	—
Vicia villosa	Amoreiras	PRT	yes	yes

Table 4. Standard varieties for forages in central Europe

Species	Variety	Country of origin	Registration	
			EU	OECD
Grasses				
Bromus inermis	Szarvasi 52	HUN	no	yes
Bromus sitchensis	Lubro	FRA	yes	yes
Bromus catharticus	Bellegarde	FRA	yes	yes
Dactylis glomerata	Floreal (early)	FRA	yes	yes
	Hera (intermediate)	POL	no	—
	Lidacta (intermediate)	DEU	yes	yes
	Baraula (late)	NLD	yes	yes
	Cambria (late)	GBR	yes	yes
Festuca arundinacea	Ondine (early)	FRA	yes	yes
	Barcel (late) (palatable)	NLD	yes	yes
Festuca pratensis	NFG (early)	DEU	yes	yes
	Lifelix (early)	DEU	yes	yes
	Benfesta (intermediate)	DEU	yes	yes
	Cosmos (intermediate)	DEU	yes	yes
	Bundy (late)	DEU	yes	yes
Lolium hybridum	Barsilo (2X)	NLD	yes	yes
	Augusta (4X)	GBR	yes	yes
	Gazella (4X)	CHE	yes	yes
Lolium multiflorium	Alternative:			
	Vitesse (2X)	NLD	yes	yes
	Barspectra (4X)	NLD	yes	yes
	Jivet (4X)	CSK	no	yes
	Billion (4X)	NLD	yes	yes
	Nonalternative:			
	Atalja (2X)	BEL	yes	yes
	Lipo (4X)	CHE	yes	yes
	Lolita (4X)	CSK	yes	yes
Lolium perenne	Arion (2X) (very early)	CHE	yes	yes
	Frances (2X) (early)	NLD	yes	yes
	Bastion (4X) (early)	NLD	yes	yes
	Talbot (2X) (intermediate)	NLD	yes	yes
	Fennema (2X) (intermediate)	DEU	yes	yes
	Citadel (4X) (intermediate)	NLD	yes	yes
	Merlinda (4X) (intermediate)	BEL	yes	yes
	Vigor RvP (2X) (late)	BEL	yes	yes
	Parcour (2X) (late)	DEU	yes	yes
	Condesa (4X) (late)	NLD	yes	yes
Phleum pratense	Odenwalder (early)	DEU	yes	yes
	Motim (intermediate)	NLD	yes	yes
	Farol (late)	NLD	no	yes

Species	Variety	Country of origin	Registration	
			EU	OECD
Poa pratensis	Balin (early)	DNK	yes	yes
	Tomi (intermediate)	NLD	yes	yes
	Monopoly (late)	NLD	yes	yes
Legumes				
Medicago sativa	Europe	FRA	yes	yes
	Vertus (ref. for *Verticilium* and *Dytilenchus dipsaci*)	SWE	yes	yes
	Verko (ref. for *Verticillium*)	HUN/DEU	yes	yes
	Luzelle (pasture type)	FRA	yes	yes
Trifolium pratense	Alpilles (2X) (early)	FRA	yes	yes
	Temara (4X) (early)	CHE	yes	yes
	Diper (2X) (intermediate)	FRA	yes	yes
	Marino (4X) (intermediate)	DEU	yes	yes
	Hermes II (2X) (late)	SWE	no	yes
	Fanny (4X) (late)	SWE	no	no
Trifolium repens	Lune de Mai (Ladino)	FRA	yes	yes
	Olwen (Hollandicum)	GBR	yes	yes
	Kent Wild White (very small leaf)	GBR	yes	yes
	Gwenda (small leaf)	GBR	yes	yes
	Menna (intermediate leaf)	GBR	yes	yes
	Lune de Mai (large leaf)	FRA	yes	yes
	Aran (very large leaf)	IRL	yes	yes

Table 5. Standard varieties for forages in northern Europe

Species	Variety	Country of origin	Registration	
			EU	OECD
Grasses				
Agrostis capillaris	Leikvin	NOR	—	yes
Agrostis stolonifera	Kromi	DNK	yes	yes
Bromus inermis	Leif	NOR	—	—
	Manchar	CAN	—	yes
Dactylis glomerata	Haka	FIN	yes	yes
	Dactus	SWE	yes	yes
	Dedinovsky 4	RUS	—	—
Festuca pratensis	Anti (northern areas)	FIN	yes	—
	Sena (southern areas)	SWE	—	—
Festuca rubra	Leik (northern areas)	NOR	—	yes
	Rubina (southern areas)	DNK	yes	yes
Lolium hybridum	Dalita	DNK	yes	yes
	Polly	DNK	yes	yes
Lolium multiflorium	Sikem (2X)	DNK	yes	yes
	Ajax (4X)	DNK	—	yes
Lolium multiflorium var. *westerwoldicum*	Barspectra (4X)	NLD	yes	yes
	Rimbo (2X)	DNK	yes	yes
Lolium perenne	Pimpernel (2X) (early)	DNK	yes	yes
	Tetramax (4X) (early)	DNK	yes	yes
	Helmer (2X) (medium)	SWE	—	yes
	Tove (4X) (medium)	DNK	yes	yes
	Trani (2X) (late)	DNK	yes	yes
	Tivoli (4X) (late)	DNK	yes	yes
Phalaris arundinacea	Pervenets	RUS	—	—
	Lara	NOR	—	yes
Phleum pratense	Vega (northern areas)	NOR	yes	yes
	Adda (northern areas)	ISL	—	yes
	Iki (northern areas)	FIN	yes	yes
	Kämpe II (southern areas)	SWE	yes	yes
	Bilbo (southern areas)	DNK	yes	yes
Poa pratensis	Lavang (northern areas)	NOR	—	yes
	Balin (southern areas)	DNK	yes	yes
Legumes				
Medicago sativa	Vega 84	RUS	—	—
	Lesina	SWE	—	yes

Table 5. Mediterranean annual pasture legumes: characterization and evaluation

Species	Number of wild species	Number of descriptors	
		Morphologic	Agronomic
Trifolium subterraneum	2041	36	8
Trifolium glomeratum	279	4	1
Medicago ssp.	255	4	2
Ornithopus compressus	111	—	2

Main descriptors used for the evaluation of *Trifolium subterraneum*

- Flowering cycle and period
- Hardseedness
- Leaf oestrogen content
- Capacity to set viable seeds on the soil surface (unburied seeds)
- Cold tolerance
- Amount of seed produced
- Dry matter production in winter.

Duplication sites

Part of the material is duplicated at the Centro de Recursos Fitogenéticos of the INIA Madrid (ESPINIAMAD). Other institutes holding duplicates partially are ESPINIASA (Spain), AUSCSIRO (Australia) and USAPIO (USA).

Regeneration status

The seed viability in the Gene Bank is currently being assessed, and all the accessions which have viability rates lower than 85% and/or seed number less than 4000 are regenerated.

Maintenance of the collection: medium-term storage

Temperature	+5°C
Humidity	30%
Storage volume	181 m^3
Container type	Aluminium foil packets

Perennial *Medicago*

Servicio de Investigación Agraria, Zaragoza, Spain

Table 6. Perennial *Medicago*: details of holdings

Species	Wild	Landraces
Medicago sativa	—	9
M. sativa rizomatosa	216	—

Projects on forage genetic resources conservation in Spain

Programme of genetic resources conservation and utilization of the MAPA

Project no. 94-036

Researcher responsible: Francisco Gonzalez
Title: Conservation, regeneration and documentation of the mediterranean annual pasture legumes collection at SIA of Extremadura.
Objectives:
1. Revision of the seed samples viability and regeneration of those whose seed germination rate is lower than 85% or the seed number is less than 4000.
2. Review and completion of the passport data of the material currently sent to the Center of Genetic Resources (CGR) and compile the material from the last collections.
3. Complete the database with the characterization and evaluation data (almost all the material has been characterized) to be sent to the CGR.
4. Send the duplicate samples, which have not been sent already, to the CGR.
5. Publish a new edition of the European Catalogue of subclover and annual medics.

Project no. 947JU400

Researcher responsible: Francisco Gonzalez
Title: Evaluation and selection of subterranean clover varieties for the cold environments of Extremadura.
Objectives:
1. To obtain a subterranean clover variety with medium cycle, good persistence, high winter growth and tolerance to frost.

Methodology:
1. Multiplication, morphological characterization and identification of the subterranean clover material from the last collections.
2. Agronomic evaluation in rows, following the descriptors:
   - Flowering cycle and period
   - Hardseedness
   - Growth habit
   - Growth vigour
   - Leaf oestrogen content
   - Capacity to set viable seeds on the soil surface (unburied seeds)
   - Amount of seeds produced
   - Dry matter production in winter
   - Cold tolerance.
3. Agronomic evaluation in plots to determine winter dry matter production and seed production.

Project 94-022

Researcher responsible: Jesus Moreno
Title: Inventory, multiplication, conservation and primary characterization of Spanish local varieties of forage grasses and legumes.
Objectives:
1. To realize the inventory of the corn and forage grasses and legumes species collected

during the last 20 years on the Galicia and Cantabrian border and conserved at the genebank of the Centro de Investigaciones Agrarias de Mabegondo (CIAM).
2. To characterize the samples of the pasture species *Lolium perenne, Lolium multiflorum, Dactylis glomerata* and *Festuca arundinacea* using morphologic and isoenzymatic characters.
3. To create nuclei collections of the mentioned species.
4. To complete the genetic resources collection through the collection and multiplication of forage legumes and grasses species populations which have low representation in the collection, from Galicia, Asturias and Cantabria regions.

R+D Sectorial Program of the Agrarian and Food Ministery MAPA

Project INIA 94-045 - Duration 1994-97.

Researcher responsible: José A. Oliveira
Title: Use of native germplasm to provide adapted cultivars of perennial and Italian ryegrass in the north of Spain.
Objectives:
1. To form breeding base populations of perennial and Italian ryegrasses.
2. Evaluation of agronomy, isoenzyme analysis, nutritive quality and presence of *Acremonium lolii.*
3. Improvement of the base populations by backcrossing, multilocal, combining individual progenies.
4. To get the genetic parameters in a base population obtained at random, to estimate the optimal selection rates.
5. To maintain the base populations and register the new varieties.

Spanish research institutions involved in evaluation of forage core collections

Centro de Investigaciones Agrarias de Mabegondo, La Coruña, Spain

Main tasks:
- Evaluation of the diversity of forage genetic resources by means of morphological, isozymes and agronomical characters.
- Creation of core collections of forage grass genetic resources.
- Creating breeding populations of *L. perenne* and *L. multiflorum.*
- Contribution to the creation of a Base Collection in the Centro de Recursos Genéticos of the Instituto Nacional de Investigaciones Agrarias (Madrid).
- Participation in the creation of a European core collection of *Lolium,* with 10 wild populations and a site of evaluation in the European Network.

Servicio de Investigación y Desarrollo Tecnológico, Badajoz, Spain

Main tasks:
- Evaluation of core collection of *Trifolium subterraneum.*
- Evaluation of core collection of annaul *Medicago* ssp.

Establishment of the European annual *Medicago* ssp. and *Trifolium subterraneum* core collections

Plan and criteria for establishment:

1. Test approximately 10% of indigenous ecotypes of each European country.
2. Complete and broaden, when possible, the passport data.
3. Classify the ecotypes in groups by flowering cycles: very early (< 120 days), early (120-130 d), intermediate (131-140 d), late (141-160 d) and very late (> 160 d).
4. Morphological characterization.
5. Agronomical characterization sown in rows, by the following characters:
   - Flowering cycle
   - Length of flowering
   - Hardseedness (after 90 days)
   - Vigour of plant growth
   - Isoflavone content (Formononetin, Genistein and Biochenin A)
   - Capacity to set viable seeds on the soil surface (unburied seeds)
   - Frost susceptibility.
6. Agronomical characterization sown in plots:
   - Winter herbage yield
   - Seed yield.

Status of national forages collections in Switzerland

A. Schori
Station fédérale de recherches agronomiques de Changins, 1260 Nyon, Switzerland

Status of the collection of forage grasses at Changins

Most of the accessions stored at the Federal Agricultural Research Station, Changins were collected in the 1970s and concern species which are bred in Changins. The main goal of this collection was to observe wild material and eventually incorporate some of their characteristics into the breeding material. Most of this genetic material is still stored (Table 1) in a cold chamber (+4°C, 30-40% RH). Owing to insufficient seed quantity and probable irregular germination, this material is generally not available for exchange.

Some accessions have been recently renewed (by growing about 40 individual plants per accession in isolation). These are in long-term storage (-21°C, sealed laminated aluminium foils). Small quantities of seeds of this material are freely available on request. Computerized characterization of this material concerns location, elevation, type of grassland in which they were collected, seed quantity and regeneration status. This material is not duplicated in other collections.

Table 1. Number of accessions for different grass species

Country	Mid-term storage	Long-term storage
Dactylis glomerata (collected from 1967 to 1979)		
AUT	4	0
CHE	81	6
DEU	10	3
DNK	1	0
FRA	34	2
ITA	11	0
YU	1	0
Total	142	11
Festuca pratensis (collected from 1973 to 1982)		
CHE	12	10
DNK	1	1
FRA	9	7
SUN	11	1
Total	33	19
Festuca arundinacea (collected from 1972 to 1979)		
CHE	21	5
DEU	2	0
FRA	22	4
USA	1	1
UNKNOWN	19	0
Total	65	10
Poa pratensis		
CHE†	15	0
DEU‡	39	0
Total	54	0

† CHE = seeds of individual plants.
‡ DEU = probably duplicated.

Breeding programs in Switzerland

Dactylis glomerata: 7 diallel crosses were carried out in 1981-82 to create adapted and yellow rust (*Puccinia striiformis*) resistant material. Genotypes from NZL, NLD, FRA and YUG as well as ecotypes and genotypes issued of previous crosses were used. The existing breeding material mostly traces back to the descendants of these diallel crosses (recurrent selection for resistance to yellow rust and stem rust (*Puccinia graminis*).

Festuca pratensis: Screening for resistance to bacterial wilt (*Xanthomonas graminis*) started in 1976 on cultivars, ecotypes and crosses. Recurrent selection also concerned resistance to crown rust (*Puccinia coronata*), stem rust (*P. graminis*) and *Drechslera sorokiniana*. We estimate the relative genetic contribution of ecotypes to be 2/3 and of cultivars to be 1/3 in our breeding material.

Acremonium uncinatum: an endophytic fungus found in about 50% of the Swiss wild material. Owing to indirect selection (induced resistance, higher drought tolerance), this fungus is present in most of our breeding material.

Festuca arundinacea: our breeding material also includes, beside ecotypes and varieties, some *Festuca x Lolium* material. Selection out of crosses of $2n$=70 Morocco fescue with meadow fescue has been attempted.

Poa pratensis: the selection out of ecotypes collected by Drs S. Badoux and W. Dietl goes on. Sixty-four new ecotypes were collected last spring.

Lolium perenne, L. multiflorum and *L. hybridum* are bred in Zürich (Dr Beat Boller). As at Changins, ecotypes included in recurrent selection schemes (*Xanthomonas graminis* and rust-resistant types) are an important source of variability and adaptability.

Trifolium pratense ($2n$ and $4n$) breeding for quality, disease resistance and persistency is exploiting local "farmer varieties" and ecotypes.

Alopecurus pratensis, Cynosurus cristatus and *T. repens* also are bred in Zürich.

Other institutes in Switzerland interested in participating in evaluation of core collections

Dr Beat Boller
FAL-Reckenholz
Reckenholzstrasse 191-211
CH-8046 Zürich
Phone 01-377-73-63
Fax 01-377-72-01

Dr Boller is now participating in the *Lolium* project of the ECP/GR Forages Working Group. As a non-EU member, he hopes to obtain funding from the Swiss government to participate in the EU project on genetic conservation (genus *Lolium* and *Festuca*). He would also be interested in comparing ecotypes collected years ago with ecotypes of the same location which have been newly collected (*Lolium* spp.). One "farm" cultivar of *Trifolium pratense* is still multiplied (bulk selection) by some Swiss farmers and could be used for evaluating the efficiency of this traditional selection (different generation available), compared with modern plant breeding.

Newly collected *Poa pratensis*

In spring 1994, eight days were devoted to collecting ecotypes of *Poa pratensis*. Locations were chosen according to maps on "agricultural aptitude" of Swiss soils and regions in order to obtain a wide sampling of climatic and edaphic conditions. The local extension service (SVVA) and/or the farmer were systematically interviewed to ensure collecting only in spontaneous pastures or meadows. At least 10 vegetative plants were collected on each site. The main region was Vaud (western Switzerland).

Table 2. Number of collection sites in western Switzerland† of *Poa pratensis* (10 plants) per location

Antagnes	5	La Barboleusaz	1
Bassins	3	La Comballaz	2
Baulmes	3	Le Sépey	2
Bex	7	Les Breuleux	1
Burtigny	4	Les Posses	1
Champagne	3	Leysin	1
Chanay	1	Orges	2
Chermignon	2	Premier	4
Concises	2	Provence	1
Genolier	5	Romainmôtier	1
Gryon	1	Vaulion	2
Huémoz	3	Vers-l'Eglise	1
Lignerolle	4	Vesancy	1
		Total	63

† With the exception of Chanay and Vesancy, located in France.

Each site was described by its geographical and topological coordinates (slope, exposure, altitude) and main use of the grassland (pasture, mowing). Specific contributions of gramineae, fabacea and other dicotyledones were estimated. Sociability (from isolated plants to big clusters) and frequency of *Poa pratensis* (Braun-Blanquet) was noted.

Statistics

Of the sites in which *Poa pratensis* was present, 78% were pastured at least once a year, 22% only mown and 60% were quite intensively exploited (fertilization, number of uses per year). Most (78%) of the ecotypes were present as isolated, 3-5 tillered plants. Only 7% of the cases covered important clusters. Most material was collected at an elevation between 500 to 1200 m above sea level.

Use

For each ecotype, 10 plants were planted in a row at Changins (54.5 x 42 cm, each row being isolated by a sown row of *Dactylis glomerata*). As planting took place on different dates (depending on collecting dates) no judgment of phenotypic value could be carried out. At the end of summer, a first evaluation of the attack by *P. stiiformis, P. poae nemoralis* and *Drechslera poae* was possible on half of this material. Average resistance is quite low but good variation seems to exist within each ecotype (Fig. 1). Promising

individual plants (135=21%) have been cloned in three duplicates and replanted for further selection in plots of 1 m^2, isolated by cockfoot. Seed will be produced of the 64 original populations for long-term storage.

Dr Fritz Matzk (Matzk 1991) kindly sent us sexual biotypes of *Poa*. These will be used in our breeding program.

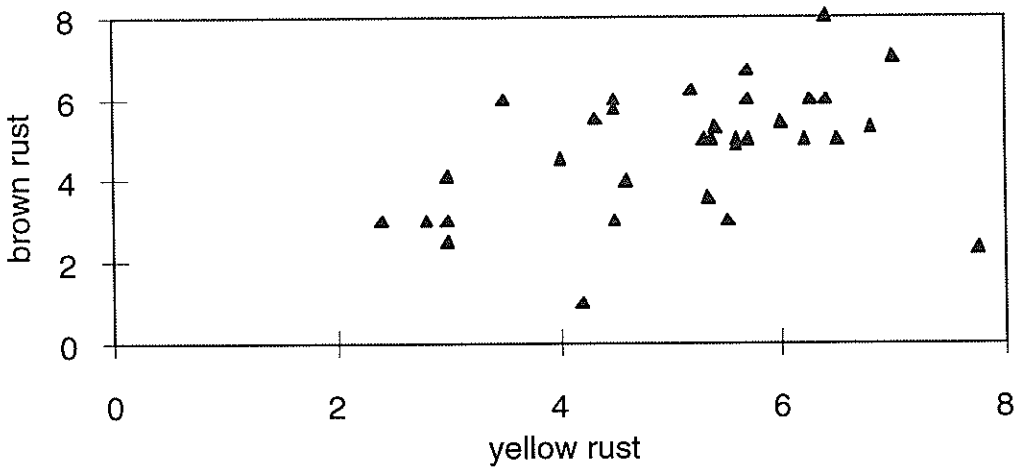

Fig. 1. Brown and yellow rust scores on *Poa pratensis* ecotypes

Reference

Matzk, F. 1991. New efforts to overcome apomixis in *Poa pratensis* L. Euphytica 55:65-72.

Status of national forages collections in Turkey

C.O. Sabancí
Aegean Agricultural Research Institute (AARI), Menemen, Izmir, Turkey

The Aegean Agricultural Research Institute (AARI), as National Project Center, is responsible for plant genetic resources activities covering collecting, multiplication and regeneration, characterization and evaluation procedures. AARI maintains centralized storage facilities and a centrally computerized information system in cooperation with other institutes and universities.

Conservation facilities of AARI are as follows:

Short-term storage:	temperature +4°C, relative humidity 6-8%
Mid-term storage:	temperature 0°C, relative humidity 6-8%
Long-term storage:	temperature –20°C, relative humidity 6%
In vitro conservation	

Field Crops Central Research Institute in Ankara has been assigned for safety duplications, where there are 43 deepfreezers for short- and medium-term storage.

Genetic resources research studies

AARI has eight departments for genetic resources activities. The Forage Crops Department has overall responsibility for collecting, multiplication/regeneration, characterization and evaluation of the related material.

Collecting

Expeditions have been conducted since the establishment of the institute, and more than 10 000 accessions have been collected so far, including wild relatives of forage crops and landraces. The last collectinh trip, made in 1991, acquired 387 accessions.

Multiplication/regeneration

Some 1500 forage accessions were included in multiplication programmes in the period 1991-94.

Characterization

Some characters such as flowering and maturity dates, and flower colour are observed during multiplication. Furthermore, studies have focused on common vetch (*Vicia sativa*) which is also involved in a breeding project in the institute.

In 1993, 100 common vetch accessions were evaluated for 30 characters, and data recorded were transferred to the documentation unit.

Status of Turkish Central Forage Databases

There are two main databases created with dBASE 3+ and extended with dBASE 4.

1. STORAGE DB containing multiplication/regeneration data.
2. COLLECTION DB containing herbarium data.

Table 1. Aegean Agricultural Research Institute forages collections (total = 6038)

Species	Common name	No.	Species	Common name	No.
Agropyron	Wheatgrass	80	*Lathyrus*	Vetchling	169
Agrostemma	Cockle	3	*Lolium*	Ryegrass	266
Agrostis	Bentgrass	11	*Lotus*	Trefoil	17
Alopecurus	Foxtail	25	*Lupinus*	Lupine	6
Alyssum	Madwort	1	*Medicago*	Medic	871
Andropogon	Beardgrass	7	*Melilotus*	Sweet clover	52
Anthemis	Chamomile	4	*Onobrychis*	Sainfoin	126
Arrhenatherum	Oatgrass	3	*Oryzopsis*	Ricegrass	22
Astragalus	Milkvetch	43	*Panicum*	Panicgrass	8
Atriplex	Saltbush	5	*Pennisetum*	Millet	1
Avena	Oat	620	*Phalaris*	Canary grass	98
Berberis	Barberry	1	*Phleum*	Timothy	32
Brachypodium		11	*Pisum*	Pea	132
Bromus	Bromegrass	18	*Plantago*	Plantain	8
Chryosopogon		6	*Poa*	Bluegrass	13
Coronilla	Crownvetch	18	*Polypogon*	Beardgrass	2
Cynosorus	Dogstail grass	1	*Puccinellia*	Alkali grass	30
Dactylis	Orchardgrass	179	*Sanguisorba*	Burnet	104
Eragrostis	Lovegrass	2	*Setaria*	Millet, Bristlegrass	14
Euphorbia	Milkweed	2	*Sorghum*	Sorghum	87
Festuca	Fescue	28	*Trifolium*	Clover	640
Hippocrepsis	Horseshoe vetch	22	*Trigonella*	Fenugreek	18
Hordeum	Barley	942	*Trisetum*	Trisetum	1
Hymenocarpus		55	*Vicia*	Vetch	1234

Table 2. Field Crops Central Research Institute forages collections (total = 1735)

Species	Common name	No.
Agropyron	Wheatgrass	142
Astragalus	Milkvetch	35
Bromus	Bromegrass	454
Coronilla	Crownvetch	96
Dactylis	Orchardgrass	45
Festuca	Fescue	34
Hedysarum	Sweetvetch	3
Lolium	Ryegrass	23
Medicago	Medic	469
Melilotus	Sweet clover	69
Onobrychis	Sainfoin	28
Trifolium	Clover	173
Trigonella	Fenugreek	84
Vicia	Vetch	187
Others		302

Status of forages collections in the United Kingdom

R. Sackville Hamilton
IGER, Aberystwyth, Dyfed SY23 3EB, United Kingdom

Forage collections in the UK

IGER
10 000 accessions of 450 species of temperate forage grasses and legumes (mainly agricultural) and 650 accessions of *Rhizobium*. Medium and long-term storage.

RBG Wakehurst
Mainly nonagricultural.

Southampton
3745 Vicieae:
1932 *Vicia*, 1491 *Lathyrus*, 235 *Lens*, 76 *Pisum*, 1 *Vavilovia*.

Status of genebank at IGER

Passport data	Complete and fully computerized
Characterization and evaluation	Primary characterization complete for about 80% of accessions Breeders' "phase 1" evaluation of all collected accessions Database contains data on heading date for about 50% of accessions
Utilization	Within IGER, 30 requests per year, 12 accessions per request Other institutes, 15 requests per year, 12 accessions per request
Safety duplications	All at RBG Kew
Regeneration status	All accessions in both long- and medium-term storage Older accessions (20+ years) need regeneration Heavily used accessions need multiplication

Research activities relevant to forages genetic resources

Project on comparison of *in situ* and *ex situ* conservation

E. Weber
University of Halle, Germany
(Presented by Evelin Willner)

The objective of the proposal is the investigation on the value of *ex situ* and *in situ* conservation for *Lolium perenne,* the most important fodder grass in the EU. Morphological as well as biochemical descriptors are available to describe the evaluation of *ex situ* and *in situ* populations. A comparison between the two conservation methods will give valuable hints (indications) for future strategies.

Lolium perenne (*L.p.*) is a perennial crop with a good adaptation to specific environments. A large *ex situ* collection exists. A detailed list was given by IBPGR (1991), now IPGRI. Special interest has arisen to add to the *ex situ* conservation the *in situ* conservation with monitoring (Oetmann 1994). A pilot study has been undertaken in Germany with 100 autochthonous populations from four (8 regions) different German areas (Oetmann 1994). The Forages Working Group of the ECP/GR recommended for the *L.p.* core collection that a minimum set of characters should be recorded (IBPGR 1993). Isozymes have been found to be of great value in characterizing *L.p.*. They have to be added as descriptors. Expected results are:

- Establishment of a common database on *L.p.* including descriptors from *ex situ* conserved and corresponding *in situ* populations;
- Description of the genetic variation between and within *L.p.* populations for morphological and biochemical descriptors;
- Description of differences between *ex situ* conserved and corresponding *in situ* populations of *L.p.*;
- Information on the value of populations for breeding new varieties of *L.p.*;
- Information on protection strategies for *in situ* conservation of *L.p.*;
- Characterization of the collection for utilization in breeding programmes for improved quality, reduced fertilizer input and care of environment due to detection of new sources for resistance.

Project milestones and deliverables

1. Successful establishment of a representative European collection with *ex situ* and *in situ* populations in parallel. Such a collection does not exist yet and needs extensive collecting trips to the places where the *ex situ* populations were collected. It is important to know the present *in situ* situation on an European scale.
2. Establishment of a database with a sufficient number of descriptors giving solid information on the populations *ex situ* and *in situ* in parallel. This will be achieved in two years. An additional year is necessary to get descriptors for plots.
3. Exploration of the potential available in *ex situ* and corresponding *in situ* populations as basis for future strategies in breeding of an important fodder crop. Special importance is given, since this crop is used over years in pasture. The comparison between *ex situ* and *in situ* conservation procedures allows determination of the optimum strategy for germplasm conservation. This is the final goal.

The deliverables are:

1. Reports to be used not only by the participants, but also by genebank scientists, fodder crop breeders and farmers. Such reports can be given after each step.
2. Technical deliverables: a database common to important countries within the EU and genetic stocks, from which samples can be distributed. These deliverables are available after multiplication, but full information is reached at the end of the project, first on spaced plants, later also on plots.

References

IBPGR. 1991. A Guide To The European Forage Databases. IBPGR, Rome.

IBPGR. 1993. Report Of A Working Group On Forages (fourth meeting) 1991. IBPGR, Rome.

Oetmann, Anja. 1994. Untersuchungen zur intraspezifischen phänotypischen Variabilität autochthoner Weidelgrasherkünfte (*Lolium perenne* L.) und ihre Bedeutung für die Erhaltung wertvoller Standorte vor Ort (*in situ*).

Other research conducted in Germany which is relevant to forages genetic resources conservation

Prebreeding of perennial ryegrass (*Lolium perenne* L.): results of a 10-year experiment (1983-93)

Ch. Paul[1], U.K. Posselt[2] and H. Scheller[3]
[1] Inst. f. Grünland- und Futterpflanzenforschung, FAL, Braunschweig
[2] Landessaatzuchtanstalt, Universität Hohenheim, Stuttgart
[3] Bayer. Landesanstalt f. Bodenkultur und Pflanzenbau, Freising

More than 700 accessions of *Lolium perenne* L. from the Polish Gene Bank (IHAR) were tested in the initial evaluation for visual indicators of plant performance across a set of 11 Locations throughout the FRG in the form of 40 single plants per population. By cross reference against a set of orthogonally tested varieties with known maturity status 900 superior individuals were selected to form 9 populations differing in maturity on the basis of more than 200 000 data. After multiplication, these populations were subjected to a conventional performance test under sward conditions at the locations Braunschweig, Weihenstephan and Hohenheim. The best ones of these populations reached the level of performance of comparable standard varieties and can now be utilized by plant breeders to enlarge the genetic variability of the presently cultivated perennial ryegrass.

Genetic diversity of autochthonous populations of the forage grass *Lolium perenne* L. (1991-93)

Anja Oetmann and G. Spatz
Gesamthochschule Kassel, Universität, Abt. Pflanzenbau II

One hundred indigenous ryegrass populations were identified along two geographical gradients in Germany. Each population was sampled by collecting 180 tillers in 1991. The total 18 000 tillers were cultivated and examined as spaced plants (*ex situ*) in 1992. Nine selected populations were investigated *in situ* 1991. The results of the *in situ* investigations show high variability between and within the populations. The most valuable populations will be conserved as gene reserves within their environments (*in situ*). Promising material will be available to private breeders, after multiplication.

Improvement of snow mould resistance by conventional and *in vitro* techniques (1990-93)

U.K. Posselt and F. Altpeter
Universität Hohenheim, Stuttgart

Many *Fusarium* species are toxin producers, among which Deoxynivalenol (DON) is the most common one. *In vitro* selection using DON as a selective agent is carried out with callus cultures and suspension cultures of *Lolium perenne*. A bioassay to test seeds from progenies for toxin resistance was established. An *in vivo* test to screen for pathogen resistance is also available.

Using existing and new genetic variability for improved resistance to *Puccinia coronata* in *Lolium* spp. (1992-95)

Hans Lellbach
BAZ, Institut für Züchtungsmethodik, Groß Lüsewitz

Genetic variability of the disease resistance is analyzed and can be utilized by the plant breeders. Ecotypes, cultivars and other genetic material will be artificially infected with the pathogen under controlled conditions (temperature, air humidity and daylength). The intensity of infestation will be estimated.

Towards a standard allelic designation and a standard *Lolium* reference

F. Balfourier [1], ***M.D. Hayward*** [2], ***G. Degenaars*** [3] ***and F. Eickmeyer*** [4]
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[2] AFRC-IGER, Welsh Plant Breeding Station, Aberystwyth, UK
[3] Dept. of Systematics, Evolution and Paleobiology, Hugo de Vries Laboratory, Amsterdam, The Netherlands
[4] Institut fur Angewandte Genetik, 3000 Hanover, Germany
(Presented by Gilles Charmet)

Introduction

Isozymes offer a unique and simple method for the characterization of genetic variation and are applicable to many different forms of genetical studies. The value of isozymes as genetic markers for the characterization of variability in germplasm collections is widely recognized (Hayward and McAdam 1977; Brown 1978; Gottlieb 1981) and they have been applied for this purpose in several surveys of variation in the *Lolium* genus (Hayward 1985; Arcioni *et al.* 1988; Charmet and Balfourier 1994). For the information to be of general applicability to a species or group of organisms and to allow comparative results to be acquired between different laboratories, standard procedures need to be adopted. This will become of increasing importance as there is a need for more detailed characterization of genetic resources, particularly in establishment of core collections.

At an EC-sponsored workshop held in Amsterdam in spring 1992 to consider the characterization of variation in the *Lolium* genus, it became apparent that the participating research groups were not necessarily referring to the same genetic variant when considering a particular case of allelic variation. This clearly arose from the differences in the methods of assay of the specific isozymes and to the interpretation of the results observed.

As standardization of procedures and designation of loci/alleles was an important objective of the working group, a comparative test was carried out by the four laboratories. The following procedure was adopted.

Materials and methods

A number of plants of *Lolium perenne* were assayed by the French laboratory to identify different genotypes for at least 15 loci. Vegetative material of each of the 32 selected plants was distributed to the three remaining laboratories for them to assay as many isozymes as they routinely assess.

Isozymes were assayed by a number of different electrophoretic methods with the ubiquitous starch gel system being the most commonly applied owing to its ease of handling and its relative cheapness. Other methods which were also used include polyacrylamide gel electrophoresis (PAGE) and isoelectric focusing. Details of the principles underlying these methods can be found in the standard texts (Tanksley and Orton 1983; Soltis and Soltis 1989).

Results

The results of this exercise reavealed that except for some minor discrepancies, the majority of plants were each identified as having the same genotype by all four laboratories. In addition to the common set of seven isozyme loci characterized by this means, an additional 22 were assessed, in many cases by three of the four labs. The

isozyme genotype for 29 loci for a total of 32 plants has thus been determined.

As the requirements of an electrophoretic survey may vary according to the goal of the project, we do not propose to present a single standard protocol. It is, however, essential to arrive at a standard designation of the loci and alleles to be found at each locus.

While agreement in the comparative test at the locus level was consistent, discrepancies arose in allelic designation. In some cases, this was due to the fact that the different systems used in the four laboratories differ in their separation ability. As a consequence, for some enzymes a different number of allelic variants was found, thus resulting in a confusing designation.

Figure 1 shows an example of these differences in banding patterns and the designations given to the controlling alleles of the Pgi-2 locus. When Pgi-2 is separated on starch system S1 (= standard Tris-Citrate / Lithium-Borate system at pH=8.3), four distinctive bands may be found for homo- and heterozygous plants. Applying system S9 (S9, S7, S8 = standard Histidine / Citrate system at different pH) to the same plants may result in the separation of a single-banded homozygous cc phenotype into a heterozygous three banded phenotype generally designated cc* (Loos and Degenaars 1992). In Figure 1, the relationships between the resulting banding patterns of the different buffer and separation conditions for the examples are demonstrated by arrows. The distances between each band are relative. The absolute mobility of each allozyme separated in system X is different from that of the same allozyme in other buffer systems in system Y.

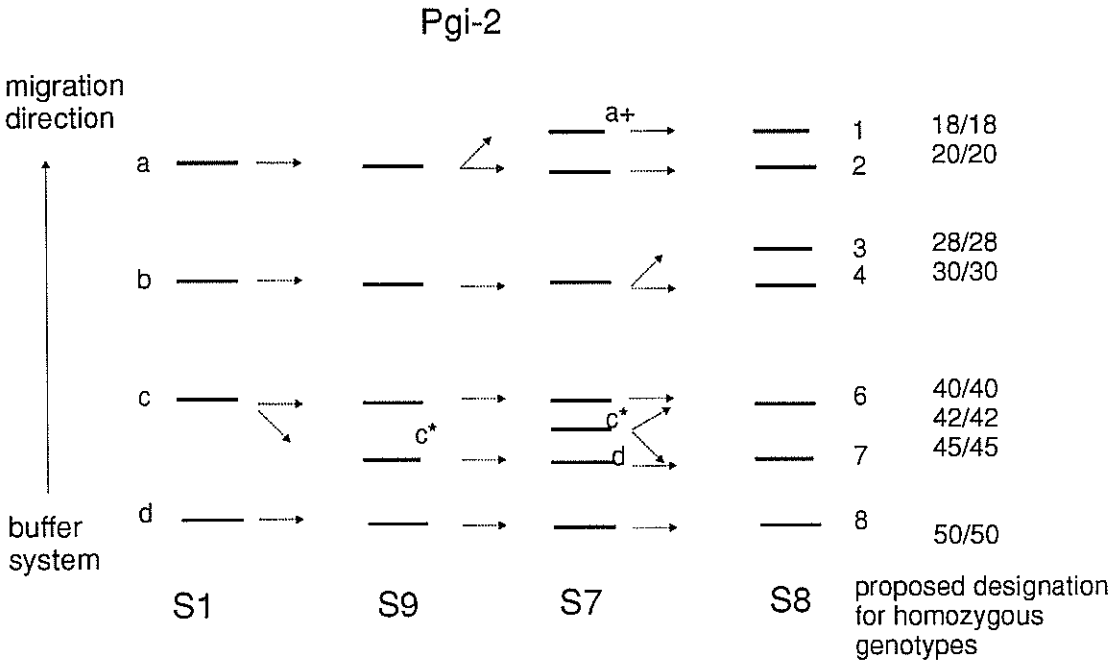

Fig. 1. Allelic separation at the Pgi-2 locus, according to various buffer systems

In order to overcome the confusion of the hitherto restricted alphabetic system for the designation of alleles, we propose a two-digit system for the labelling of alleles. The designations 10, 20, 30 etc. are restricted to genotypes that were consistently identified in our comparative test, and in general represent the widely recognized alleles at the

Table 1. Proposed designation of the genotype of the 32 studied plants (reference collection) for a common set of 15 loci

Plant no.	ACP 1	ACP 2	DIA 1	DIA 2	GOT 1	GOT 2	GOT 3	IDH 1	MDH 1	MDH 2	PGI 2	PGM 1	PRX 1	SDH 1	SOD 1
1	40/50		40/40		30/30	20/30	30/30		20/20		20/20	20/20	40/40		30/30
2		20/20	40/40		30/30	20/30	30/30		20/20			20/20	40/40		30/30
3	20/40	20/20	40/40		30/30	30/30	30/30	30/30	20/20		20/20	20/20	40/40		30/30
4	40/40	20/30	40/40		30/30	30/30	30/30	30/30	20/20		20/42	20/30	40/40		30/30
5		20/30	40/40	30/30	30/30	20/30		40/40	20/20		20/45	30/30	40/40	30/30	30/30
6	40/40	20/20	40/40	30/30	30/30		30/30	30/40	20/20	20/30	30/30	30/30	40/40	30/30	30/30
7	40/40	30/50	40/40	30/30	30/30	30/30	30/30	30/30	20/20	30/30	30/30	20/30	40/40		30/30
8	48/50	30/30	40/40	30/30	30/30	30/30	30/40	30/40	20/20		20/45	20/20	40/40		30/30
9	20/40	20/50	40/40	30/40	30/30	20/30	30/30		20/20	20/20	20/30	20/20	40/40		30/30
10	20/40	30/30	40/40		30/30	20/30	30/30	40/40	20/20		18/28	20/20	40/40		30/30
11	20/50	20/30	40/40		30/30		30/30	30/40	20/20		18/20	20/20	40/40		
12		20/30	30/40	30/30	30/30	20/30	40/50	40/40	20/20		20/28	20/30	40/40		
13	40/40	20/20	40/40		30/30	30/30	30/40	40/40	20/20		20/30	20/30	40/40		30/30
14		30/30	40/40		30/30		30/30		20/20				40/40		20/30
15	20/40	20/30	40/40		30/30	30/30		40/40	20/20		40/45	20/20	40/40		30/30
16		20/20	40/40		30/30	30/30		30/40	20/20		40/50	20/30			30/30
17			40/40		30/30	30/30			20/20			20/20	40/40		30/30
18			40/40		30/30	30/30	30/30	30/30	20/20			20/30	40/40		30/30
19		20/30	40/40		30/30	20/30	30/30	40/40	20/20		30/42	20/30	40/40	30/30	30/30
20		20/30	40/40		30/30	30/30	30/30	30/30	20/20		20/30	20/30	40/40		30/30
21	20/40	20/30	40/40	30/30	30/30		30/30	30/40	20/20		20/20	20/20	40/40		30/30
22		20/30	30/30		30/30		30/50	40/40	20/20		30/30	20/30	40/40		30/30
23	40/40	20/20	40/40		30/30		20/30	30/40	20/20		20/30	20/20	40/40		30/30
24		20/20	30/40		30/30		30/50	30/40	20/20		20/30	20/20	40/40		30/30
25	40/50	20/38	40/40		30/30			30/30	20/20		30/45	20/30	40/40		30/30
26	50/50	30/30	40/40		30/30	30/30		30/40	20/20		30/42	30/30	40/40		30/30
27	20/40	20/20	40/40		20/20		40/40	40/40	20/20		20/30	20/20	40/40	20/30	30/30
28			40/40		30/30		30/50	40/40	20/20		20/45	30/30	40/40		30/30
29		20/30	40/40				30/30	30/30	20/20		20/20	20/30	30/40		30/30
30		20/38	40/40		30/30		30/30	40/40	20/20			20/20	40/40	20/30	30/30
31			40/40		30/30	30/30	30/40	40/40	20/20		20/30	20/20	40/40	30/30	
32		20/20	30/40		30/30	20/30	30/40	30/40	20/20		20/30	20/20	40/40	30/30	20/30

relevant loci. This two-digit designation provides the possibility for the labelling of additional alleles whose products are revealed as bands that lie between the standards. For example for Pgi, a plant showing an allelic variant that migrates more slowly than the standard 'c' allele (coded 40/40 in our new designation) would be designated as 41/41 (or 40/41 in the heterozygous state) where the number given indicates the relative position of the new variant compared with the variants coded by 40 and 50.

To illustrate this system of designation, Table 1 gives genotypes of the 32 studied plants, for a common set of 15 loci.

Discussion and conclusion

To improve the utility of the various applications of the standard procedures and to compare results, it is proposed that a reference collection based upon that used in the current survey be established. Seed stocks of *Lolium* genotypes, homozygous for the different standard alleles, will be established and located at the genebanks of IGER, Aberystwyth, INRA, Clermont-Ferrand and CPRO, Wageningen. In addition, the reference collection of 32 plants will be maintained at Clermont-Ferrand and Hanover. Tiller material of specific designated genotypes will be made available on request to all reasearchers working with *Lolium* who wish to make comparisons of their material with the designated standards, without necessarily having to apply the same electrophoretic systems. This could be a major step forward for the international comparison and evaluation of genetic resources and the establishment of core collections.

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Research on forage genetic resources conservation in the Nordic countries

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Description of Nordic timothy varieties and local populations stored in the Nordic Gene Bank

The objective of this project is to describe the 370 timothy accessions stored in the Nordic Gene Bank. All the 370 accessions will be described in one location in each of the five Nordic countries. Each population/variety is tested as spaced plants (7 plants/1.5 m row) in two replicates. The varieties Engmo and Bilbo are used as control varieties and were planted 21 times each in each replication. The project started in 1994 and will end in 1996. The project is funded by Nordic Gene Bank.

Maintenance and seed increase of Nordic forage varieties and local populations stored in Nordic Gene Bank

In the 1970s and early 1980s a large number of local populations were collected in the Nordic countries. Some of these were stored directly in the Nordic Gene Bank. These populations had therefore usually a very limited amount of seed. The rest were seed increased once, before they were stored in the genebank. These accessions usually have larger amounts of seed with better fertility than the first group.

To improve on the conditions of our forage accessions we each year propagate about 100 accessions, that have either low fertility or little seed. The accessions are propagated mainly in the country of origin. The project is funded by the Nordic Gene Bank.

Research conducted in Poland relevant to forage genetic resources

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Plant Breeding and Acclimatization Institute

Department of Genetics, Laboratory of Plant Genetic Resources - Polish Gene Bank (Radzikow near Warsaw)
Name of research programmes:
- Long-term seed storage of crops and related wild species.
- Determination of sowing quality of seed stored in genebank.
- Development of the documentation of plant genetic resources and information exchange.
- Collection of wild ecotypes from Fabaceae family.

Department of Forage Crops - Laboratory of Grasses and Papilionaceus Plants (Krakow)
Name of research programme:
- Collection and evaluation of alfalfa initial materials for breeding purposes.
- Collection and evaluation of clover initial materials for breeding purposes.

Botanical Garden (Bydgoszcz)
- Collection and evaluation of ecotypes of selected grass species.

Variability of some selected features in red clover and alfalfa plant collections

A. Labza and R. Lutynska

Evident differences of red clover in the habitat, number of stems, height of plants, time to flowering, quantity of root nodules and 1000-seed weight were observed. Small differences in the degree of mildew appearance were noted. Results show also some tendency for higher Formononetin concentration in tetraploid cultivars. However, in ecotypes collected throughout Poland the Formononetin concentration in dry matter was considerably lower.

Evaluation of grasses in the collection of the Botanical Garden of PBAI in Bydgoszcz

W. Majtkowski

Investigation was carried out on 6256 accessions mainly from national and foreign expeditions. After the evaluation of 12 morphologic and phenologic traits, data concerning 4909 accessions were introduced into the computer documentation. On this basis 246 prospective ecotypes were noted to have traits important from an agricultural point of view. Nearly 1800 accessions were given to breeders.

The results of studies on the variation of ecotype characteristics of fodder grass in southeastern Poland

J. Jargiello and B. Sawicki

Ecotypes of *Dactylis glomerata* L., *Festuca arundinacea* Schreb., *Lolium perenne* L., *Phleum pratense* L. and *Poa pratensis* L. were gathered and evaluated in a field collection. The observations and measurements recorded were on yield, wintering, infestation with diseases, height of plants, inflorescence length, width and length of basal and flag leaf blades as well as phenology. Ecotypes collected constituted a rich source of variability. The obtained results allow us to state that collecting grass ecotypes of disappearing sites constitutes an appropriate way of obtaining valuble materials for breeding purposes.

Bank of seeds of the Botanical Garden of PBAI in Bydgoszcz

G. Zurek

The germination capacity of freshly harvested seeds and of those stored in a seedbank for 12 years proved that for 90% of samples, seed preparation and storage methods were efficient. Statistically significant decreases of germination capacity were observed in some samples related to the period 1977-81. This proves the necessity of continuing the investigation to separate samples designed for rejuvenation and to improve the methods of preparation and seed storage.

Reference

All above citations from:

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Research projects conducted in Portugal relevant to forages genetic resources

M.M. Tavares de Sousa
National Plant Breeding Station, 7351 Elvas Codex, Portugal

Institution	Project leader	Research
Estação Regional de Culturas Arvenses Direcção Regional de Agricultura de Entre Douro e Minho Quinta de S. José - S. Pedro de Merelim 4710 BRAGA Codex Tel:(351-53)621711 Fax:(351-53)621711	Violeta Rolim Lopes	- Collecting, conservation, utilization and breeding, mainly of *Lolium multiflorum*. - Characterization and evaluation
Estação Nacional de Melhoramento de Plantas Dept. of Forages, Pastures and Grain Legumes Apartado 6 7351 ELVAS Codex Tel:(351-68)622844 Fax:(351-68)629295	M.M. Tavares de Sousa	- Collecting, conservation, utilization and breeding, mainly of vetches, annual medics, subterranean clover, triticale for forages and oats for forages - Ecophysiology for cold and drought stress
Universidade de Évora Dept. of Phytotechniques Apartado 94 7001 ÉVORA Codex Tel:(351-66)22106 Fax:(351-66)711163	Mário de Carvalho	- Study of cultural systems with introduction of temporary pastures and annual forages
	J.M. Efe Serrano	- Study of quality and nutritional value of silage
	Ermelinda V. Lourenço	- Adaptation and physiological studies on pastures and forage crops
Estação Florestal Nacional Rua do Borja, 2 Tapada das Necessidades 1350 LISBON Codex Tel:(351-1)601661 Fax:(351-1)3973163	Eugénio Ferreira	- Selection and multiplication of *Rhizobium* strains for annual medics, lucerne, annual *Trifolium* and other legumes

Institution	Project leader	Research
	Nuno Costa	- Study of temporary and permanent pastures under *Quercus ilex* and *Quercus suber* mixtures and production. - Introduction of subtropical shrubs as forage species
Instituto Superior de Agronomia Dept. of Agriculture and Animal Production Tapada da Ajuda 1300 LISBON Tel:(351-1)3637824 Fax:(351-1)3635031	José Manuel F. Abreu	- Study of quality and nutrional value of forages and pasture crops. - Study of utilization of rough materials such as straw, by different animals (ruminants)
Estação Agronómica Nacional Dept. of Genetics and Plant Breeding Forages Section 2780 OEIRAS Tel:(351-1)4431505/4430442 Fax:(351-1)4420867	A.M. Dordio	- Study of the agronomic use of annual medics, utilization and seed multiplication of *Trifolium resupinatum*, fertilization of sown pastures in marginal lands, mainly with phosphate and potash
	D. Coelho Rebelo	- Introduction of exotic species in C_4 - *Setaria splendida* and others
Universidade de Trás-os-Montes e Alto Douro Dept. of Phytotechniques Dept. of Genetics and Biotechnology Apartado 202 5001 VILA REAL Codex Tel:(351-59)321631 Fax:(351-59)74480	Nuno T. Moreira	- Mixtures for hay or silage production (grasses and legumes), in different environments. - Studies of fertilization in "lameiros", natural pastures and sown pastures in the northern region
	Valdemar P. Carnide	- *Lolium* and *Festulolium* breeding for grazing or hay production - *Triticale* breeding for forage crop

Comparison between Belgian perennial ryegrass ecotypes and varieties

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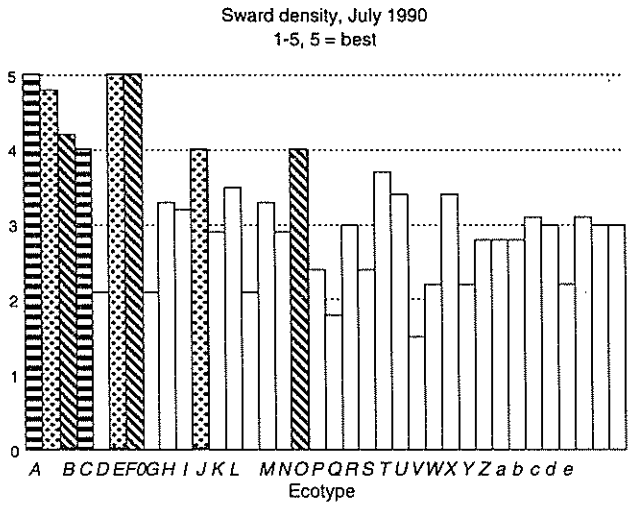
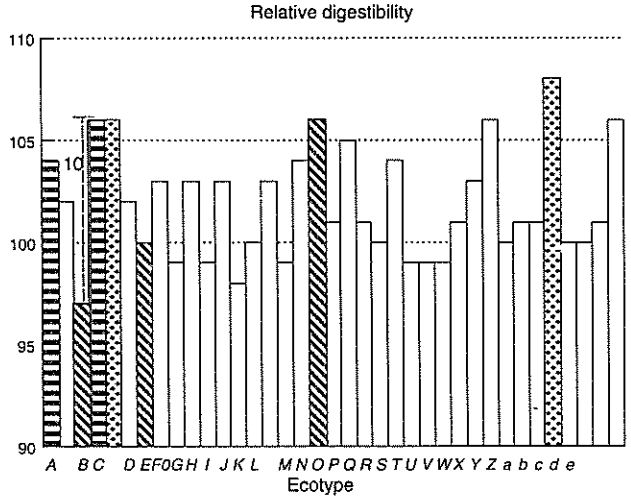
Summary
Ecotypes collected in old grassland were tested for yield performance, digestibility and persistence. Most ecotypes were inferior to the varieties but some origins have valuable characteristics.

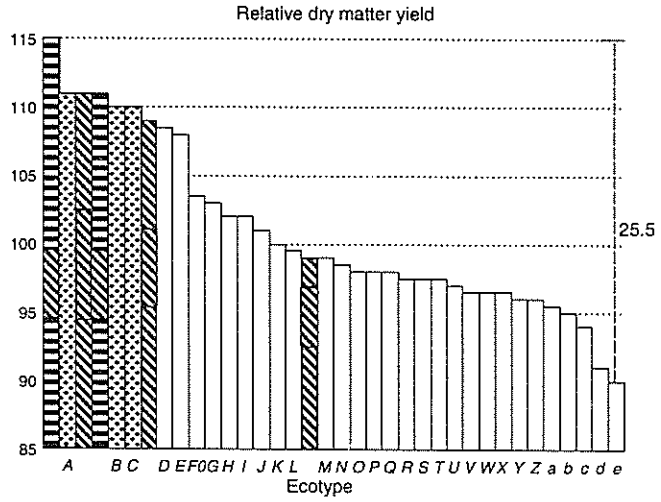
Introduction and methods
Natural grassland and 31 old pastures in the coastal province were surveyed in 1986 and 1987. The majority "had always been grassland" but some pastures had been sown more than 30 years ago.

About 100 core samples were taken in March/April, replanted in isolated plots at RvP and allowed to set seed. In the spring of 1988 a trial with these 31 ecotypes and 5 varieties was installed. Over 1988, 1989 and 1990, 10 cuts were taken. The digestibility of three cuts in the sowing year was analyzed. Regrowth, drought tolerance during the dry summers of 1989 and 1990 and persistence were scored.

Results







Discussion

1. Apart from a few exceptions (A, C), the persistence was unacceptably low. The sward density suffered after the first spring cut and weeds (which were rogued) introgressed.
2. Despite this low sward density, the yield performance of the better ecotypes did not decline.
3. The variation in digestibility was small. Ecotypes B and a look promising.
4. If it holds true that old pastures are well adapted to grazing, the selection of surviving plants out of these mowing trials should generate a useful breeding population.

Research projects conducted in the United Kingdom

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Methods of regeneration of *Lolium*

Start date: 1993. Duration: 5 years. In this project, the potential for the occurrence of genetic shifts on regeneration is being estimated. Differences in female contribution are measured by harvesting each mother separately. Differences in male contribution are estimated by daily observations on progress of anthesis in each plant. Consistency of these differences between years is being measured by repeating the same regenerations in successive years. Consequences for optimal regeneration methodology are being explored. There is a need to expand this project into a broader basis across different regeneration sites and conditions and different regeneration methodologies. A sample histogram of seed yields per mother plant is shown in Figure 1.

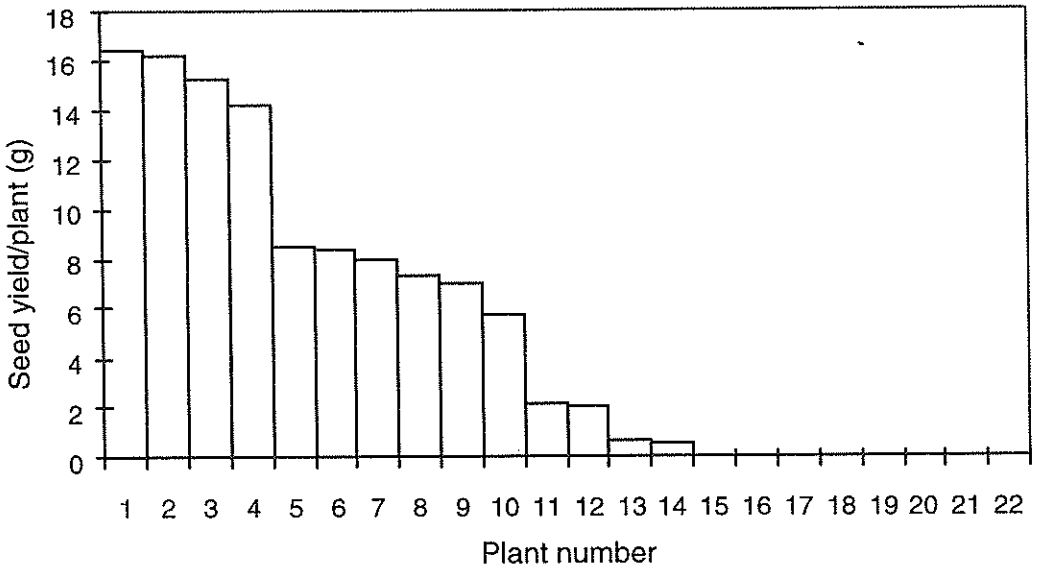

Fig. 1. 1991 multiplication of BA11446 (Poland)

Methods of regeneration of *Trifolium*

Start date: 1994. Duration: 5 years. This project is measuring patterns of cross-pollination in regeneration islands by means of (a) observation on bee flight patterns and (b) paternity analysis by isozymes. The aim is to establish the extent of non-randomness of cross-pollination and the consequences for optimal distribution of pots in regeneration islands.

Ecogeography of *Trifolium* species in Turkey

(jointly with Turkey, ICARDA and Univ. of Birmingham)

Start date: 1995. Duration: 3 years. This project will involve collecting, characterizing and evaluating populations of numerous species of *Trifolium* from contrasting habitats across

Turkey, together with collecting very detailed passport data. Intended outputs are improved taxonomy, improved ecogeographical distribution maps of species and improved field identification keys to the genus as well as ecogeographical analysis of patterns of genetic variation within species. Characterization and evaluation will be based on vegetative morphology, reproductive characteristics, and molecular analyses.

Genetic resources of *Trifolium* in Uruguay: comparison of native (*T. polymorphum*) and introduced (*T. repens*) species occupying the same sites

(jointly with INIA Uruguay)

Start date: 1995. Duration: 3 years. In Uruguay naturalized populations of *T. repens* coexist in the same fields as native *T. polymorphum*. This project will (a) assess the extent to which introduced *T. repens* has adapted to the local conditions of Uruguay, in particular to drought which is generally more severe than in most of the range of *T. repens;* and (b) assess whether the more drought-tolerant native *T. polymorphum* has potential to replace *T. repens* as the principal pasture legume of Uruguay.

Molecular characterization of *Lolium* and *Festuca*

A series of projects has been and is being undertaken by PhD students, characterizing *Lolium* and *Festuca* by molecular techniques, principally isozymes, RAPDs and RFLPs. AFLP and minisatellites technology is also being developed.

Studies on *Lathyrus*

Ongoing PhD projects at University of Southampton. Details not available.

In situ conservation

In situ conservation of genetic diversity in Turkey

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The flora of Turkey is very rich in diversity. It consists of some 9000 taxa, 30 % of which are endemic. Such an abundance in biodiversity can be attributed to having three major floristic regions: Euro-Siberian (Black Sea coast), Mediterranean (Aegean and Mediterranean coasts), and Irano-Turanian (Middle, East and Southeast Anatolia); and being centres of the origin, domestication and microgene.

Plants studied in this project are wild and weedy relatives, and landraces of cultivated crops such as cereals, forages, food legumes, industrial crops, vegetables, ornamental, fruits, nuts and grapes, medicinal and aromatic plants, endemic species.

The *in situ* project is an important part of the National Plant Genetic Resources Research Project, and will be applied for both agricultural and forest tree species in collaborative work with the Ministry of Agricultural and Rural Affairs, Ministry of Forestry and Ministry of Environment.

The objectives of the project are:

1. To identify and establish *in situ* conservation areas in Turkey for the protection of wild genetic resources originating in Turkey
2. To test and develop a new approach for conservation of genetic diversity
3. To provide sustainable *in situ* conservation of wild genetic resources.

Project components

1. Site surveys and inventories
2. Gene management zones
3. Data management
4. National plan for *in situ* conservation.

Survey and inventory sites and proposed gene management zones:

1. Kazdað in the northwest represents Euro-Siberian, Mediterranean and Irano-Turanian elements
2. Ceylanpýnar State Farm in the southeast represents Mediterranean and Irano-Turanian elements
3. Anatolian Diagonal in south and central Turkey represents Mediterranean, Irano-Turanian and Euro-Siberian elements.

The Aegean Agricultural Research Institute has responsibility for performing the project in Kazdað, and partly in Anatolian Diagonal. From an agricultural point of view, chestnut and plum have been specified as target species for Kazdað, and nine potential sites having the possibility of becoming gene management zones have been selected. Inventory studies will take place to make clear the ecogeographic ranges and environmental heterogeneity for target species. Initial survey studies have already started in Anatolian Diagonal, where common vetch will probably be one of the target species.

A database will be created for data management using a geographic information system. The national plan for *in situ* conservation will provide the foundation for review of the project, facilitate coordination and cooperation of gene management zones into other nature conservation strategies, and outline an implementation plan for continuing *in situ* conservation activities.

In situ conservation of forage legumes and grasses in Bulgaria

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During the first stage of the *in situ* consevation project for forage legumes and grasses, five habitats in four different floristic areas have been marked: Strandja, East and Midle Rhodopi, Rila and Vitosha. They were chosen according to the following requirements:

- existence of forage grass species diversity
- the area is not a part of a national reservation
- the history and the way it has been used could be determined (meadows, pastures, degree of grazing, irrigation, fertilization).

The habitats for *in situ* conservation in Bulgaria may be divided into two main groups:

1. Natural habitats unimproved by humans: pastures with long periods of interruption and single haymowing.
2. Natural habitats changed by humans: seminatural meadows with irrigation, fertilization and double or triple haymowing (without ploughing and aditional. sowing)

The areas for *in situ* conservation include places of different altitudes, from 280–710 m to 1150–1540 m, and hilly and semihilly closed valeys with small ravines. The habitats with typical mountainous topography are with steep and gentle slopes between spruce-fir and fir-tree forests. The diverse topography, soils and rocks and the existence of specific ecological spots have brought out the great diversity of species. Strandja and East Rhodopi are characterized by a mediterranean type of vegetation. The annual clover and alfalfa types constitute the plant communities in these areas (*Trifolium vesiculosum, T. cherleri, T. hirtum, T. echinatum, T. diffusum, Medicago minima*). Single plants of *Lupinus graecus* and *L. angustifolium* relating to the group of endangered species have been found in East Rhodopi.

The remaining three habitats include high mountainous parts (1150–1540 m) where grasses dominate over legumes, mainly perennial species. At the locality Yavora the cereal grasses are 58% of the total herbage, the prevailing species being *Andropogon grilus, Poa pratensis* and *Festuca fallax*.

At Vitosha grasses constitute 62% of the vegetation with the prevailing species being *Agrostis alba, Agrostis vulgaris, Phleum pratense, Festuca pratensis* and *F. rubra*. The legume grasses occupy 29% of the herbage and are mainly perennial clovers and vetch.

Of special interest for *in situ* conservation are the natural meadows in Rila with a long history of exploitation, more than 40 years.

Because of human intervention for improvement, the number of species has decreased and species with the same ecological requirements prevail, mainly *Trifolium repens, T. pratense, T. hybridum, Lolium perenne, L. multiflorum* and to a lesser degree *T. dubium* and *Lathyrus pratensis*. The ratio of legumes to cereals is 50%.

The areas for *in situ* conservation were determined according to the species diversity, their importance for the locality, degrees and ways of exploitation of the natural habitats. We find it expedient to include a habitat of the seminatural type, since the species association has been maintained naturally without additional sowing or ploughing for more than 40 years.

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Appendix II. ISO country codes used in this report

AUS	Australia
BEL	Belgium
BGR	Bulgaria
CAN	Canada
CHE	Switzerland
CSK	Czechoslovakia (former)
DDR	East Germany
DEU	Germany
DNK	Denmark
ESP	Spain
FIN	Finland
FRA	France
GBR	Great Britain
GRC	Greece
HUN	Hungary
IRL	Ireland
ISL	Iceland
ITA	Italy
JPN	Japan
NLD	Netherlands
NOR	Norway
NZL	New Zealand
POL	Poland
PRT	Portugal
ROM	Romania
RUS	Russia
SUN	Soviet Union
SWE	Sweden
TUR	Turkey
USA	United States of America
YUG	Yugoslavia

Appendix III. Institute codes used in this report

AUSADEL	Australian Medicago Genetic Resources Centre, Adelaide, Australia
AUSCSIRO	Commonwealth Scientific and Industrial Research Organization, Canberra City, Australia
BELCROGRVP	Rijkscentrum voor Landbouwkunding Ondrzoek, Rijksstation voor Plantenveredeling, Merelbeke, Belgium
BGRIIPR	Institute of Introduction and Plant Genetic Resources K. Malkov, Plovdiv, Bulgaria
CHERAC	Station Féderal de Recherches Agronomiques de Changins, Nyon, Switzerland
CSKPIEST	Research Institute of Plant Production, Piestany, Czechoslovakia
CSKRYZUNE	Research Institute of Plant Production, Praha, Czechoslovakia
CSKTROUBSK	Research and Breeding Institute for Fodder Plants, Czechnslovakia
CSKZUBRI	Research and Breeding Institute for Fodder Plants, Zubri, Czechoslovakia
CYPARI	Agricultural Research Institute, Nicosia, Cypress
DDRGAT	Zentralinstitut für Genetik und Kulturpflanzenforschung, Gatersleben, Germany
DEUGBRC	Zentralinstitut für Genetik und Kulturpflanzenforschung, Gatersleben, Germany
DEUIPK	Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK), Malchow/Poel, Germany
ESPINIALO	Servicio de Investigación Agraria, Badajoz, Spain
FRAINRAGVS	Institut National de la Recherche Agronomique, Guyancourt, France
FRAINRALUS	Centre de Recherches de Lusignan, Lusignan, France
FRAINRAMAG, FRAGVSMAG	Domaine Pluridisciplinaire du Magneraud, Surgères, France
FRAINRAMPG	Station d'amelioration des plantes, INRA, Montpellier, France
GBRRBG, GBRRBGK	Royal Botanic Gardens Kew, Haywards Heath, West Sussex, United Kingdom
GRCFCPI	Fodder Crops and Pastures Institute, Larissa, Greece
GRCTOBIN	Tobacco Institute of Greece, Drama, Greece
HUNRCA	Research Centre for Agrobotany, Tapioszele, Hungary
INDIARI	Indian Agricultural Research Institute, New Delhi, India
IRLAFT	An Foras Taluntais, Oak Park Research Centre, Carlow, Ireland
ISRIGB, ISRIGIB	Israel Gene Bank for Agricultural Crops, Bet Dagan, Israel
ISRNEVEYA	Newe Ya'ar Research Center, Haifa, Israel
ITAIDG	Istituto del Germoplasma, Bari, Italy
ITAIMGV, ITAIMGVPG	Istituto di Allevamento Vegetale, Perugia, Italy
ITAISCFL	Istituto Sperimentale per le Colture Foraggere, Cagliari, Italy
ITAPERUG	Faculty of Agriculture, University of Perugia, Perugia, Italy
MARHASSAN	Institut Agronomique et Veterinaire Hassan, Rabat, Morocco
POLIHAR	Plant Breeding and Acclimatization Institute, Radzikow - Warsaw, Poland
PRTENMP	Estaçao Nacional de Melhoramiento de Plantas, Elvas, Portugal
REGNGB, SWEREGNGB	Nordic Gene Bank, Alnarp, Sweden

ROMICCPT	Research Institute for Cereals and Industrial Crops, Fundulca, Romania
RUSVIR	N.I. Vavilov Research Institute of Plant Industry, St. Petersburg, Russia
TURARARI, TURARI, TURPGRRI	Aegean Agricultural Research Institute, Izmir, Turkey
USAPIO	Plant Introduction Office, Beltsville Agricultural Research Center, Beltsville, MD, USA
YUG, YUGB	Unidentified institutes in former Yugoslavia

Status of forages collections in Italy

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General information

The total number of samples/accessions of the forage plant collections stored (*ex situ*) in Italy is approximately 12 276 (Table 1, Fig. 1). Nearly 50% of them (5752) are stored at the IDG; another large collection (4516) is stored at the Experimental Institute of Cereal Crops of Bergamo; only about 10% (2017) are stored in six other Italian centres. The highest number of species and genera is that stored at the IDG (64 and 17 respectively) and that stored at the Plant Breeding Centre of Studies of Perugia (15 and 12 respectively). The other six institutes store very few species and genera (from 1 to 3). There are certainly many other institutes and centres storing and/or maintaining forage crops, but so far they have not answered the questionares. This is not due to lack of willingness to cooperate but mainly to lack of funds, personnel, organization, adequate information and experience in the field of genetic resources. One point which should never be ignored is that any single operation needs time, people, energy and therefore funds. The southern part of Italy certainly needs many more researchers than northern Italy. The Italian government is aiming to improve the situation. In this context the IDG, jointly with other centres and Universities, is dedicating a lot of time to train new and young graduates in the field of plant genetic resources.

Table 1. Collections of forage plants in Italy

Institute	Number of genera	species	samples
Germplasm Institute CNR, Bari	17	64	5752
Experimental Institute of Cereal Crops, Bergamo	1	1	4516
Department of Agrobiotechnology, National Agency for Atomic Energy, CRE Casaccia (Roma)	3	3	750
Experimental Institute of Cereal Crops, Fiorenzuola d'Arda (Piacenza)	1	1	600
Plant Breeding Centre of Studies, Faculty of Agriculture, Perugia	12	15	323
Experimental Institute of Cereal Crops, Montanaso Lombardo (Milano)	1	1	302
Dekalb Research Centre, Chiarano (Treviso)	1	1	25
Agronomy Institute, Faculty of Agriculture, Pisa	1	1	8
Total	37	87	12,276

Forage plant collections at the IDG (Germplasm Institute, Bari)

If with the most recognized and cultivated forage crops one includes wild and related species, the number of accessions stored at the IDG is higher than that reported in Table 1. In fact, the IDG is storing 9693 accessions (samples) of forage plants, of which 2292 are Gramineae (Table 2) — including more than 15 genera and 82 species — and 7401 are Leguminosae (Table 3) — including 15 genera and 206 species. Most of the accessions have a different country of origin (from 1 to 56). The genera with the highest number of species are *Vicia, Vigna, Trifolium, Medicago, Lathyrus, Secale, Phalaris, Agropyron, Festuca, Lolium* and *Sorghum*. The genera with the highest number of accessions are *Vicia, Medicago, Vigna, Trifolium, Lathyrus, Hedysarum, Secale, Sorghum, Lolium, Triticale, Dactylis, Phalaris, Dasypyrum* and *Festuca*.

Table 2. Forage plants at the IDG Bari (Gramineae database)

Genus	Number of		
	accessions	species	origins [‡]
Agropyron	80	7	4
Brachypodium	21	4	3
Bromus	13	4	7
Dactylis	224	1	6
Dasypyrum	151	1	3
Eragrostis	12	1	2
Festuca	131	6	5
Lolium	313	6	11
Panicum	94	2	7
Pennisetum	53	3	4
Phalaris	158	8	8
Phleum	23	2	6
Secale	382	12	11
Sorghum	341	6	11
Triticale	264	1	12
Others [†]	32	18	12
Total	2292	82	—

[†] *Agrostis, Alopecurus, Cynodon, Cynosurus, Eleusine, Elymus, Holcus, Koeleria, Lagurus, Melica, Milium, Poa, Polypodon, Setaria, Stipa, Vulpia.*

[‡] Number of countries from which accessions were acquired.

Table 3. Forage plants at IDG Bari (Leguminosae database)

Genus	Number of		
	accessions	species	origins †
Anthyllis	1	1	1
Astragalus	1	1	1
Dorycnium	15	2	1
Hedysarum	149	4	3
Lathyrus	299	15	18
Lotus	38	3	2
Medicago	1159	23	8
Melilotus	13	4	4
Onobrychis	46	2	1
Psophocarpus	1	1	1
Scorpiurus	36	3	4
Trifolium	488	28	10
Trigonella	88	3	8
Vicia	4115	66	56
Vigna	952	50	54
Total	7401	206	—

† Number of countries from which accessions were acquired.
Source: Germplasm Institute, CNR, Bari, Italy.

Collecting activities in Italy since 1991

Since 1991 the IDG in collaboration with the IPK of Gatersleben, and international organizations such as IBPGR (today IPGRI), has organized several expeditions for collecting genetic resources in Italy and Albania. None of them was an oriented mission for collecting forage plants. Even so, from 1991 to 1994, a total of 124 samples was collected (Table 4). The samples collected belong to 15 genera, mostly *Secale, Avena, Vicia, Lathyrus, Vigna, Sorghum* and *Medicago*. Only a few samples were collected for the other genera.

Table 4. Forage plants collected by IDG Bari in Italy and Albania

Genus	1991	1992	1993	1994	Total
Avena	2	—	13	5	20
Agropyron	—	—	2	—	2
Dasypyrum	—	—	4	—	4
Lathyrus	1	5	8	2	16
Lolium	—	—	—	1	1
Medicago	1	—	2	4	7
Onobrychis	1	—	—	—	1
Panicum	1	—	—	—	1
Phleum	—	—	1	—	1
Secale	6	1	2	12	21
Sorghum	1	1	3	6	11
Trifolium	3	—	2	1	6
Trigonella	1	—	—	2	3
Vicia	3	3	7	5	18
Vigna	2	3	2	5	12
Total	22	13	46	43	124

Source: Germplasm Institute, CNR, Bari, Italy.

Needs for the future

More efforts should be made to have more information on the number of institutes or centres storing or mantaining forage crops and/or plants. If possible, a national network should be established to rationalize the collections and promote exchange of materials for better management, characterization, utilization, documentation and conservation. A national project to reach these objectives has been prepared by the Germplasm Institute of Bari, jointly with other institutions, and submitted to the attention of the National Research Council of Italy. The project has been titled GERMNET.

In the future, germinability tests should be carried out to estimate seed viability of those accessions that were never distributed and utilized. In the last TCC meeting (fifth meeting) of ECP/GR in August 1993, the Forages Working Group suggested guidelines to set up core collections for *Lolium perenne* and to continue collecting of forage genetic resources throughout Europe. The working group also provided an inventory of tasks, not completed, among which was the establishment of core collections. Within this context the creation of a core collection could be suggested for some important species of *Vicia* (excluding *faba*).

Status of national forages collections in the Nordic Countries (Denmark, Finland, Iceland, Norway and Sweden)

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Table 1. Forage species maintained at the Nordic Gene Bank, 1995

Species	No. of accessions
Agrostis spp.	218
Bromus spp.	32
Dactylis spp.	239
Festuca spp.	570
Lathyrus spp.	1
Lolium spp.	166
multiflorum	(22)
perenne	(141)
Medicago spp.	31
Phleum spp.	422
Poa spp.	360
Trifolium spp.	467
pratense	(300)
repens	(106)
Total	2506

Table 2. Status of the forage collection at the Nordic Gene Bank (25 March 1995)

	Varieties	Landraces	Collected	Breeding lines	Total
Mixture	0	0	2	0	2
Agrostis canina+cap.	0	0	1	0	1
Agrostis capillaris	8	1	177	2	188
Agrostis cap+stolon	0	0	1	0	1
Agrostis gigantea	1	0	0	1	2
Agrostis stolonifera	3	0	17	1	21
Agrostis tenuis	0	3	0	0	3
Alopecurus pratensis	0	3	24	1	28
Bromus arvensis	2	0	0	0	2
Bromus benekeni	0	0	1	0	1
Bromus commutatus	0	0	1	0	1
Bromus inermis	3	0	22	0	25
Bromus ramosus	0	0	1	0	1
Bromus rigidus	0	0	2	0	2

	Varieties	Landraces	Collected	Breeding lines	Total
Bromus secalinus	0	0	2	0	2
Calamagrostis purp	0	0	2	0	2
Cynosurus cristatus	1	0	1	0	2
Dactylis ascherson	0	0	1	0	1
Dactylis glomerata	31	1	201	5	238
Danthonia decumbens	0	0	1	0	1
Deschampsia caespit	0	1	2	0	3
Deschampsia flexuosa	0	0	7	0	7
Festuca	0	0	1	0	1
Festuca arundinacea	1	0	17	0	18
Festuca ovina	1	0	23	0	24
Festuca pratensis	31	2	97	2	132
Festuca rubra	36	1	346	7	390
Festuca trachyphylla	3	1	1	0	5
Holcus mollis	0	0	1	0	1
Lolium multiflorum	22	0	0	0	22
Lolium perenne	52	4	77	8	141
Lolium remotum	0	0	1	0	1
Lolium temulentum	0	0	1	0	1
Lotus corniculatus	1	0	0	0	1
Medicago lupulina	5	1	0	0	6
Medicago sativa	24	1	0	0	25
Phalaris arundinacea	1	2	45	2	50
Phleum alpinum	0	0	17	1	18
Phleum pratense	40	96	259	9	404
Poa alpina	0	0	1	1	2
Poa chaixii	0	0	1	0	1
Poa palustris	1	0	1	0	2
Poa pratensis	39	9	292	10	350
Poa pratensis+palust	0	0	1	0	1
Poa supina	0	0	1	0	1
Poa trivialis	3	0	0	0	3
Trifolium alexandri	1	0	0	0	1
Trifolium balansae	1	0	0	0	1
Trifolium campestre	0	0	1	0	1
Trifolium hybridum	13	0	27	3	43
Trifolium incarnatum	1	0	0	0	1
Trifolium medium	0	0	3	0	3
Trifolium pratense	57	129	113	1	300
Trifol.prat+Phle.prat	0	7	1	0	8
Trifolium repens	24	3	79	0	106
Trifolium resupinatum	1	0	0	0	1
Trifolium spadiceum	0	0	2	0	2
Vicia cracca	0	0	1	0	1
Total	407	265	1876	54	2602

Nordic institutions interested in participating in evaluation of core collections

The institutions listed here are interested in participating in the evaluation of European core collections. Each institution must, however, decide for each species in question, if the necessary resources are available and/or whether the institution has some general interest in the species. All the institutions listed are cooperating with the Nordic Gene Bank, which is coordinating the work on forage genetic resources in these countries.

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Status of national forages collections in Poland

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Detail of forage collections in Poland (March 1995)

Genus and species	Advanced cultivars, breeder's lines	Primitive cultivars, landraces	Wild (semi-natural) ecotypes	Total
Agrostis alba	4	-	-	4
Agrostis stolonifera	2	-	-	2
Agrostis tenuis	18	-	-	18
Alopecurus pratensis	3	-	-	3
Anthylis vulneraria	-	3	-	3
Bromus inermis	9	-	91	100
Dactylis glomerata	44	-	5838	6010
Festuca arundinacea	18	-	682	837
Festuca heterophylla	1	-	-	1
Festuca ovina	14	-	-	14
Festuca pratensis	34	-	3362	3428
Festuca rubra	70	-	-	70
Lolium hybridum	16	-	-	16
Lolium multiflorum	63	-	-	63
Lolium perenne	39	-	2082	2176
Lotus corniculatus	1	7	121	129
Lotus uliginosus	-	4	76	80
Medicago lupulina	1	-	-	1
Medicago sativa	8	-	-	8
Medicago varia	11	-	-	12
Melilotus albus	1	-	-	1
Melilotus officinalis	-	-	-	1
Onobrychis viciaefolia	4	10	-	14
Phalaris arundinacea	2	-	-	2
Phleum pratense	41	-	2427	2468
Poa compressa	1	-	-	1
Poa nemoralis	2	-	-	2
Poa pratensis	64	-	2233	2329
Poa trivialis	1	-	-	1
Trifolium alexandrinum	1	-	-	1
Trifolium hybridum	3	-	-	3
Trifolium incarnatum	1	-	-	1
Trifloium pratense	82	22	-	106
Trifolium repens	31	-	-	31
Total	585	46	16912	17936

Forage collecting activities in Poland (1993-94)

1993

Department of Forage Crops of PBAI - Krakow

Region Southwest part of Krakow district
Species collected - 5 samples of *Trifolium pratense*

Region South part of Sieradz disrict, middle part of Czestochowa district, east part of Katowice district
Species collected - 13 samples of *Trifolium pratense*

Region Southwest part of Bielsko - Biala district
Species collected - 13 samples of *Trifolium pratense*

Region West part of Nowy Sacz district, southeast part of Bielsko, Biala distict
Species collected - 10 samples of *Trifolium pratense.*

Botanical Garden of PBAI - Bydgoszcz

Region East part of Poland, Lomxa and Lublin district
Species collected - 198 samples of: *Agrostis alba* (2), *A. canina* (1), *A. stolonifera* (3), *A. tenuis* (6), *Alopecurus pratensis* (1), *Arrhenatherum elatius* (2), *Bromus inermis* (7), *Cynosurus cristatus* (4), *Dactylis aschersoniana* (1), *D. glomerata* (13), *Festuca arundinacea* (3), *F. capillata* (2), *F. ovina* (2), *F. pratensis* (8), *F. rubra* (36), *Holcus lanatus* (9), *Lolium perenne* (35), *Phalaris arundinacea* (3), *Phleum pratense* (15), *Poa compressa* (1), *P. nemoralis* (1), *P. palustris* (1), *P. pratensis* (41), *Trisetum flavescens* (1).

1994

Department of Genetics, Laboratory of Plant Genetic Resources - Polish Gene Bank (Radzikow) and Research Institute of Vegetable Crops - Skierniewice

Region Northeast part of Poland (Suwalki district)
Species collected - *Trifolium pratense* (2).

Department of Genetics, Laboratory of Plant Genetic Resources - Polish Gene Bank (Radzikow)

Region Southeast part of Poland (Kielce and Przemysl districts)
Species collected - *Anthylis vulneraria* (2), *Medicago sativa* (3), *Onobrychis viciaefolia* (2), *Ornithopus sativus* (2), *Trifolium pratense* (2).

Department of Forage Crops of PBAI - Krakow

Region Warszawa and Lublin district (Pilawa, Ryki etc.)
Species collected - *Trifolium pratense* (2), *T. repens* (4).

Region Olkusz (Katowice district)
Species collected - *Festuca* spp. (30).

Botanical Garden of PBAI - Bydgoszcz

Region South part of Poland (Nowy Sacz district, Pieniny and Tatra mountains)
Species collected - 113 samples of: *Agrostis alba* (1), *A. canina* (1), *A. stolonifera* (1), *A. tenuis* (2), *Alopecurus pratensis* (2), *Cynosurus cristatus* (5), *Dactylis glomerata* (19), *Festuca arundinacea* (3), *F. ovina* (1), *F. pratensis* (13), *F. rubra* (17), *Holcus lanatus* (2), *Lolium perenne* (12), *Phalaris arundinacea* (2), *Phleum pratense* (8), *Poa compressa* (3), *P. nemoralis* (1), *P. palustris* (1), *P. pratensis* (18), *Trisetum flavescens* (1).

Status of forages collections in Portugal: Conservation, characterization, evaluation, documentation, regeneration and use

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Introduction

Pastures and forages are an important economic and production factor in Portugal. With a livestock population of 1,370,000 cattle, 5,847,000 sheep and 862,000 goats, the country devotes 838,000 ha to permanent pastures (FAO 1992). According to Dordio (1988) and estimating the areas to be used in temporary pastures we have a total of 1,682,000 ha with temporary pastures (winter, dryland and irrigated pastures). In total, the area occupied by permanent and temporary pastures can be estimated to be 2,520,000 ha.

Cereal production has been given, up to now, the main emphasis in the agricultural policy, encouraged through the attribution of subsidies and, therefore, cereal farming has expanded over unsuitable soils (shallow, stony or even skeletal) resulting in very low yields. This situation is not sustainable and the land use has to be rethought. Most of the unsuitable land for cereals could revert to permanent or temporary pastures (Tavares de Sousa 1994). The Portuguese scientific community working in forages has to be prepared for these changes in the production system. Pastures and forages genetic resources will play an important role.

There is an urgent need to collect, study, preserve and use the enormous wealth of pastures and forages genetic resources in Portugal's continental and Atlantic territories.

The need for a well-established coordinating mechanism for plant genetic resources has been felt for quite some time and the National Institute for Agricultural Research (INIA) is committed to instituting a functional coordination which will allow a rationalization of efforts and effective and sustainable use of our biodiversity. Several meetings were held and a proposal for a coordinating mechanism was approved; the institutionalization is expected soon.

Status of collections

Conservation

To date, seven collections were identified holding a total of 2691 accessions. Tables 1 to 6 show the number of accessions, by species, held in each collection. All collections but one are maintained in good to acceptable conditions, three under long-term seed storage (-18°C to -16°C), two under medium-term (+3°C to +10°C) and one under short-term (ambient temperatures). Packaging is also acceptable, varying from plastic bags to aluminium laminated packets.

Characterization and evaluation

A collection not yet characterized and evaluated is like a hidden treasure: it is rich but we do not know how rich it is! Characterization and evaluation add an enormous value to a sample. The exact knowledge of what a sample is and what agronomic potential worth it has makes it more readily useful to the users. Therefore, four of the seven collections are under ongoing characterization and evaluation work.

Table 1. Forages germplasm conservation, characterization and evaluation at Estação Regional de Culturas Arvenses[†]

Species	Total no. samples	Characterization			Evaluation		
		No. samples	No. characters	Descriptor list	No. samples	No. characters	Descriptor list
Dactylis glomerata	22	10	15	IPGRI	10	10	IPGRI/UPOV /OEC
Lolium multiflorum	74	38	15	IPGRI/OEC/ UPOV	38	10	IPGRI/UPOV /OEC
Ornithopus sativus	2	1	15	IPGRI			
Holcus lanatus	8						
Lathyrus tingitanus	1						
Lolium perenne	1						
Medicago spp.	2						
Ornithopus compressus	9						
Ornithopus spp.	2						
Plantago lanceolata	1						
Trifolium campestre	1						
T. glomeratum	4						
T. incarnatum	3						
T. repens	2						
Trifolium spp.	2						
Total	134						

[†] Department of Plant Selection, Quinta de S. José, S. Pedro de Merelim, 4700 Braga. Curator: Violeta Lopes.

Table 2. Forages germplasm conservation, characterization and evaluation at the Estação Nacional de Melhoramento de Plantas[†]

Species	Total no. samples	Characterization			Evaluation		
		No. samples	No. characters	Descriptor list	No. samples	No. characters	Descriptor list
Medicago spp.	375	375	7	IPGRI	73	3	
Ornithopus spp.	28	30	6	IPGRI			
Scorpiurus spp.	3	1		IPGRI			
Trifolium subterraneum	387	256	20	IPGRI			
Trifolium spp.	183	24	7	IPGRI			
Bromus spp.	7						
Dactylis spp.	101						
Festuca spp.	28						
Holcus spp.	12						
Lathyrus spp.	74						
Vicia spp.	146						
Total	1344						

[†] Section of Pastures and Forages, Department of Forages, Pastures and Grain Legumes, Apartado 6, 7351 Elvas Codex. Curator: João Carneiro.

Table 3. Forages germplasm conservation, characterization and evaluation at the Estação Agronómica Nacional[†]

Species	Total no. samples	Characterization			Evaluation		
		No. samples	No. characters	Descriptor list	No. samples	No. characters	Descriptor list
Lathyrus spp.		1		Nat. Var. Catalogue	1		Nat. Var. Catalogue
Trifolium alexandrinum	38	2		Nat. Var. Catalogue	2		Nat. Var. Catalogue
Trifolium spp.		2		Nat. Var. Catalogue	2		Nat. Var. Catalogue
Vicia spp.		3		Nat. Var. Catalogue	3		Nat. Var. Catalogue
Lathyrus articulatus	8						
L. arvensis	2						
L. cicera	4						
L. clymenum	1						
L. ochrus	8						
L. sativus	4						
L. tingitanus	1						
Trifolium resupinatum	10						
Vicia benghalensis	25						
V. ervilia	4						
V. lutea	4						
V. narbonensis	10						
V. sativa	100						
V. villosa	50						
Total	269						

[†] Forages Breeding Section, Department of Genetics and Breeding, 2780 Oeiras. Curators: A. Dordio, D. Coelho Rebelo.

Table 4. Forages germplasm conservation, characterization and evaluation at the Universidade de Trás-os-Montes e Alto Douro (UTAD)[†]

Species	Total no. samples	Characterization			Evaluation		
		No. samples	No. characters	Descriptor list	No. samples	No. characters	Descriptor list
Dactylis glomerata	45	40	15	IPGRI	40	5	
Festulolium	15	23	12	IPGRI			
Festuca arundinacea	8						
Lolium multiflorum	7						
Lolium perenne	12						
Total	87						

[†] Department of Genetics and Biotechnology, Apartado 202, 5001 VILA REAL Codes. Curator: Valdemar P. Carnide.

Table 5. Forages germplasm conservation at the Portuguese Plant Germplasm Bank (BPGV)†

Species	No. of samples
Bromus spp.	13
Dactylis spp.	122
Festuca spp.	63
Lathyrus sylvestris	2
Lathyrus spp.	38
Lolium multiflorum	44
Lotus corniculatus	4
Medicago spp.	126
Ornithopus spp.	13
Panicum miliaceum	10
Plantago lanceolata	1
Scorpiurus vermiculatus	4
Trifolium spp.	306
Vicia sativa	14
Total	760

† Quinta dos Peões, Gualtar - 4700 Braga. Director/Curator: Rena M. Farias.

Table 6. Forages germplasm conservation at the Engineering Instituto Superior de Agronomia†

Species	No. of samples
Bromus diandrus	1
Plantago lanceolata	1
Vicia spp.	30
Total	32

† Department of Botany and Biological, Tapada da Ajuda, 1399 Lisboa Codex. Curators: M. Lisete Caixinhas, Maria Teresa Carvalho Vasconcelos.

Documentation

When referring to plant genetic resources it is not difficult to justify the importance of its documentation. Therefore, if characterization and evaluation are indispensable, documentation is crucial for the proper management of collections and to promote the sustainable use of plant genetic resources.

Although the conservation, characterization and evaluation of the Portuguese forages germplasm collections are acceptable the same cannot be said for their documentation. Most collections are manually documented except for one which has passport data computerized and another that has the characterization and evaluation data computerized and passport data manually documented.

Documentation is, undoubtedly, an area where much attention has to be given. Without a proper documentation system the management, use of the collections and the flow of information are hampered.

Regeneration and use

Although the importance of maintaining accessions' viability as high as possible is unquestionable, not only because of the costs it entails but as well as to limit the loss of genetic diversity, to avoid genetic erosion or genetic changes in the seeds, the time comes when viability declines or seed stocks fall below acceptable quantity, and therefore the need for regeneration arises.

As not many data are available on the regeneration of collections a realistic assessment of the status of this activity cannot be made. The only data available report the regeneration of 11 accessions of a species in one collection.

Two main goals can be identified that justify the collecting, study and maintenance of a germplasm collection: the preservation of the biodiversity, and its sustainable use.

Portuguese breeders have long perceived such importance and if sometimes the first goal, to preserve the biodiversity, was not met, as some valuable collections were irremediably lost, this was due to a different approach on the use of germplasm, dictated, at earlier times, by the immediacy of its usefulness without the preoccupation of an integrated programme anticipating the sustainable use and the preservation of the biodiversity as a legacy for the benefit of present and future generations.

Table 7 summarizes the use of germplasm showing the genus and the released varieties identified by its commercial names.

Table 7. Forages germplasm use in Portugal

Institute	Species	Cultivar
Department of Plant Selection, Estação Regional de Culturas Arvenses, Braga	*Lolium multiflorum*	Bragelim †
Department of Forages, Pastures and Grain Legumes, Estação Nacional de Melhoramento de Plantas, Elvas	*Lathyrus cicera*	Grão de Gramicha
	Vicia benghalensis	Ervilhaca das Fontainhas
	V. sativa	Ervilhaca da Piedade
		Ervilhaca Gil Vaz
	V. villosa	Ervilhaca das Amoreiras
Department of Genetics and Breeding, Estação Agronómica Nacional, Oeiras	*Lathyrus cicera*	Cacém
	L. clymenum	Bugio
	L. ochrus	Pombal
		Barra
		Negrito
	Trifolium alexandrinum	Belém
		Gigante da Lage
	T. resupinatum	Maral
		Resal
	Vicia benghalensis	Lage
	V. sativa	Barril
	V. villosa	Casal

† Not yet commercialized.

Conclusions

There is certainly a need for more collecting of forages and pastures genetic resources in the country. However, the strategies for the collecting activities should be drawn from the analysis of the passport data of the existing accessions in order to maximize the meagre financial and human resources available. This collecting should serve as gap-filling or for specific characters or areas.

Conservation methodologies, although acceptable, should be monitored in the light of the FAO's proposed Genebank Standards and corrected when and where appropriate. Characterization and evaluation of the biodiversity already preserved in germplasm collections in the country should be fostered in order to facilitate and promote the use, in a sustainable manner, of the available genetic resources. Documentation is of paramount importance for success in the use of plant genetic resources. It is necessary to document what characteristics an accession has in order to make it useful and available to users. Documentation of the existing collections has to be promoted in the form of standard and compatible formats, therefore facilitating the use of germplasm and the exchange of related data.

Regeneration is an inevitable activity in the management of germplasm collections. It is an extremely important activity upon which the integrity and the availability of a collection depends. Resources must be allocated for the timely and properly regeneration of collections in order to have fresh seed samples to make them available for the users. Whereas the investment in the conservation and study of plant genetic resources in Portugal has been very scarce and without constancy, it has paid off very well. In Portugal, at least 20 varieties directly derived from autochthonous germplasm have been commercialized and one will be very soon, besides the varieties commercialized in other countries as is the case with clover and lupins.

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Resources of perennial forage at the All-Russian Research Institute of Plant Industry (VIR)

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Crop introduction activities on a regular basis were initiated in Russia in 1922. That year has been regarded as the starting point of extensive research on forage crops. During the period from 1970 to 1994, the Institute's Department of Forage Crops in cooperation with the staff of Experiment Stations organized 138 perennial forage plant germplasm collecting missions within the territories of C.I.S. In 1969, the research and experimental network of VIR incorporated permanent regional collecting missions: the European, Siberian, Far Eastern, Kazakhstan and Middle Asian ones. Before that, the Institute was launching two explorations each year on average, but after the establishment of permanent missions their annual number increased to 5-6 germplasm explorations.

During the abovementioned period 11 038 accessions of forage crops were added to the Institute's collection. The largest number of plant samples was collected by the teams of the European (3912 accessions), Kazakhstan (3298 accessions) and Siberian (2225 accessions) missions.

Beginning in 1969, the Department of Forage Crops worked on establishing anew and replenishing the existing collections of unconventional forage crops. With this, the clover collections became 2.5 times larger, while the collection of arid grasses became 3 times larger and was enriched by introducing new drought-resistant crops (*Psathyrostachis juncea, Elymus* L., *Leimus* Hochst., etc.). The Department founded new collections of desert plants (*Haloxylon, Calligonum, Ceratoides, Kochia, Salsola* and other forage plants); new silage plants (*Symphytum, Polygonum, Silphium perfoliatum* L., *Isatis, Rhaponticum carthamoides* (Willd), etc.); rare leguminous and other plants (*Astragalus* L., *Galega orientalis* Lam., *Hedisarum, Antillis, Malva, Amaranthus*, etc.).

With the development of plant breeding, even from the 1920s, the demand for initial plant breeding materials for forage crop breeding abruptly increased. Utilization of plant germplasm in breeding practice never was and still is not the same for different groups of forage plants. The higher the breeding level and the more ancient the crop, the greater is the degree of involvement of the VIR's global collection in breeding practice and the more numerous are the cultivars bred on the basis of its accessions (Table 1). The rate of participation of the collection accessions in breeding processes is quite low in the areas of modern agricultural reclamation (northeastern Siberia, Far East, etc.), especially in newly introduced species, the cultivars of which have been bred from local populations by simple methods, though quite efficient and well-justified at the present moment. Thus, the collection utilization rate in forage cultivar breeding makes up 56.0% for the whole analyzed period. However, in the new cultivars commercialized during the last 10 or 15 years the percentage of utilization of the collections of major crops is 60-70%, while for some crops, such as alfalfa, this rate approaches 100% (of the number of breeding cultivars). As for unconventional crops (*Galega orientalis, Elymus, Agropyron, Psathyrostachis juncea, Silphium perfoliatum*, etc.), such cultivars are quite few (25%).

In 1944, the structure of the collection accessions was as follows: almost 2/3 of the collection (62%) consisted of wild samples, 10.5% of local varieties, and 27.5% of breeding cultivars (Table 2). In the process of plant introduction, the specific composition of the perennial forage crop collection has been constantly enriched. The study of perennial grasses was started with 11 forage plant species. In 1990, in the VIR's genebank there were 481 species of legumes, grasses, large grasses, desert grasses, semi-shrubs and small

semi-shrubs. Of all this diversity, not more than 25 or 30 species have been intensively utilized in this country. For example, only three species of leguminous forage crops are reported to occupy large agricultural areas (*Medicago sativa* and *M. varia*, *Trifolium pratense*). Nine more species are well known but have been used on a limited scale (*Onobrychis*, *Lotus*, *Trifolium repens*, Swedish clover, *Medicago falcata*). The situation with perennial grasses is similar; only six species are widely used in crop production. All this is enough evidence of the fact that the major part of the species stored in the collection are potentially very promising for breeding purposes not only in Russia, but also in other countries of the world.

Table 1. Perennial forage crop varieties commercialized in the former USSR and Russia since initiation of breeding activities

Varieties	Crop group			
	Grasses (bromegrass)	Legumes (alfalfa)	Unconventional	Total
1922-94				
Breeding and local	352 (47)	308 (117)	29	689
VIR collection: number	107 (13)	133 (75)	8	267
%	50 (34)	57 (83)	28	39
1984-94				
Breeding and local	68 (13)	71 (28)	12	151
VIR collection: number	41 (5)	53 (27)	3	97
%	60 (38)	75 (96)	25	64

Table 2. The structure of VIR's perennial forage crop collection (classified into crop groups) in 1944

Accessions	Legumes			Grasses	Unconventional	% of whole collection
	All groups (%)	Alfalfa (%)	Clover (%)			
Domestic breeding	7.5	10.5	6.5	4.5	1.5	5.5
Local	10.5	29.0	27.0	3.5	-	10.5
Foreign	29.0	32.0	23.5	17.0	2.0	22.0
Wild	53.0	28.5	43.0	75.0	96.5	62.0
Total	100	100	100	100	100	100
Number of accessions						
units	13 075	—	—	12 711	1632	27418
% of whole collection	48	—	—	45	7	100

At present, the collection of the Department of Forage Crops amounts to 27 606 accessions (Table 3). The basic collection of desert forage crops endemic of the northern desert areas has remained at the Near-Aral Experiment Station of Plant Genetic Resources, where it is maintained in viable conditions.

Table 3. Composition of the VIR collection of perennial forage crops (at 1 January 1995)

Crop	No. of accessions
Legumes	
Medicago varia and *M. sativa*	3088
Medicago falcata and other *Medicago* spp.	1221
Trifolium pratense	4054
Swedish clover and other *Trifolium* spp.	3111
Onobrychis	951
Other leguminous plants	1560
Grasses	
Phleum pratense (timothy grass)	1649
Dactylis glomerata (cock's-foot)	960
Bromus inermis (awnless brome grass) and other spp.	1280
Agropyrum	700
Festuca pratensis (meadow fescue) and other spp.	1592
Festuca rubra (creeping fescue)	656
Lolium perenne and *L. multiflorum*	1335
Poa pratensis (Kentucky bluegrass)	1725
Other grass spp.	2352
Rare crops	
Symphytum, Silphium and others	302
Galega, Astragalus and others	623
Desert forage plants	32
Total	27606

The Department of Forage Crops maintains the forage crop collection in viable conditions. The collection is studied at the Institute's Experiment Stations by field experiments evaluating commercial agribiological traits (winter-hardiness, vegetation period, plant height, foliage, green matter and seed yield, etc.). Fundamental laboratories of the Institute assist forage crop experts in examining chemical composition, amino acid composition, drought and cold tolerance, resistance to diseases, pests, unfavourable environments, soil salinity, soil acidity and overmoisturing under flooding). In cooperation with the Research Institute of Agricultural Microbiology, the response of the samples to inoculation with nitrogen-fixing bacteria is studied. Research is also focused on agribiological and cyto-embryological methods of enhancing seed productivity of alfalfa and clover. The all-round study of wild and cultivated species of forage crops serves as a basis for the development of intraspecific ecogeographical classifications of

commercially valuable species and taxonomic systems of genera and subgenera by examining the taxa in herbarium collections, natural populations *in situ* and field plantings. A traditional direction of research at the Department of Forage Crops has been the evaluation of perennial forage plants for their resistance to biotic and abiotic environmental factors. The first experiments in determining frost resistance of clover were carried out by E.I. Yakushev and V.I. Dushechkin under the leadership of Dr. I.I. Tumanov. Further research helped to identify biotypes in clover populations by the character of development and perennial longevity of the central shoot, and to find out the close linkage between the composition of morpho/biotypes in clover populations and resistance of varieties to low temperatures and rotting. Assessment of plant samples by their resistance to low temperatures was also done on the collections of alfalfa, melilot and sainfoin.

In the process of studying the water regime of *Medicago, Agropyrum, Bromus inermis, Psathyrostachis juncea* and *Elymus sibiricum*, drought-resistant samples were identified and water-holding ability parameters were specified for these species. *Agropyrum, Psathyrostachis juncea* and *Kochia* were also analyzed for resistance to such stress factor as soil salinity. At present, resistance of leguminous plants to soil acidity is a burning problem of current research. Upon the results of plant evaluation for resistance to extreme environmental factors, recommendations were developed for agricultural practice. For *Agropyrum*, water supply parameters were specified for the autumn/winter season, which would determine plant productivity in the vegetation period of the next year. For clover, it appeared possible to predict plant hibernation and, hence, future productivity of rosette branching in the first year of plant life and accumulation of reserve substances in the root.

Concerning further increase of plant productivity and protein accumulation in plants, one of the main trends presently developed in forage production is studying nitrogen-fixing ability in perennial grass varieties and their variety/strain specificity. Under conditions of Pavlovsk, Volgograd and Zeya Experiment Stations of VIR, Middle Asian Branch of VIR, Kirghizia and Nakhichevan, in 1987-1994, VIR's scientists identified 54 varieties of alfalfa, clover, Dakota vetch, melilot, trigonella and amaranth, which demonstrated response when inoculated with 46 strains of nitrogen-fixing bacteria, exceeding the control level of green matter yield by 20% to 94%. The best effect of seed inoculation was observed during the second year of plant life. The process of studying 34 alfalfa varieties at the Middle Asian Branch of VIR showed that the highest symbiotic potential was characteristic of breeding cultivars and varieties obtained through hybridization with inoculation of strains created by using mutagenic factors at the Research Institute of Agricultural Microbiology (CXM-1, CXi1-105, etc.).

The problem of seed productivity in leguminous crops, although not as acute as 10-15 years ago, continues to be of deep concern. In the hot continental climate of Kazakhstan (the Near-Aral Experiment Station of VIR), population genetics and cyto-embryology aspects of the alfalfa reproduction system were studied, and theoretical and methodological principles of alfalfa breeding were developed with the goal to receive high-yielding varieties under conditions of limited self-pollination. This was accompanied by identification of inbreeding resistant forms, selection of plant forms with high percentage of fertile ovules in flower ovaries, with high and stable development after fertilization, and with sufficient pollen formation. The research accomplished helped to set forward a model of a synthetic population, retaining unreduced seed productivity in the next synthesized generations. The model's optimum self-fertility level average for populations was 30-50%, with autotripping level of 30-40%. Such synthetic populations combine self- and cross-pollination, which reveals the effect of heterosis in various traits and, first of all, in seed productivity.

Among the obtained self-fertile populations, 10 sources with seed productivity and earliness were identified. Two populations were stabilized in their seed productivity

haracters. Alfalfa varieties demonstrated considerable variation of flower morphology and the effect of a number of flower parameters on tripping efficiency. The most easily dehiscing were flowers of *M. sativa*. One of the ways to increase alfalfa seed productivity was to study interrelations of pollinator bees and plants belonging to different alfalfa species and populations. In the northern Aral Sea Coast region it was observed that alfalfa was visited by 82 species of bees, though only 9 of them were efficient pollinators. Two species of bees were found in this region for the first time, while another two were quite new for science. Research has been started on the existence of chemical compounds harmful for animals in forage matter, such as saponin, phytoextragens and foam-forming substances. Antinutrients in alfalfa and other legumes may cause such diseases as tympany. There was observed significant variation in foam-forming ability between species and populations. The highest content of foam-forming substances (9-13 ml) was reported in *Medicago falcata* and *M. sativa*. Low foam-forming ability was observed in about 9% of cultivated alfalfa varieties.

In the last 25 years, collections of desert and unfamiliar crops have been established and studied. In many of such crops, cultivars have been bred (small desert semi-shrubs, *Galega orientalis, Trifolium apertum, Silphium perfoliatum*). A group of species has been identified as easily adapted to mechanized seed production (*Rumex tianschanicus, Poligonum, Isatis*), together with a number of crops of very high nutritional value which, however, require profound breeding improvement (*Symphytum* spp., *Rhaponticum, Polygonum*, etc.).

Status of national forages collections in Spain

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Most important Spanish institutions working on forages

Mediterranean annual pasture legumes

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Francisco González López

Perennial forages grasses and legumes

Centro de Investigaciones Agrarias de Mabegondo
Apartado 10 - 15080 La Coruña (Spain)
José Alberto Oliveira

Perennial Medicago

Servicio de Investigación Agraria. Diputación General de Aragón
Apartado 727 - 50080 Zaragoza (Spain)
Ignacio Delgado Enguita

Perennial forage grasses and legumes

Centro de Investigaciones, Agrarias de Mabegondo (CIAM), La Coruña, Spain

Table 1. Perennial forage grasses and legumes: details of holdings

Species	Wild species	Landraces	Cultivars	Breeding lines	Total
Lolium perenne	145 (Spain 124; France 19; Portugal 2)		2 (Spain)	2 (Spain)	149
Lolium multiflorum	Yes	Yes			73
Lolium rigidum	18 (Spain 17; Portugal 1)				18
Lolium canariense	7 (Spain)				7
Dactylis glomerata	22 (Spain)		1 (Spain)		23
Festuca arundinacea	20 (Spain)				20
Lolium repens	1 (Spain)				1
Lolium pratense	2 (Spain)		1 (Spain)		3

Table 2. Perennial forage grasses and legumes: agronomic evaluation†

Species	Wild	Landraces	Total
Lolium perenne	87	—	87
Lolium multiflorum	10	19	29

† Characters observed: morphological (tillering, growth habit); physiological (heading date, aftermath heading); drought and disease tolerances, growths, etc.

Table 3. Perennial forage grasses and legumes: isoenzymatic evaluation

Species	Wild	Landraces	Total
Lolium perenne	14	—	14
Lolium multiflorum	9	8	17

Documentation status

Passport data (14 descriptors), evaluation data and ecological data of forage genetic resources are recorded in a database in dBASE IV. Evaluation data are recorded manually in the field.

Maintenance of the collection: medium-term storage

Storage volume	50 m^3
Relative humidity	50%
Temperature	2 to 4°C
Container type	Paper packets

Duplication sites

IGER, Welsh Plant Breeding Station, Genetic Resources Unit, Aberystwyth, Dyfed SY23 3 EB
103 seed samples of *Lolium perenne.*

Availability of material

29 wild populations of *Lolium perenne*
5 wild populations of *Lolium multiflorum*
Freely available but limitations in quantity of seeds.

Mediterranean annual pasture legumes

Servicio de Investigación y Desarrollo Tecnológico, Apdo 22. 06080 Badajoz, Spain

Table 4. Mediterranean annual pasture legumes: details of holdings

Species	Wild species	Landraces	Cultivars	Breeding lines	Total
Trifolium subterraneum	1888	6	29	136	2059
Medicago spp.	488	1	11		500
Trifolium glomeratum	345				345
Ornithopus compressus	204		2		206
Trifolium cherleri	71				55
Trifolium striatum	28				16
Others †					> 50

† *Trifolium tomentosum; T. bocconei; T. stellatum; Biserrula pelecinus; Astragalus cymbicarpus; Scorpiurus vermiculatus; Cytisus scoparius; Hedysarum coronarium;* etc.

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