

**Report of a
Working Group
on Forages**
(Second Meeting)

**Held in Carlow,
Ireland
7-11 Oct.
1985**

**UNDP/IBPGR EUROPEAN
COOPERATIVE PROGRAMME
FOR CONSERVATION AND
EXCHANGE OF CROP
GENETIC RESOURCES**



International Board for Plant Genetic Resources



United Nations Development Programme

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

Forages Working Group

REPORT

of the second meeting of a Working Group
held at the Oak Park Research Centre
Carlow, Ireland

8-11 October, 1985

UNDP-IBPGR
Rome, November 1985

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INTRODUCTION

The second meeting of the forage grasses and legumes Working Group of the European Cooperative Programme for the Conservation and Exchange of Crop Genetic Resources (ECP/GR) (Phase II) was convened at the invitation of the Oak Park Research Centre, Carlow, Ireland, 8-11 October, 1985. A list of participants is shown in Appendix I.

The participants were warmly welcomed by Mr. P.J. O'Hare, Director of the Research Centre. On behalf of the ECP/GR Secretariat, Mr. P.M. Perret gratefully thanked the European Data Bases for the work they had achieved so far. He drew members' attention to the fact that this meeting was the last of Phase II of the ECP/GR; consequently a detailed programme with adequate recommendations had to be developed for Phase III of the ECP/GR, in which the inputs-in-kind to be expected from each country should be specified.

Professor A. Dovrat and Mr. B. Tyler were unanimously elected co-chairmen of the Working Group. The agenda, as approved, is provided in Appendix II.

REPORT

REVIEW OF CURRENT ACTIVITIES

Data bases

1. Members of the Working Group had received before the meeting drafts of the European Forages Lists of accessions held in genebanks for

- Annual Medicago and Trifolium subterraneum (Spain)
- Festuca and Dactylis (Poland)
- Perennial Medicago (France)
- Perennial Lolium and Trifolium repens (UK)
- Trifolium pratense (Switzerland)

In addition, draft European Lists for Poa (Federal Republic of Germany), Phleum (Nordic countries), Vicia spp. and annual Lolium and Phalaris (Italy) were presented during the meeting. It was also noted that the draft European List for Bromus was circulated. However, due to the unforeseen absence of Dr. L. Horvarth, this list was not available at the meeting. The list of European forage data bases is shown in Appendix III.

2. The scientists responsible for the respective data bases reported on constraints which had been encountered in implementing the work. The most common constraints are:

- a) Slow return of data from genebanks/institutes;
- b) Ambiguity in definition of descriptors and descriptor states;

- c) Lack of important descriptors, e.g. collector's number and status of accession; and
- d) Misspellings of cultivar names.

3. After study of the lists submitted, it was readily apparent that all descriptors which had been sent to the data bases could be transformed into the EEC/IBPGR standard passport descriptors. It was agreed that institutions could continue to send their data in their own format on the condition that an unambiguous definition of each descriptor and the reference to the EEC/IBPGR descriptor list accompany the data set. In addition, the descriptors: Donor name, Donor number, Collecting Institute, etc. were explained (their definitions are given in Appendix IV).

4. In an attempt to identify collections which had not sent data it was recognized that some breeders' collections were not included. It was recommended that further efforts should be made by national genebanks/members of the Forages Working Groups/data bases to obtain such data. Members were informed that the Centre for Genetic Resources the Netherlands has recently been established, and data will be supplied to the respective data bases in the near future. Some institutions had not sent a complete data set, since their documentation work is still in progress.

5. Some attempts had been made in the draft European Forage lists to identify duplicates, especially of landraces/cultivars. Special attention was paid to the Trifolium pratense list. Since the amount of duplicates did not exceed about 20%, it was felt that there was no urgent need to try to rationalize the collections. A certain amount of duplication is felt permissible for security purposes.

It was recommended, however, that data bases continue to locate obvious duplicates, in order to compile a list of accessions without duplications.

Progress in collecting

6. The first meeting of the Working Group provided recommendations on emergency collecting (para. 9 of the report of the first meeting; Report of a Working Group on Forages, held in Larissa, Greece, 7-9 Feb. 1984). Progress in this area was reviewed on a crop-by-crop basis:

Red clover: The Centre for Genetic Resources the Netherlands has recently started a programme of collection; 41 accessions have already been obtained and 200 accessions are expected. It was considered particularly useful to have close collaboration between the Netherlands, Federal Republic of Germany and Belgium.

The Welsh Plant Breeding Station, Aberystwyth, UK is approaching seed firms in order to obtain landraces. The Fodder Crops and Pasture Institute, Larissa, Greece, has collected 36 ecotypes in 1985 (sponsored by IBPGR) and will continue this programme in 1986. The Nordic Gene Bank has supported collections in the southern parts of Scandinavia, including some of the Swedish and Finnish islands and this work is continuing.

Lucerne: Local varieties of lucerne in Belgium have been collected in 1985. Wild M. falcata (7 samples) have been collected in Greece. The IBPGR/EUCARPIA Project for identification and multiplication of landraces is progressing and members strongly supported this type of activity.

Trifolium alexandrinum and T. resupinatum: Collecting of T. alexandrinum, T. resupinatum and related taxa are in progress in Egypt, Greece and Israel (sponsored by IBPGR). It is hoped that collecting can be completed in 1986 in Turkey.

White clover: Greece has reported on collecting wild ecotypes.

Lolium perenne: Landraces and cultivars from endangered habitats were collected in Greece and UK.

IBPGR Working Group on Forages of the Mediterranean and Adjacent Areas

7. The IBPGR had held a Working Group on Forages of the Mediterranean and Adjacent Areas Arid and Semi-arid Areas, at Limassol, Cyprus 24-26 April 1985 (published in June, 1985; AGPG:IBPGR/85/89). The members welcomed the initiative of IBPGR and stressed the need for collaboration in the respective objectives of the 2 programmes.

8. It was recommended that there should be active exchange of information especially on passport data. The recommendation from the Mediterranean Working Group, "IBPGR is urged to carry out a number of surveys on several of the major priority genera to include data from floras, herbarium specimens, published papers and passport data in existing collections", was endorsed by the Working Group. Table 2 of the Mediterranean report provides a detailed account of priority areas for collecting and it is reproduced in Appendix V.

PROPOSED WORKPLAN 1986-1989

Data bases

9. After the registration of the minimum passport descriptors recommended during the first meeting of the Working Group, it was now decided to add additional descriptors in order to increase the usefulness of the data bases to the breeders. A list of all descriptors for further registration, including those already registered in the data bases, is provided in Appendix IV. More passport data may be required at a later stage of the programme.

10. The Working Group noted the interest of the Biology Department of the University of Southampton, UK for a Viciaeae data base and of the University of Pau, France for a Lathyrus data base. It was requested that the ECP/GR Secretariat contact these 2 institutions to seek a joint agreement on sharing responsibilities as the European Lathyrus data base. Active exchange of information and cooperation between the European Vicia data base at the Germplasm Institute Bari, Italy and the International Legume Database at the University of Southampton is recommended.

The Germplasm Institute, Bari, proposed to act as an European data base for Hedysarum and this was unanimously accepted.

It was also recommended that the Levi Eshkol School of Agriculture from the Hebrew University of Jerusalem, Israel, act as an European data base for T. alexandrinum, T. resupinatum and wild related taxa.

Since the members from Czechoslovakia and Hungary were unable to be present at the meeting, it was suggested that the ECP/GR Secretariat attend to eventual additional proposals for new forage data bases which might come from these countries.

11. European forages data bases expressed their willingness to continue their activities according to the recommendations of this meeting. They are also prepared to publish catalogues when finalized.

Evaluation

12. The Working Group discussed at length the usefulness of implementing cooperative programmes for evaluation per se at an international level and concluded that the result

of such exercises are of limited value due to high Genotype x Environment (G x E) interactions. A relevant paper titled "Broad Adaptation in Forage Grasses" was tabled at the meeting and is provided in Appendix VI. Members considered the possibilities of studying G x E interactions through a collaborative network of trials. Such projects had already been carried out by other international organizations and the results are not conclusive (see Appendix VI). It was agreed that this research should be assigned a low priority in the framework of ECP/GR. However, it was recommended that evaluation on a national level should be strengthened. National programmes should inform the respective data bases on their current activities in evaluating the germplasm.

13. The Working Group was of the opinion that a list of standards for characteristics such as disease resistances, spring growth, etc. would greatly facilitate the comparison of evaluation data between countries. Dr. P. Guy volunteered to circulate a draft list to forages specialists for comments and approval.

14. The Working Group stressed the importance of accurate botanical identification and/or verification. This problem has developed with regard to certain species and subspecies held in genebanks and the expert advice of a botanist is needed.

15. Electrophoretic analysis may add to our knowledge of the patterns of variability and their distribution. It is also a tool in verifying the accuracy of regeneration and will promote the use of genetic resources. It was recognized that Poa pratensis would be the most suitable subject at this stage for further investigations due to its inbreeding and apomictic nature. The ECP/GR should investigate the possibility of performing these analyses.

16. The data accumulated in data bases should be used to prepare maps of original locations of samples in order to identify gaps in collections. This could be complemented by the data from herbaria, reports and literature. It was recommended that this study should concentrate, as a first step, on Lolium perenne and Trifolium pratense, which both have a widespread distribution in Europe.

Collecting

17. Continuation of urgent collecting: On the basis of recommendations made during the first meeting urgent collecting remains to be achieved as follows:

<u>Red clover:</u>	Belgium, Federal Republic of Germany, France, Greece, Italy, Netherlands, Poland, Spain, UK;
<u>White clover:</u>	Greece;
<u>Lucerne:</u>	Federal Republic of Germany, Italy, Spain, Wadi-Oases of North Africa;
<u>Perennial ryegrass:</u>	Austria, Federal Republic of Germany, Greece, Italy, Netherlands, Switzerland, UK;
<u>Lolium multiflorum:</u>	Belgium, Italy, Netherlands, UK.

18. Urgent collecting of new material: Hedisarum coronarium is disappearing in North Africa and in southern Europe (at least in Italy and Spain) and prompt action is recommended by the pertinent countries. Concern was expressed regarding the genetic erosion of subspecies of Festuca arundinacea in North Africa and the Mediterranean region in general and also Onobrychis and diploid Dactylis. Special attention should be given to these species when the collecting as proposed by the Mediterranean Working Group is carried out.

19. There is an increasing need amongst breeders (in France, Netherlands, Poland and UK) for additional Festuca species and especially wild relatives of F. arundinacea. It was noted that F. arundinacea subsp. nechtritziana is cited in the Hungarian Flora but no accessions have been located in European genebanks.

Regeneration of collections

20. The Working Group stressed the importance of the regeneration of collections to assure continuity of the supply of material by genebanks. It was pointed out that ideally the collector/collecting institute should be responsible for initial regeneration of the material and that further regeneration is the responsibility of genebanks. It was emphasized that the regeneration of collections will be a burdensome task for national programmes in the coming years. Whilst the regeneration of self-fertile species does not pose major technical problems, there is a great need for the development of suitable procedures for the regeneration of the outcrossing species of forage plants.

21. Recognizing the importance of information on the regeneration of samples to the breeders, the Working Group recommended to add to the passport data the descriptors: Country of regeneration, Year of last regeneration, Method of regeneration (see Appendix IV).

Training

22. The Working Group noted the offer of the Instituto Nacional de Investigaciones Agrarias, Badajoz, Spain for a group training course on "Collection, regeneration and conservation of annual legumes". It was also stressed that the specialized training on an individual basis should be encouraged as it is the most effective way to fulfil trained personnel requirements.

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AGENDA

1. Opening
2. Election of Chairman
3. Adoption of Agenda
4. Review of current activities
 - 4.1 European forages data bases
 - 4.1.1 Discussion on the European forages lists
 - 4.1.2 Identification of duplicates
 - 4.1.3 Identification of gaps
 - 4.2 Review of progresses in collecting since recommendations of the first meeting of the Working Group
 - 4.3 Report of an IBPGR Working Group on Forages of the Mediterranean and Adjacent Arid and Semi-arid Areas (April, 1985)
5. Formulation of a workplan for the period 1986-89
 - 5.1 Further registration in forages data bases
 - 5.1.1 Completion of passport data
 - 5.1.2 Selection of characterization/evaluation descriptors for further registration and their definitions
 - 5.2 Selection of additional taxa to be dealt with by the Working Group
 - 5.3 Commitments of data bases for further registration
 - 5.4 Evaluation programme
 - 5.4.1 Network project to study Genotype x Environment (G x E) interactions in relation to particular characters of potential value to breeders
 - 5.4.2 Other needs for preliminary evaluation
 - 5.5 Urgent collecting requirements
 - 5.6 Regeneration collecting
 - 5.7 Training
 - 5.8 Other business
6. Writing of report and recording decisions reached and recommendations made under 1 - 5 above
7. Consideration of report and approval by Working Group

EUROPEAN FORAGE DATA BASES

1. Established data bases

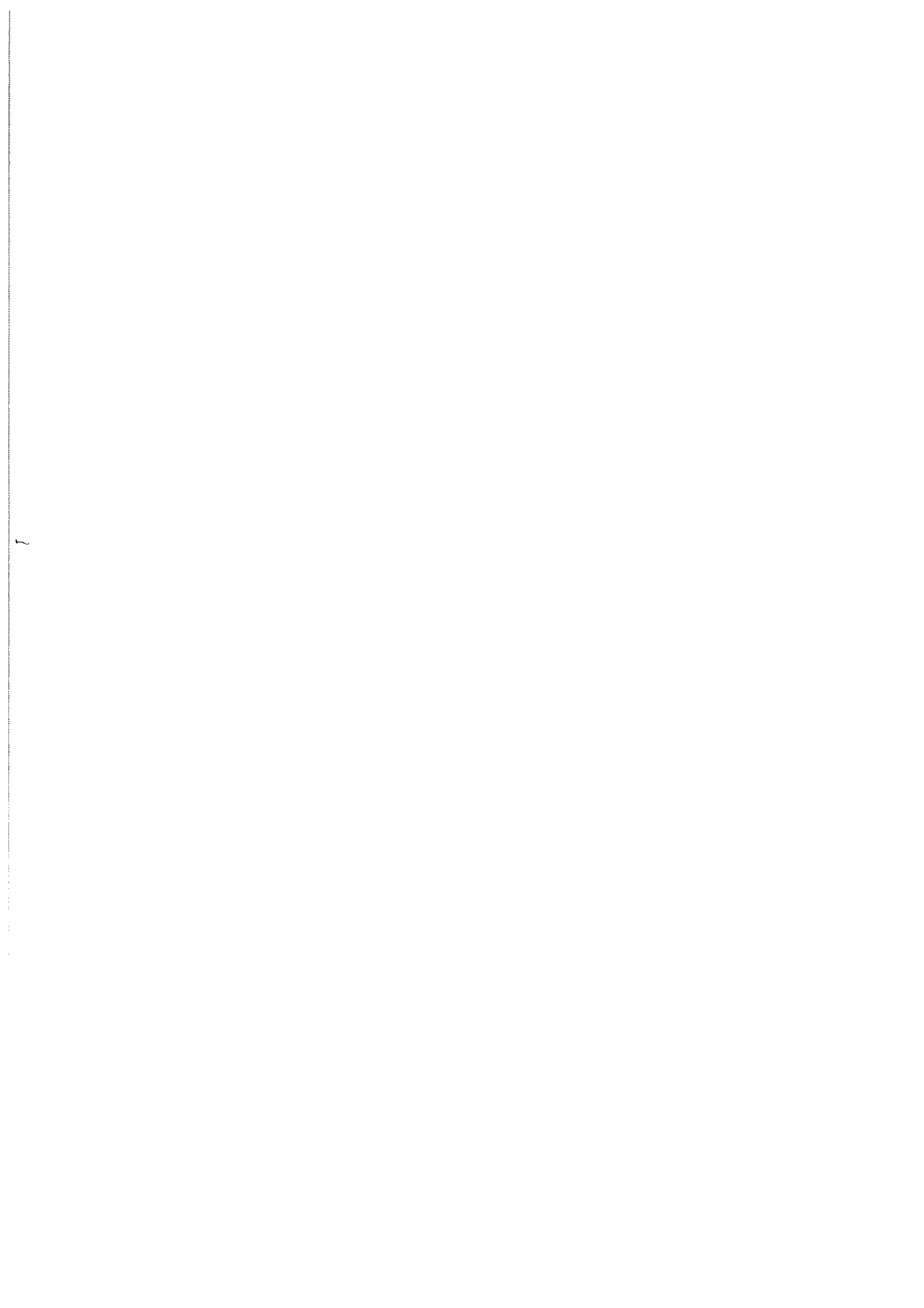
<u>Bromus</u> spp.	Research Centre for Agrobotany, Institute for Plant Production and Qualification, H-2766 Taposzele, Hungary
<u>Dactylis</u> spp. and <u>Festuca</u> spp.	Plant Breeding and Acclimatization Institute, Radzikow, 05-870 Blonie, Poland
<u>Trifolium subterraneum</u> , and <u>Medicago</u> (annual species)	Servicio de Investigacion Agraria, Apartado 22, 06080 Badajoz, Spain
<u>Lolium multiflorum</u> , <u>L. perenne</u> and <u>Trifolium repens</u>	Welsh Plant Breeding Station, Plas Gogerdan, Aberystwyth, Dyfed SY23 3EB, Wales, UK
<u>Lolium</u> (annual species), <u>Phalaris</u> spp. and <u>Vicia</u> spp.	Laboratorio del Germoplasma, Consiglio Nazionale delle Ricerche, Via G. Amendola, 165/A, I-70126 Bari, Italy
<u>Medicago</u> (perennial species)	GEVES-INRA, La Miniere, F-78280 Guyancourt, France
<u>Poa</u> spp.	Institut für Pflanzenbau und Pflanzenzuchtung der Bundesforschungsanstalt für Landwirtschaft, Braunschweig-Volkenröde, Bundesallee 50, D-3300 Braunschweig, Federal Republic of Germany
<u>Phleum</u>	Nordic Gene Bank, S-23053 Alnarp, Sweden
<u>Trifolium pratense</u>	Federal Agricultural Research Station, Changins, 1260 Nyon, Switzerland

2. Data bases proposed by the second Working Group

<u>Hedysarum</u>	Istituto del Germoplasma, Consiglio Nazionale delle Ricerche, Via G. Amendola, 165/A, I-70126 Bari, Italy
<u>Trifolium alexandrinum</u> , <u>T. resupinatum</u> and wild related taxa	Field Crops Department, Faculty of Agriculture, Hebrew University of Jerusalem, P.O. Box 12, Rehovot 76-100, Israel

3. Data bases under consideration

<u>Lathyrus</u>	Biology Department, University of Southampton, Southampton, SO9 5NH, UK and Institut de Biocenotique Experimentale des Agrosystemes, Université de Pau, 64000 Pau, France
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LIST OF PASSPORT DESCRIPTORS
TO BE REGISTERED BY FORAGE DATA BASES 1/

1.0. GENE BANK HOLDING THE ACCESSION

Standard acronym for genebank/collections holding the accession for which data has been sent to the central data base.

Acronyms consist of 3 - letter country code plus code of the genebank/holding institute

1.1 ACCESSION NUMBER

This number serves as a unique identifier for accessions and is assigned by the curator when an accession is entered into his collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number is still not available for re-use. Letters should occur before the number to identify the genebank or national system (e.g. MG indicates an accession comes from the genebank at Bari, Italy; ABY an accession from Welsh Plant Breeding Station, Aberystwyth, UK)

1.2 DONOR NAME

Acronym (as in 1.0) of institute or individual responsible for donating the germplasm

A list of acronyms is being compiled by the Plant Breeding and Acclimatization Institute, Radzikow, Poland and will be distributed to all genebanks

1.3 DONOR IDENTIFICATION NUMBER

Accession number in donor's collection

1.4 OTHER NUMBERS ASSOCIATED WITH THE ACCESSION

Any other identification number known to exist in other collections for this accession, e.g. USDA Plant Inventory number (not collector's number, see 2.1)

Up to 2 numbers should be registered

1/ The descriptor numbers indicated at left conform to those in Forage Legume Descriptors (EEC/IBPGR, 1984) and Forage Grass Descriptors (EEC/IBPGR, 1985)

1.5 SCIENTIFIC NAME

1.5.1 Genus

1.5.2 Species

1.5.3 Sub-taxa

(e.g. subspecies of Dactylis glomerata, Medicago sativa, and botanical varieties of Festuca pratensis and F. arundinacea, etc.)

The data base will take the responsibility to select the most suitable taxonomic classification

1.6.1 CULTIVAR NAME/LANDRACE NAME/BREEDER'S LINE NUMBER

1.6.2 PEDIGREE

1.6.3 ORIGINATOR/MAINTAINER

Acronym (as in 1.0) of institute or individual originating the material or responsible for its maintenance

1.10 NUMBER OF TIMES ACCESSION REGENERATED

Number of regenerations or multiplications since original collection

1.12 ORIGINAL ENTRY

0 - No (regeneration occurred)

+ - Yes (original seeds, from the collector or breeder)

1.13 COUNTRY OF REGENERATION

FAO/IBPGR country code

1.14 YEAR OF LAST REGENERATION

1.15 METHOD OF REGENERATION

1 Field - with precautions taken against alien pollination

2 Glasshouse - with precautions taken against alien pollination

3 Open pollination

2.1 COLLECTOR'S NUMBER

Original number assigned by collector of the sample, normally composed of the name or initials of the collector(s) followed by a number.

This number is indispensable for identification of duplicates and therefore it should always be quoted when exchanging the seed

2.2 COLLECTING INSTITUTE

Acronym as in 1.0

2.3 DATE OF COLLECTION OF ORIGINAL SAMPLE

In the format DD/MM/YY

2.4.1 COUNTRY OF ORIGIN

FAO/IBPGR country code

2.4.2 ADMINISTRATIVE REGION/PROVINCE WHERE SAMPLE HAS BEEN COLLECTED

2.6 LOCATION OF COLLECTION SITE

Number of kilometres and direction from nearest town or village or map grid reference (e.g. TIMBUKTU 7S means 7 km south of Timbuktu).

One of the places mentioned should be easily identified in an atlas

2.7 LATITUDE OF COLLECTION SITE

Degrees and minutes followed by N (north) or S (south), e.g. 1030S

2.8 LONGITUDE OF COLLECTION SITE

Degrees and minutes followed by E (east) or W (west), e.g. 7625W

2.9.1 ALTITUDE

Elevation above or below sea level in metres

2.9.2 ASPECT

Compass degrees 1-360°

2.9.3 SLOPE

Clinometer degrees

2.11 STATUS OF SAMPLE

- 1 Wild
- 2 Farm land
- 3 Farm store
- 4 Backyard
- 5 Village market
- 6 Commercial market
- 7 Institute
- 8 Other (specify in the NOTES descriptor, 11)

2.18 SITE PHYSIOGRAPHY

- 1 Plain
- 2 Valley bottom
- 3 Valley slope
- 4 Terrace
- 5 Summit
- 6 Other (specify in the NOTES descriptor, 11)

2.19 HABITAT

2.19.1 General habitat of site

- 1 Forest deciduous
- 2 Forest evergreen
- 3 Forest mixed
- 4 Scrub
- 5 Parkland
- 6 Orchard
- 7 Grassland
- 8 Moorland
- 9 Heath
- 10 Arable
- 11 Wasteland
- 12 Other (specify in the NOTES descriptor, 11)

2.19.2 Specific habitat

- 1 Hedgerow
- 2 Clearing
- 3 Path
- 4 Alongside water, i.e. river, lake, etc.
- 5 Alongside building
- 6 Alongside path, road, track, etc.
- 7 Other (specify in the NOTES descriptor, 11)

2.19.3 Grassland habitat

- 1 Abandoned
- 2 Grazed only (specify intensity in the NOTES descriptor, 2.27.1)
- 3 Conservation only (specify in the NOTES descriptor, 2.27.1)
- 4 Mainly grazed (specify in the NOTES descriptor, 2.27.1)
- 5 Mainly conservation (specify in the NOTES descriptor, 2.27.1)
- 6 Zero grazed
- 7 Lawn
- 8 Sports turf
- 9 Other (specify in the NOTES descriptor, 11)

11. NOTES

Give additional information where descriptor state is noted as 'Other' as, for example, in 2.11 and 2.19.1. Also include here any further relevant information

APPENDIX V

Table 2. Priority areas for collecting (to be discussed with each national programme which will participate in planning and execution and deposit of material) *

Collecting area	Genera/species to be collected	Interested country / institutions	Collecting suggestions Date	Collected by	Probable funding
1) Sicily	annual medics, annual <u>Trifolium</u> , <u>Hedysarum coronarium</u> , <u>Ornithopus</u>	Australia, Spain, ICARDA 3/	1986	-	IBPGR
2) Central & South Italy	<u>Onobrychis</u> , <u>Hedysarum</u> , <u>Trifolium repens</u>	Italy, Australia, Iran, (Spain)	1986/87	-	Italy?
3) Atlas, North Africa	<u>Trifolium fragiferum</u> , <u>Medicago</u> , <u>Hedysarum</u> , <u>Festuca</u> , <u>Dactylis</u>	Australia, Italy, ICARDA	1987	IBPGR 2/	ICARDA
4) Coastal	<u>Ornithopus</u> , <u>Hedysarum</u> , grasses	Morocco, Spain, ICARDA (Australia)	1987	IBPGR 2/	ICARDA
5) Iran	annual <u>Medicago</u> , <u>Onobrychis</u> , <u>Vicia</u> , <u>Lathyrus</u> , <u>Pisum</u> , <u>Coronilla</u> , grasses	Iran, ICARDA, (certain areas), Australia	1986	Iran	IBPGR
6) Cyprus	<u>Trifolium</u> , <u>Vicia</u> , <u>Lathyrus</u> ,	Cyprus, ICARDA <u>Pisum</u> , <u>Coronilla</u>	1987	Cyprus	Cyprus?
7) Turkey, Syria	most forages	all programmes	1986	ICARDA	ICARDA
8) Arabian Peninsula	lucerne from wadi/oases	at risk of genetic erosion	1988	IBPGR	IBPGR
9) Iberian Peninsula	perennial <u>Medicago</u> , <u>Ornithopus</u> , <u>Dactylis</u> , <u>Festuca</u> ,	Spain, Australia <u>Trifolium subterraneum</u>	1986/7	-	Spain?
10) Afghanistan & Baluchistan	whole range including <u>Cenchrus</u> , <u>Eragrostis</u>	Iran, ICARDA	1987	ICARDA/IBPGR 2/	ICARDA
11) Iraq	<u>Pisum</u> , <u>Coronilla varia</u> , grasses	ICARDA	1988?	-	ICARDA
12) Madis/Oasis N. Africa	<u>Medicago sativa</u>	ICARDA	1988	IBPGR	IBPGR
13) Aegean Islands	annual medics & clover, <u>Vicia</u>	Australia, ICARDA	1986	Australia	IBPGR/Australia

* Table taken from IBPGR Report of a Working Group on Forages of the Mediterranean and Adjacent Areas Arid and Semi-arid Areas, at Limassol, Cyprus 24-26 April 1985 (AGFG: IBPGR/85/89)

1/ For Australia read the programmes on Trifolium and Medicago
 2/ IBPGR to provide for grasses
 3/ ICARDA: International Center for Agricultural Research in the Dry Areas

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BROAD ADAPTATION IN FORAGE GRASSES

M.D. Hayward ^{1/}

The adaptability of forage cultivars to the wide range of environments encountered in European agriculture has been of major concern to forage breeders, agronomists and the seed trade. Over the past 30 or so years several studies have taken place on the agronomic performance and characterization of a variable number of cultivars at different locations throughout Europe with the intention of identifying cultivars with differing patterns of adaptation.

One of the most comprehensive studies of adaptation in the forage grasses and legumes was that organized under the aegis of the OECD ^{2/} Grass, Clover and Lucerne Trials in OECD Countries, European Productivity Agency, 1960). This trial examined the performance of 24 varieties of Lolium perenne, 20 of Dactylis glomerata, 19 of Phleum pratense, and 14 of Festuca pratensis amongst the grasses at 14 locations throughout Europe. The latitudes ranged from Italy in the south to Ultuna, Sweden in the north. In this study, like several others, detailed data were collected on a wide range of characters over several years at most of the locations. Like many other studies these data were not subjected to critical statistical analyses and hence no valid conclusions could be drawn on patterns of adaptations.

Breeders and agronomists require techniques which will allow them to identify any systematic variation in the pattern of response of cultivars to differing environments. Two techniques are generally applicable to this problem, the joint regression analysis of Finlay and Wilkinson, 1963 and the multivariate procedures based on pattern analysis (Byth, 1977). (For general review of these methods, see: Hill, 1975. Genotype x Environment Interaction - a challenge to plant breeders. J. Agric. Sci., 85: 477; and Clements, Hayward and Byth, 1983. Genetic Adaptation in Pasture Plants, In: Genetic Resources of Forage Plants CSIRO 101). It is strongly advocated that in the conduct of any future trials, the utility of these techniques to answer the questions being posed by such trials, should be taken into account in the initiation and planning of such experiments.

From the multi-site trials conducted so far it has been recognized that forage cultivars do differ in their patterns of adaptation. Many of these patterns have been, or may be, accounted for on a physiological basis. However, in order for breeders to have the potential to produce cultivars of either broad or specific adaptation it is necessary to obtain an understanding of the genetic basis of adaptation.

Some information is available on the influence of varietal structure on adaptation (see Clements et al., loc. cit.) but little is known about the breeding and selection methods which are necessary in order to obtain any desired form of varietal adaptation. Such information may be obtained only by the conduct of multi-site trails involving plant material on which a known genetic structure has been imposed (e.g. homozygous lines, F₁ hybrids, multi-lines, etc.) or a specific mating design (progeny test procedures) applied. Tests of this latter form are currently being undertaken in a cooperative programme between the Welsh Plant Breeding Station, UK Department of Genetics of the University of Birmingham, UK, and the Department of Forage Genetics of the University of Perugia, Italy at 3 sites within the UK and 1 in Italy. The objective

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^{2/} OECD: Organization for Economic Cooperation and Development

of this trial, which involves a triple test cross analysis of a breeder's population deriving from a cross of UK and Italian material, is to determine the nature of the gene action responsible for performance overall and at any specific site. This will enable the breeder to assess the potential, and to develop an appropriate breeding strategy, for the production of widely adapted cultivars or cultivars specific to any of the limited number of locations being tested.