ICARDA-133 En

GENETIC RESOURCES PROGRAM

Annual Report for 1987

GENETIC RESOURCES PROGRAM

ANNUAL REPORT 1987

The International Center for Agricultural
Research in the Dry Areas

Aleppo, Syria

CONTENTS

GENETIC RESOURCES PROGRAM

STRATEGIC PLAN

1. Program objectives

The Genetic Resources Program was established to preserve and make available for crop improvement purposes, useful gene pools of those crop species which are of interest to the Center. To achieve this overall objective the Program mobilizes its resources to:

- Enrich ICARDA's germplasm collections through plant exploration and the acquisition of desirable genetic material from other genebanks and scientific institutions.
- Characterize and evaluate the Center's germplasm through collaboration and participation with scientists at ICARDA and in the national programs.
- Enlarge the genetic resources data base by documenting pertinent information on the germplasm collections.
- Preserve the germplasm in controlled environment and assist the NARS in developing their gene banks for native germplasm.
- Distribute upon request germplasm and related information to scientists on a worldwide basis.

The Genetic Resources Program also conducts research on a modest scale to characterize genetic diversity and to promote the utilization of the Center's germplasm. The Program also has a commitment to provide training that would enhance the technical competence of scientists and technicians in the national programs to handle their genetic resources collections.

A Seed Health Laboratory forms part of the Program to safeguard against the accidental spread of seed borne pathogens and pests as a result of the movement of breeders' seeds and germplasm to and from the ICARDA. A Virology Laboratory, also a part of the

Program, is pursuing its major objectives to study the incidence of virus diseases throughout the region, to develop control procedures and screen for the presence of viruses both in germplasm collections and breeders' materials.

2. Genetic Resources

2.1. Summary of achievements (1984-1987)

A five-year work-program was developed in 1984, when the Program was established. In this work-plan high priority was accorded to rejuvenation and storage, and to evaluation and documentation of the germplasm accessions. Initially lower priority was given to collecting activities, to training and research to enhance the utilization of the germplasm because of limited resources and personnel.

The accomplishments of the Program during the past four years especially in the documentation, regeneration and evaluation of the germplasm are within the target set for this period (Table 1).

Fourteen separate collecting missions were undertaken jointly with national programs in Cyprus, Morocco, Egypt, Jordan, Syria, Turkey and Pakistan and a total of 8100 new germplasm entries were added to the genebank as a result of these missions. In addition 22,497 new accessions were obtained from other genebanks and scientists. About 46,000 accessions were evaluated for 4 to 29 traits jointly with the crop programs and documented. Three germplasm catalogs have been published and three others are in the final stages of preparation for publication.

About 36,000 entries have been multiplied and placed in medium-term storage ($2^{o}C \pm 2^{o}C$, 15-20% relative humidity) with the required seed storage weight. An additional 8000 samples are also stored in controlled environment to minimize their further deterioration until multiplication can be accomplished. Approximately 49,000 (57 per cent) accessions need to be

Table 1. Progress and present status of the germplasm collections at ICARDA.

Crop	Number of accessions			
	Total	Evaluated to date	In medium term storage	In long term storage
Cereals				
Barley	15942	12129	12624	
Durum wheat	20085	13213	7000	
Bread wheat	10419	2780	2780	
Wild relatives	3009	2245	2385	
Food Legumes				
Lentil	6498	6343	6190	4958
Chickpea	6437	4978	5927	
Faba bean	2892		2737	
Wild relatives	234	219	229	
Forages				
Annual medics	4302	1778	1020	
Pisum spp.	3301		1920	3221
Vicia spp.	3548	379	1175	
Lathyrus spp.	934	346	256	
Other species	7780	1850	398	
Total	85381	46260	44641	8179

multiplied or regenerated to obtain sufficient quantities of high quality seeds for preservation. The Program has distributed about 39,000 seed samples from the genebank to scientists worldwide.

Training is considered essential to build up the capability of national programs to manage their own germplasm resources, and develop efficient collaboration in genetic resources work within ICARDA's region. Several national genetic resources programs already have the basic gene bank equipment (deep freezers, seed drying equipment, micro-computers) mainly as donations from IBPGR. To assist national scientists involved in genetic resources activities in the establishment of national germplasm collections and in the efficient utilization of the facilities available, the

GRP has provided training and has started to repatriate a duplicate collection to countries in the region.

A short training course (4 weeks) was organised jointly with IBPGR and ACSAD in which 14 trainees participated from 9 Arab countries. The Program provided training (2-6 weeks) in genetic resources management for 8 trainees from 4 national genetic resources centers, and specialized training in germplasm documentation and electrophoresis techniques for 5 participants. Lectures are also presented by the GRP staff to trainees in the residential training courses of the commodity programs. On-job training in plant exploration and collecting techniques was provided for national program staff members who participated in the joint collecting missions.

Work has started on a modest scale, to utilize electrophoretic techniques to complement the field evaluation with biochemical characters. Results obtained were used to characterize genetic diversity within and among accessions, to reveal genetic gaps and geographic associations in germplasm collections and to identify distinct genotypes from populations of wild species related to ICARDA's mandate crops. With the assistance of the IBPGR and in collaboration with the PFLP scientists, an ecogeographic survey was also undertaken in Syria to reveal associations between the distribution of pasture and forage legumes and ecological factors.

2.2. Program priorities

Considering the achievements of the program, the present status of collections and the future needs for special types of germplasm within ICARDA and in NARS, a shift in the direction of the program is proposed. In the medium and long term, high priority will be given to:

1. The preservation of ICARDA's germplasm in both active and base collections in the new facilities at Tel Hadya and the establishment of duplicate base collections at selected

genebanks in other countries, and possibly in Norwegian permafrost coalmines. The development of effective procedures for monitoring the viability of the stored seed samples. (35% of resources).

2. The training of national germplasm bank personnel and the development of a network of collaborators for genetic resources work in the Region. (15% of resources).
3. The collection of germplasm of wild relatives and landraces to fill gaps in the collections. Increasingly more emphasis will be placed on developing the collections of wild species and on the collections of landraces from dry areas. (15% of resources).

The relative resource allocation among activities will change according to the proposed priorities (Table 2). A considerable increase in resources allocated to training and to the development of a genetic resources network within WANA is needed. The

Table 2. Projected changes in relative resource allocation among program activities.

	Resource allocation (% of total)		
Activities	**Current**	**Midterm**	**Longterm**
Collecting and acquisition	15	15	5
Maintenance	35	35	40
Characterization and evaluation	15	10	10
Documentation and data management	20	15	15
Distribution	10	10	10
Training and regional network	5	15	20

characterization and documentation of germplasm will require relatively less resources because these activities will concentrate on the newly collected and acquired germplasm when the characterization of existing collections is completed. The improvement of the data base system to make it more suited to genetic resources management will increase the efficiency of documentation while requiring less resources.

On long-term, collecting and acquisition of new germplasm is expected to decrease as the collections will become more representative of the existing gene pools of ICARDA mandate crops. An increase in resources allocated to the maintenance of germplasm is needed since the expected storage life of seed samples in the Active collection is about 15-25 years. Regeneration techniques applied should also be improved to minimize genetic changes by increasing the effective population size and decreasing selective pressures.

A further increase in resource allocation to training and regional network will also be necessary to duplicate ICARDA germplasm in the places of origin and to assist the NARS in the development of comprehensive national genetic resources collections. Regeneration of germplasm accessions near the place of origin and the establishment of "in situ" reserves for wild progenitors in collaboration with NARS would also be considered.

Research to study the genetic composition of populations adapted to stress environments and specific problems associated with the genetic maintenance of self- and cross-pollinated species will be conducted within the framework of projects for Ph.D students, postdoctoral fellows and visiting scientists, and in collaboration with the commodity programs. Ecogeographic studies and the biochemical characterization of germplasm will be extended in collaboration with IBPGR and other institutions. Research on the factors affecting the longevity of seeds of wild species will be initiated.

Collecting and training activities are normally conducted in consultation and collaboration with IBPGR. ICARDA will continue

to maintain active and working collections of all its mandated crops and to utilize them jointly with NARS. These collections will continue to be made freely available for users all over the world, but especially in WANA.

3. Seed Health Laboratory

3.1. Objectives: 1. To minimize the risk of spreading pests and pathogens with ICARDA's seed exchange.
2. To provide training in areas related to seed health to staff from National Programs (gene banks, seed programs, quarantine).
3. To conduct research on epidemiology and control of seed borne pathogens.

3.2. Summary of achievements (1982-1987)

In 1982, a scientist has been seconded from Bonn University with financial support from the German Academic Exchange Service to establish a Seed Health Laboratory (SHL) at ICARDA. The support continued until December 1987.

A system of channeling all incoming and outgoing seed through the SHL has been developed. All consignments are inspected visually for admixture of weed seed and soil as well as seeds with visible disease symptoms. For outgoing seeds, in addition the multiplications are carefully inspected in the field and specific health tests for statutory quarantine pathogens are carried out. If seeds are found infected or contaminated with quarantine pathogens, they are not send to the respective country.

For incoming seeds, those originating from a country where a pathogen not found in Syria occurs, are specifically tested. Example: wheat seeds from India, Pakistan, Afghanistan, Nepal, Iran and Mexico are tested by centrifuge wash test for contamination with spores of Tilletia indica (Karnal bunt). Infected/contaminated seeds are banned from planting. As additional safeguard, incoming seeds are planted for the first

generation in an "isolation area". The plants are regularly inspected and those found infected are destroyed.

Todate the activities have been concentrated on the most immediate need, that is the International Nurseries. The germplasm collection has not yet received the attention it deserves. Only small percentage of the 85,000 accessions has been tested for some fungal pathogens (Ascochyta spp. and Fusarium spp. in lentil and chickpea).

In the WANA region aspects of seed health are undervalued in seed production/seed certification as well as in seed exchange. This is partly due to the lack of trained personnel.

The Seed Health Laboratory contributed to residential training courses and specialised courses, i.e. five "Seed Production" and "Seed Testing" training courses held at Aleppo and one training course on Seed Production in Egypt.

In the individual training, trainees are exposed to the day-to-day problems in operating a seed health laboratory. Nine technicians from: Syria (3), Ethiopia (3), Egypt, Turkey and Iran have spent between one and twelve weeks in the Seed Health Laboratory.

Since priority was given to establishment of the laboratory, routine health testing of incoming and outgoing seeds, and training; research was given little attention. Different seed health testing methods were compared, and some experiments on the improvement of seed treatment (testing equipments for treatment of small quantities, evaluating adhesives for better seed coverage) and the treatment of barley against stripe disease have been conducted.

3.3. Future plans

The Seed Health Laboratory will continue to act as a service unit to facilitate the germplasm exchange by minimizing the risk of accidental spread of pests and pathogens. Activities in field inspection should increase. More attention has to be given to

the germplasm collections. In future, only material tested for viruses, bacteria and fungi should be stored. Test methods for bacteria need refinement.

In 1988, a first Seed Health Training Course, combined with a workshop and sponsored by the Ethiopian Seed Corporation and the ICARDA Seed Production Project, will be held in Addis Ababa. Seed Health will be also included in the Seed Technology Course in Sana'a, Yemen A.R.

Training materials, such as an audiotutorial module on seed health testing methods, are being developed. The links with the National Programs will be strengthened by publishing a newsletter jointly with the ICARDA Seed Production Project.

Research topics that would contribute to the production of healthy germplasm include:

- Epidemiology of selected seed borne diseases, e.g. Ascochyta blight and Fusarium wilt (the importance of seed-borne inoculum as compared to air- or soil-borne inoculum for disease development in dry areas, critical threshold for fungal pathogens, below which no transmission would be expected in an arid climate, etc.).
- Seed treatment, with emphasis on bacteria.
- New methods for detection of pathogens in seed.

4. Virology Laboratory

4.1. Introduction

With few exceptions, little work has been done on plant viruses in the countries of ICARDA mandate (West Asia and North Africa). The information available indicate that some viruses are of concern to ICARDA because of economic damage inflicted by them. Examples are bean leaf roll virus in faba bean and chickpea, bean yellow mosaic virus in faba bean and barley yellow dwarf virus in cereal crops. Several other viruses, particularly when

seed-transmitted, are of great potential importance. Because of their importance a virology laboratory was established at ICARDA in 1985 with funding from the Dutch Government (as restricted-core). Back stopping to the virology lab of ICARDA is provided by the Research Institute for Plant Protection (IPO), Wageningen, The Netherlands, through a linkage project also financed by the Dutch Government. Because all crop improvement programs encounter virus problems, the virology laboratory was linked to the Genetic Resources Program to be at the service of the whole institute.

4.2. Summary of achievements (1985-1987)

Field surveys: A survey of faba bean viruses in Egypt, Lebanon, Morocco, Sudan, Syria and Tunisia indicated that bean leafroll, bean yellow mosaic, broad bean mottle and broad bean stain viruses were the most common and their average incidence varied between 5 and 20%. Five other viruses were also detected but they were of low incidence (less than 1%). On chickpea, bean leaf roll virus seemed to be the only virus of economic importance.

The survey of viruses affecting cereal crops indicated that barley yellow dwarf virus (BYDV) is prevalent in all the countries surveyed (Algeria, Jordan, Morocco, Syria and Tunisia), but high incidences (20 - 50%) were only found in Tunisia and Morocco. Three strains of BYDV were identified and details on serotyping of BYDV isolates are developed.

Yield loss assessment: Yield loss experiments conducted to evaluate losses induced by three commonly present viruses on faba bean indicated that even late infection (during pod setting) could lead to 39, 38 and 19% yield loss, respectively.

Screening for virus disease resistance: Screening faba bean lines over the last two years focused on resistance to bean leaf roll virus (BLRV) and bean yellow mosaic virus (BYMV). No faba bean

genotype has been identified as resistant to BLRV; however, few lines were found to have good tolerance to BYMV. Screening chickpea germplasm for BLRV resistance started this year.

Screening cereals (bread wheat, durum wheat and barley) identified germplasm with tolerance to BYDV. A net-work supported by an IDRC grant, was established in the region to collaborate on BYDV research. Cereal lines found to be tolerant to BYDV in Aleppo, are being sent to Tunisia and Morocco (Settat & Agadir) for further evaluation under different conditions.

Seed-borne viruses: detection and reducing chances of spread: Five food legume viruses and one cereal virus naturally present in the region are seed-borne. Tests to detect them in seeds were developed. A collaborative program with the seed health laboratory and the food legume and cereal programs to produce faba bean and barley virus-free seeds is in progress.

4.3. Training

Technical competence in plant virology is limited in the region. Two trainees, one from the University of Damascus and the other from Tishreen University, finished their M.Sc. thesis research at the virology laboratory. In addition, short term training (6 weeks) on virus diagnosis was provided to one trainee from Tunisia and one from Morocco. The virology laboratory is involved in the residential courses given by the different programs of ICARDA.

4.4. Future directions

When the virology laboratory was established at ICARDA in 1985, the following were envisaged as the main tasks: (i) survey crops of the ICARDA's mandate for viruses, (ii) study the ecology of viruses that are of economic or potential importance, (iii) develop methods of control with emphasis on prevention of spread

by seed and on breeding for resistance, (iv) check incoming and outgoing seeds (germplasm) for virus freedom and the development or improvement of methods required, and (v) start documentation on virus diseases of ICARDA crops.

As indicated in the summary of achievements 1985-1987 many of the expected activities were initiated. However, the future directions of the virology laboratory are outlined as follows:

1. Field surveys should be carried out in the future by the researchers of the national programs. In-puts to make such surveys possible could be provided by the virology laboratory at ICARDA.
2. Develop more simple and sensitive techniques for virus detection.
3. Continue efforts in training scientists from the region.
4. Continue screening for virus disease resistance in breeding lines and wild species to build-up germplasm pools for this trait with more emphasis on chickpea and cereals, and develop faster methods to identify virus resistance in crops.
5. Continue the efforts in producing virus-free germplasm for international distribution.
6. Initiate research on viruses of forage crops.
7. Develop and strenghten a virology network in the region.

The allocation of resources available to the virology laboratory at present and in the future are indicated in Table 3. It has been recommended that virology research at ICARDA to be core funded starting 1989.

Table 3. Comparative allocation of resources available to the virology lab to different activities at present and in the future.

Activity	% resource allocation		
	Present	Midterm (2–4 years)	Longterm (5–20 years)
Surveys	25	15	5
Screening for resistance	30	30	30
Testing for seed-borne viruses	20	15	15
Improving diagnostic techniques	10	15	20
Training	15	20	20
Innovative approaches for virus-disease control	0	5	10

PROGRAM REPORT FOR 1987

1. Program highlights

High priority was again accorded to preservation, documentation and evaluation of the germplasm collections in 1986/87. However, collecting activities have gained considerable importance in response to the expressed needs of ICARDA scientists. This program element has emerged to be a priority activity, moreso, because of the growing interests in wild and related species. Accordingly, more resources were deployed for expanded work in this area. Training and genetic resources research, although important, continued to be low-keyed activities because of limited resources. Program highlights in 1986/87 were:

- Significant progress was made in enlarging the germplasm holdings by collecting geographically and genotypically representative germplasm of ICARDA's mandate crops. A total of 10,180 accessions were added to the collections as a result of collecting trips in Egypt, Morocco and Syria and through requests from other genebanks. The total number of accessions in the germplasm collections has increased to 85,381.
- Multiplication of new accessions of bread wheat (2,284) durum wheat (604), lentil (168), chickpea (270), faba bean (98), annual Medicago species (288), Vicia species (439) and Lathyrus species (242) for characterization and evaluation.
- Regeneration of 19,628 entries of cereal, food legume and forage germplasm to meet storage requirements and for distribution. A total of 25 hectares was devoted to the multiplication and regeneration of germplasm.
- The germplasm data base was enlarged to include additional passport and collection information for 2,801 new entries and evaluation data for 4,611 accessions.
- The production of a second barley germplasm catalog for 4,129 accessions and a faba bean passport information catalog for 3,265 entries.

- The Program processed 12,967 accessions for storage in controlled environment and prepared and dispatched 11,601 entries to scientists in 28 countries.
- An evaluation study for disease reaction in Triticum turgidum var. dicoccoides indicated that this species could be a valuable source for resistance to yellow rust, Septoria blotch and common bunt.
- In a continuing study to evaluate durum wheat landraces, results suggested that the germplasm of landraces could be exploited to increase productivity of durum wheat cultivars.
- Evaluation studies conducted on 1026 lentil accessions, 225 entries each of Vicia villosa, and Lathyrus sativus, 100 of V. narbonensis and 100 accessions of two other Lathyrus species indicated there is a wide variability in these germplasm materials which can be utilized by plant breeders.
- Experiments using polyacrylamide gel electrophoresis (PAGE) demonstrated (a) the presence of certain variants of storage protein in the wild progenitor of durum wheat (T. turgidum var. dicoccoides) which are associated with good cooking quality of durum wheat and (b) that SDS-PAGE technique could be used to identify genotypes in the wild lentil and chickpea collections for hybridization studies.
- The Seed Health Laboratory performed 3793 tests on representative samples of seed lots in an effort to intercept pests and disease organisms that might be present in the outgoing and incoming seeds.
- The Virology Laboratory continued its survey of viruses affecting cereal but especially food legume production in Morocco, Tunisia and Syria.
- Evaluated yield loss in faba bean due to prevalent viruses affecting this crop.
- Screened (a) 300 faba bean lines for their reaction to bean leaf roll and bean yellow mosaic viruses and (b) 720 cereal accessions for reaction to barley yellow dwarf virus.

- Tested 3000 seed lots of cereals and faba bean for seedborne viruses prior to international shipments.

2. New germplasm in 1986/1987

The filling of geographic and genetic gaps in ICARDA's germplasm collections through collecting missions and acquisition of samples from other collections continued in 1987. Germplasm from certain areas in North Africa is underrepresented in ICARDA's collections. Collecting missions to these countries are therefore being given priority. In 1987 germplasm collections were made in collaboration with national programs and other scientists in Egypt, Morocco and Syria.

Landraces from stress environments in ICARDA region were found to be important sources of drought and salt tolerance by ICARDA scientists. In order to obtain additional germplasm adapted to dry and saline conditions, a collecting mission was undertaken to explore for cereal landraces in the northern part of Sinai and the north-western coastal areas in Egypt. With the participation of national program scientists, 104 populations and 438 single head samples of Hordeum vulgare, 33 populations of Hordeum distichum, 56 populations and 140 single head samples of Triticum aestivum, 8 populations of Lens culinaris, and 1 population of Pisum sativum were obtained.

There are reports on the widespread genetic erosion of traditional cereal and food legume germplasm due to the rapid expansion of modern cultivars and the replacement of legumes with more economic crops in Morocco. Two collection trips were therefore undertaken in 1987 to preserve representative germplasm of local varieties and landraces. A cereal collection expedition with scientists from ICARDA, from the National Agricultural Research Center, Japan, and from the Institut National de la Recherche Agronomique (INRA), Morocco, was organized to explore areas in Morocco which were not previously sampled. The mission

was split into two teams to ensure a maximum coverage of the areas in the northern part of the country. The region sampled ranged from sea-level to 2150 m elevation in the middle Atlas mountains. The collection sites included some with highly saline soils (Tatouan area), irrigated fields, and some very dry sites near the desert (south of Oujda area). A total of 188 germplasm samples was collected. This included 59 barley, 57 durum wheat, 50 bread wheat, 7 Hordeum bulbosum, 3 H. murinum, 5 Aegilops spp., 2 Avena sativa, 1 Vicia faba and 1 Phaseolus samples.

A food legume collecting mission was undertaken from 25 June to 13 July, jointly with local scientists and the Genetic Resources Unit of ICRISAT. The aim of the mission was to explore and collect chickpea landraces from those areas where chickpea production has started to decline because of persistent drought and disease problems. It is anticipated that there will be a rapid spread of winter-sowing of chickpea using breeding material supplied by ICARDA. The areas covered by the mission included the main chickpea growing areas where the rate of genetic erosion was found to be greater than expected. In the Settat-Safi region, yields were extremely low as the crops were affected by severe drought and Fusarium wilt. In many cases, it was difficult to collect even small seed samples since the farmers harvested a very limited quantity of seeds which were reserved for sowing the following season. In the Meknes-Fez region, especially in the north, and north-west of Meknes, sunflower production, which is subsidized by the government, is expanding and is rapidly replacing other crops including chickpea. A total of 182 samples was collected during the mission; these include 123 chickpea, 31 lentil, 20 faba bean and 8 forage legume accessions. Subsamples of the chickpea landraces collected will also be planted by the Moroccan national program for evaluation and for comparison with the winter-planted breeding material from ICARDA.

A collection trip was also undertaken in the main durum wheat growing regions of Syria in June, 1987. This was a joint mission with the Genetic Resources Unit of the Agricultural Research

Station at Douma, Syria. Priority was given to explore and collect durum wheat landraces while recording pertinent environmental data. Considerable effort was made to obtain landraces which had been cultivated for a long time in any particular region. A total of 268 samples was collected of which, 157 were durum wheat landraces. The landraces were collected as bulk samples and, whenever possible, as single spike samples as well. Valuable material was obtained from the western parts of the country and north of Hassakeh. Collection in the plains in the southern, central and northern parts of Syria yielded only a limited number of durum wheat landraces, since most of the local varieties have already been replaced in these areas. In addition to the durum wheat landraces, samples of Hordeum distichum (26), H. vulgare (1), H. bulbosum (1), Triticum aestivum (8), durum wheat varieties (6), Triticum turgidum var. dicoccoides (2), different legume species (40), and horticultural crops (27) were obtained.

In addition to the planned germplasm collecting trips, scientists in the Food Legume Improvement Program obtained samples of lentil (213), chickpea (152) and faba bean (224) from farmers' stores during a survey of food legume pests in Syria. These germplasm materials were obtained in regions which were not previously sampled and will therefore constitute an important addition to genebank material at ICARDA.

In addition to field expeditions, germplasm samples were requested and obtained from other genebanks and scientific institutions. Altogether a total of 10,180 new entries from 18 countries were added to the collections which now total 85,381 accessions (Table 1,2).

3. Multiplication and characterization of new germplasm

New germplasm samples collected or obtained in the previous year may have attributes of immediate use in breeding programs. It is essential therefore to multiply these samples at the

Table 1. Country of origin and number of new germplasm accessions in 1986/87.

	Cereals				Food legumes				Forages		
Country	Barley	Durum wheat	Bread wheat	Wild species	Lentil	Chickpea	Faba bean	Wild species	Medics	Trifolium species	Other species
Algeria					2	3					
Argentina					3						
Australia									56		
Czechoslovakia					1						
Cyprus						1			187	10	
Egypt	137		56		8						1
Ethiopia					3						
France					1	5					
India					3	1					
Iran					1						
Italy									148		
Morocco	59	57	50	15	31	123	21			35	6
Poland							14				
Portugal						2					
Spain					4						
Syria	27	163	8	3	233	154	224	6			7
Tunisia										11	
Turkey	1	2537	5254	491	9	2	1	5			
Total	224	2757	5368	509	299	291	260	11	391	56	14

Table 2. Present status of germplasm collections at ICARDA.

Crop	Number of accessions		Number of Descriptors used
	Total	Evaluated to date	
Cereals			
Barley	15942	12129	22
Hordeum spontaneum	1208	1208	4
Hordeum bulbosum	205	182	5
Durum wheat	20085	13213	14-25
T. turgidum var. *dicoccoides*	919	855	19
Aegilops spp. (26 species)	677		
Bread wheat	10419	2780	25
Sub Total	49455	30367	
Food Legumes			
Lentil	6498	6343	8-26
Chickpea	6437	4978	4-29
Faba bean	2892		
Wild *Lens* (4 species)	195	185	8
Wild *Cicer* (8 species)	39	34	6
Sub Total	16061	11540	
Forages			
Medics 26 species)	4302	1778	17-34
Lathyrus (27 species)	934	346	24-26
Vicia (34 species)	3548	379	16-34
Pisum spp.	3301		
Other spp.	7780	1850	34
Sub Total	19865	4353	
Total	85381	46260	

earliest opportunity to obtain adequate amount of seeds for evaluation and preservation. An isolation area at Tel Hadya serves this purpose, where the health status of the new genetic material is carefully monitored to prevent the introduction and spread of pests and diseases. Selected descriptors are routinely used to obtain information for the preliminary characterization of the new germplasm.

In 1986/87, 2284 new entries of bread wheat and 604 new durum wheat accessions were planted in the isolation area and characterized for five traits. All the new food legume germplasm was also multiplied. New accessions of chickpea (141) and lentil (150) which had sufficient seeds, were sown on larger plots and evaluated for five and seven traits, respectively. New samples of faba bean (98 populations) were planted for multiplication in a screenhouse. Flowers were tripped to enhance pod setting but no intercrossing between plants of the same populations was made.

A total of 1430 new forage germplasm was multiplied in a plastic house or in the field depending on the seed quantitites available. The Vicia (460), Lathyrus (249), annual medics (242) and Pisum (31) accessions, planted in the isolation area, were characterized for 6 important traits.

4. Germplasm regeneration, preservation and distribution

In 1986/87, germplasm accessions with low seed viability and/or low seed supply were again regenerated to obtain sufficient amount of high quality seed for conservation, evaluation and distribution. Altogether, 19,628 accessions of cereal, food legume and forage germplasm including wild species were sown and harvested from a total of 25 hectares at Tel Hadya (Table 3).

The processing and storing of germplasm in controlled environment are ongoing activities. In the past year 12,967 entries were prepared and deposited in storage (Table 3).

ICARDA has an open-door policy as regards germplasm exchange

Table 3. Germplasm regeneration and status of preservation in medium term storage in 1987.

Crop Group and Species	Number of Accessions	Area Planted (ha)	Number of acc. stored in 1986/87	Total number of acc. in storage
Cereals				
Hordeum spp.	2769	0.4 (1-4 rows)		12624
T. durum	8329	6.8 (1-4 rows)	4000	7000
T. aestivum	2283	0.7 (1-4 rows)	1780	2780
Wheat wild relatives	896	1.3 (1-5 rows)	1177	1177
H. spontaneum				1208
Sub-total	14277	9.2	6957	24789
Food Legumes				
Lens culinaris	1631	2.2 (1-4 rows)	609	6190
Cicer arietinum	439	0.9 (1-3 rows)	350	5927
Vicia faba	288	10.0 (1-12 rows)	185	2737
Wild relatives	325	(Plastic house)	97	229
Sub-total	2683	13.1	1241	15083
Forages				
Medicago spp.	242	0.3	1020	1020
Vicia spp.	1465	1.4	1175	1175
Lathyrus spp.	930	0.9	256	256
Pisum spp.			1920	1920
Other spp.			398	398
Sub-total	2668	2.6	4769	4769
Total	19628	24.9	12967	44641

and the use of its genetic materials. The underlying principle is that germplasm collections are held in trust by the Center and are available without reservation to the global community of scientists for research. Consistent with this policy, the Genetic Resources Program has been devoting considerable resources to

fulfill requests for germplasm from the Center's genebank. In 1986/87, a total of 11,595 entries were sent to scientists in 28 countries (Table 4). In addition the GRP supplied seed samples from 5916 accessions to scientists in the commodity programs at ICARDA.

Table 4. Number of germplasm samples distributed to different countries in 1986/87.

	Cereals			Food legumes				Forages		
Country	Barley	Durum wheat	Wild species	Chickpea	Lentil	Faba bean	Wild species	Medicago species	Vicia species	Other species
Algeria				2						
Argentina				100	85					
Australia	4				39				113	40
Canada	698									
Colombia									29	
Cyprus	40									
Egypt			4							
Ethiopia		200								
France	20							23	75	71
Germany F.R.					20				26	
India	30	201	8			30			176	
Iran				1223	968					
Iraq								15		
Italy		4672	30							
Japan				36	53					
Jordan			116					15		
Kenya		200								
Morocco		96								
Netherlands	2									
Pakistan		200			500				65	
Portugal		41								
Spain					70					
Sweden								61		38
Syria									40	20
Tunisia				1						
Turkey		220	12							
USSR				341	227		6	50	10	15
USA	59	8	57				3			97
Total	853	5838	227	1703	1962	30	9	164	534	281

5. Evaluation of germplasm collections

5.1. Evaluation of *Triticum turgidum* var. *dicoccoides*

A set of 200 entries of *T. dicoccoides*, collected in Italy and West Asia, was evaluated for resistance to yellow rust (*Puccinia striiformis*), *Septoria tritici* blotch (*Mycosphaerella graminicola*) and common bunt (*Tilletia foetida* and *T. caries*) jointly with the

Table 5. Evaluation of germplasm of Triticum turgidum var. dicoccoides for reaction to yellow rust (YR), Septoria tritici blotch (ST) and common bunt (CB), 1986/87.

Country of origin	Number of entries	Number of entries resistant		
		YR*	ST**	CB**
Italy	16	2	16	12
Jordan	58	0	50	48
Lebanon	3	3	3	3
Syria	58	8	58	56
Turkey	58	2	49	52
Unknown	7	1	7	5
Total	200	16	183	176

* Evaluation based on one replication
** Evaluation based on two replications

wheat pathologist of the Cereal Improvement Program. The nurseries were planted at two locations. The entries were screened for yellow rust and common bunt at Tel-Hadya, and for Septoria blotch at Lattakia. Accessions ranged from resistant (scored 0) to highly susceptible (scored 9).

A wide range of variation in disease reaction was observed among the different genotypes for all the three diseases. Ratings for yellow rust infection varied from 0 to 9, for the common bunt from 0 to 6 and for Septoria tritici blotch from 0 to 8. A total of 183 accessions was scored as resistant to Septoria tritici blotch, 16 to yellow rust and 176 to common bunt (Table 5). Some of the entries appeared to be free from all three diseases indicating the presence of combined resistance. Ten such genotypes were identified from the germplasm originating in Syria, two from Turkey and one from an unknown origin in West Asia.

Following confirmation of resistance to these diseases, selected entries will be utilized as sources of resistance in durum wheat improvement. Collecting missions will be organized to explore and acquire additional germplasm from the regions where resistant genotypes were obtained.

5.2. Evaluation of durum wheat landraces

In a collaborative project between the GRP and the University of Berlin (W. Germany) 24 landraces and 10 varieties of durum wheat were evaluated. Two local checks (Sham-1 and Haurani) were included into the experiment, planted in double lattice design (6X6) at Tel-Hadya. The plot size was $7.2m^2$ and each entry was sown at a seed rate of 420 seeds per square meter (175-220kg/ha). Ammonium sulphate (40 kg/ha) and triple superphosphate (60kg/ha) applied before planting, were supplemented by additional ammonium sulphate (80kg/ha) at boot stage.

Data were recorded for 19 characters including number of days to emergence, germination density, number of days to: awn appearance, heading, maturity, and filling period, number of tillers and spikes per square meter, plant height, growth habit, vigour, low temperature damage, grain yield, straw yield, harvest index, lodging, 1000-kernel weight, spike and leaf colour, and reaction to yellow rust. The mean values of 6 quantitative traits and the harvest index are presented in Table 6.

Considerable variation was detected among the entries for the characters evaluated. Most of the landraces were significantly taller than the varieties studied. Many entries were later in heading time than Sham-1; however, three entries, Adana-108, Atsiki-1 and Atsiki-4 were significantly earlier. Significant variation was also found in 1000-kernel weight; two Turkish landraces (Urfa and Bittis) had the largest kernels and their 1000-kernel weights were significantly higher at P=0.05 level than those of local checks (Sham-1 and Haurani). Three Turkish varieties, Adana 207 (3864kg/ha), Gediz (3850 kg/ha), Bintep (3817

Table 6. Mean values of 7 traits for varieties and landraces of durum wheat grown at Tel Hadya 1986/87.

Entry	No. of tillers per m^2	Biol. yield kg/ha	Grain yield kg/ha	Harvest index	1000 K.W. (g)	No. of days to heading	Plant height (cm)
BALIKESIR	697	9438	1553	16	33	152	123
ADIYAMAN	766	7993	1421	17	35	151	116
BINTEP*	653	11572	3817	33	35	143	101
YOZGAT	725	7513	1379	18	32	156	115
URFA	817	9979	1724	18	37	151	115
ERZINKAN	845	9910	1558	16	28	157	116
GOKGOL*	797	8455	1833	22	28	150	79
ADANA 108*	647	9978	2905	29	25	139	91
MANISA	677	9448	1747	19	31	148	131
LIMNOS	719	9131	1698	18	31	149	128
JAPIGA*	738	10916	3275	30	33	142	88
GEDIZ*	604	11455	3851	34	33	142	90
GAZIANTEP	668	9778	2204	22	31	146	119
KUNDURU*	628	10457	1915	22	34	153	122
CANAKKALE	725	8764	2213	22	31	151	126
AYDIN	619	9455	1765	18	29	148	128
AMASYA	702	9152	1669	18	34	156	123
MYRINA	711	7899	1466	17	30	141	118
TOKAT	701	9267	2097	22	33	155	122
SHAM 1*	673	11554	3479	29	30	142	91
CAKMAK*	827	9198	2355	25	27	152	75
ANKARA	671	9021	2178	25	34	155	123
ANTAKYA	758	8285	1568	19	33	149	115
HOURANI*	676	9912	2623	27	33	146	124
K. MARAS	669	11098	2743	25	36	145	122
BURSA	704	8243	1541	18	30	149	124
MARDIN	702	8539	1727	20	34	153	110
DENIZLI	662	9501	1810	19	35	153	125
BITLIS	684	7847	1231	15	38	160	104
ATSIKI 1	680	9645	2599	27	32	138	112
DIYARBAKIR*	646	9496	2747	29	35	147	97
ATSIKI 4	723	10159	2904	28	32	136	94
MOUNDROS	696	11663	3559	31	35	142	113
IZMIR	517	8566	1414	17	29	150	132
MONDUR*	636	9440	2305	24	28	151	104
ADANA 207*	600	11316	3865	34	36	141	96
LSD P< 0.05	106	1935	757	5	4	2	7
Overall mean	693	9557	2243	23	32	148	112

* Varieties

kg/ha) and one Greek landrace, Moundrous (3558 kg/ha) had significantly higher grain yields than the local check Haurani (2622kg/ha), but their yields did not differ significantly at P=0.05 level from the other local check, Sham-1 (3478 kg/ha). Many of the landraces had significantly lower harvest index than the local checks; three Turkish varieties (Bintep, Gediz, Adana 207) however, significantly exceeded the local landrace check Haurani in this respect.

The results of the trial indicate that certain landraces have desirable traits which can be incorporated into existing cultivars to improve the yield of durum wheat. Concerted efforts are being made by the Genetic Resources Program to assemble landraces of durum wheat which can be exploited in the breeding program.

5.3. Evaluation of lentil germplasm

A total of 1026 lentil accessions which had not been previously evaluated, was planted in an unreplicated trial with 2 systematically repeated checks, Syrian Local Small (SLS) and Syrian Local Large (SLL). Twenty two characters were evaluated using the format of the IBPGR/ICARDA descriptor list. The data obtained were documented and subsequently analyzed.

Characters evaluated were days to 50% flowering, flower colour, number of flower/peduncle, leaf pubescence, leaf size, tendril length, days to 90% maturity, plant height, height of the lowest pod, lodging, pod pigmentation, pod shedding, pod dehiscence, number of seeds/pod, 100-seed weight, seed coat colour, seed coat pattern, colour of seed coat pattern, cotyledon colour, biological yield, grain yield, and harvest index.

A summary of measurements of 9 quantitative characters is given in Table 7. The standard deviation of each character for the repeated checks were used to assess the magnitude of environmental variation. Considerable variation was detected in the germplasm accessions for all characters studied. The range of flowering time, measured in days to 50% flowering, was from 99 to 143 days.

Some of the accessions flowered earlier than the checks. As many as 64 accessions required less than 105 days to flower, whereas the SLS and SLL checks flowered at 114 and 115 days after sowing, respectively. Plant height also varied among accessions; a total of 219 accessions were taller than the maximum value (39 cm) observed in the SLL check. The height of the lowest pod, measured from the surface of soil, varied from 2 to 33 cm; the coefficient of variation for this trait was considerably larger for the germplasm entries than for the local checks indicating the magnitude of genetic variation in the germplasm evaluated. The number of seeds per pod measured as a mean of 30 pods varied from 0.7 to 2.0; some entries (54) had more seeds per pod than the maximum value (1.8) in the SLS check. The standard deviations for biological and grain yield in the repeated checks were high, implying a strong environmental influence. The accessions had a higher variation for yields; this suggested genetic variation for yield. The influence of the environment on harvest index was less pronounced.

Variation in the qualitative characters was also detected (Table 8). Some of the accessions showed no lodging, pod shedding nor pod dehiscence. Polymorphism was observed in 394 accessions for seed colour and in 46 entries for cotyledon colour. The information obtained from this evaluation was utilized to select accessions with desirable traits for the lentil breeding program.

5.4. Multiplication and evaluation of wild lentil and chickpea accessions

Wild Lens and Cicer species including the progenitors of the cultigens may represent valuable sources of genes not available in the cultivated species. Since both lentil and chickpea originated in the "Fertile crescent" area, the wild germplasm collected in Syria in 1986 is an important addition to the existing collection.

All the new samples (89) of wild species of Lens collected in Syria in 1986 were planted in a plastic house together with

Table 7. Summary of statistics on 9 quantitative traits evaluated in 1026 cultivated lentil accessions.

Characters	Mean		Minimum		Maximum		Standard Deviation		C.V.%	
Days to flowering	117.0	(114.4)*	99.0	(114.0)	143.0	(116.0)	8.6	(0.8)	7.3	(0.7)
Days to maturity	162.5	(159.3)	151.0	(156.0)	185.0	(165.0)	8.5	(2.0)	5.2	(1.3)
Plant height (cm)	33.4	(30.0)	10.0	(23.0)	57.0	(39.0)	7.2	(3.1)	21.6	(10.3)
Lowest pod height (cm)	17.5	(14.8)	2.0	(9.0)	33.0	(18.0)	5.7	(1.9)	32.6	(13.0)
No. of seed/pod	1.3	(1.6)	0.7	(1.3)	2.0	(1.8)	0.3	(0.1)	20.0	(8.3)
100-seed weight (g)	3.9	(2.9)	1.6	(2.6)	7.9	(3.3)	1.3	(0.1)	33.0	(4.9)
Biological yield (g/m^2)	314.1	(335.4)	81.3	(226.7)	760.0	(488.0)	113.4	(50.0)	36.0	(14.9)
Grain yield (g/m^2)	108.0	(133.6)	3.3	(80.0)	368.0	(173.0)	56.2	(20.8)	52.0	(15.6)
Harvest index	0.3	(0.4)	0.03	(0.3)	0.8	(0.5)	0.13	(0.04)	37.3	(10.4)

* Values in brackets refer to the check Syrian Local Small (ILL 4401)

Table 8. Frequencies of descriptor states for some characters scored on 1026 lentil germplasm accessions in 1986/87.

	Leaf pubescence		Leaf size		Lodging susceptibility		Pod shedding		Pod dehiscence	
* Descriptor States	No. of Observation	Frequencies (%)	No. of Obs.	Freq. (%)	No. of Obs.	Freq. (%)	No. of Obs.	Freq. (%)	No. of Obs.	Freq. (%)
0	137	13			120	12	364	36	408	40
3	756	74	164	16	269	26	388	38	352	34
5			412	40	460	45	169	16	167	16
7	133	13	450	44	177	17	105	10	99	10

* According to the IBPGR/ICARDA Descriptor list, 0, 3, 5 and 7 stand for the absence, slight, medium and high expression of the character, respectively.

94 wild genotypes from the existing collection. Heterogeneous samples were initially separated on the basis of seed characters and planted into separate pots. A total of 232 subsamples were planted and evaluated for days to flowering, leaflet shape (first leaf), stipule shape, number of leaflet/leaf, seed coat pattern, cotyledon colour, 100-seed weight and number of seed/plant.

All the new accessions were identified taxonomically and mixed samples (Lens orientalis + Lens ervoides, Lens culinaris + Lens orientalis and Lens culinaris + Lens ervoides) were separated. All the samples collected as Lens nigricans appeared to be Lens odemensis or Lens orientalis. To date, no L. nigricans sample is available from Syria. The earlier reports on the occurence of Lens nigricans in this country were most probably based on "odemensis" type samples.

Wild chickpea accessions of 8 annual species were also planted in 210 pots in a plastic house for multiplication and characterization. Characters evaluated were days to flowering, number of leaflets, 100-seed weight, seed coat surface, and testa colour. Some of the characters evaluated were also used to separate and identify morphologically similar species such as Cicer pinnatifidum and C. judaicum or C. bijugum, C. reticulatum and C. echinospermum.

Hybrid seeds obtained in 1986 from a cross between a single leaf mutant of Kabuli chickpea (ILC 1250) and Cicer reticulatum (ILWC 21) were also planted. All the F1 plants had compound leaves, purple flowers and the size of seeds was intermediate between the parents. The hybrid plants were all fertile and yielded 21 to 34 seeds.

Most of the genotypes of wild species of Cicer yielded sufficient seeds for a second cycle multiplication in the field. Two Cicer bijugum and 19 C. reticulatum samples will be planted again in a plastic house because of the limited amount of seed. A total of 137 genotypes from 8 Cicer species will be evaluated for cold tolerance, cyst nematode, leaf miner and Ascochyta blight resistance by the Food Legume Improvement Program in 1988.

5.5. Evaluation of annual forage legume species

During the 1986/87 cropping season, four experiments were conducted in collaboration with the forage scientist in the Pasture, Forage and Livestock Program, to evaluate 225 accessions of Vicia villosa, 100 accessions of Vicia narbonensis, 225 accessions of Lathyrus sativus, 57 accessions of L. cicera and 43 accessions of L. ochrus. The experimental layout for each of the trials, was a simple lattice design with 2 replicates, and a 3-row 3.0 m plot size.

The following characters, days to first flowering, 50% flowering, 100% flowering, days to podding, days to maturity, plant height, number of branches per plant and seed yield (kg/ha) were recorded. The accessions were also scored on a 1-5 scale (1 good, 5 poor) for establishment, seedling vigor, winter and spring growth, cold effect, leafiness, growth habit and pod shattering.

5.5.1. Woolly-pod vetch (Vicia villosa)

The 225 accessions of V. villosa showed a wide range of variability (Table 9). Early and late genotypes were identified. Plant height ranged between 22.5 cm-100 cm. The variation in the number of branches per plant (6-23 branches/plant) reflected a corresponding variation in seed yield (511-2352 kg/ha). An important finding was the identification of genotypes with a high proportion of leaf retention as this is related to dry matter production.

Thirty six genotypes were selected for further evaluation to assess dry matter and seed yield production.

5.5.2. Narbon vetch (Vicia narbonensis)

V. narbonensis showed highly desirable attributes when grown in dry conditions. An important trait observed in narbon vetch is its resistance to bird damage during the early stages of growth.

It appears to be one of the most resistant Vicia species. Some genotypes flowered early and set pods that matured before Orobanche infection. Substantial variation was observed in plant height, number of branches per plant and in seed yield. A total of 25 accessions were selected for further tests in dry areas.

5.5.3. Chickling vetch (Lathyrus sativus)

Wide variability was found among the 225 L. sativus accessions evaluated (Table 10). The range of variation for days to germination, flowering, podding, and maturity were 19-23 days, 108-137 days, 125-156 days and 153-181 days, respectively. A range of 17-40 cm was observed for plant height and 259-1074 kg/ha for seed yield. The best 36 genotypes were selected by the forage scientist for further tests.

5.5.4. Ochrus vetch (Lathyrus ochrus)

Although the number of accessions (43 accessions) evaluated was low, substantial variability was found (Table 10). Days to germination ranged between 19-23 days, flowering 108-126 days, days to podding 114-133 days and days to maturity 156-166 days. Plant height varied from 15-29 cm and seed yield from 247-1568 kg/ha. An important character was the resistance of certain genotypes to Orobanche. Sixteen selections were identified for further testing.

5.5.5. Dwarf chickling (Lathyrus cicera)

The L. cicera accessions were appraised together with the Lathyrus ochrus entries. Only a limited number of accessions were available for evaluation (Table 10). Sixteen accessions showed desirable characters such as early maturity and high seed yield and were selected for further evaluation in microplot field trials.

Table 9. Range of variability of eight characters in a germplasm collections of Vicia villosa and V. narbonensis accessions.

Characters	V. villosa				V. narbonensis			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Days to first flowering	114.0	156.0	134.9	0.69	100.5	134.5	111.7	0.64
Days to 50% flowering	120.5	162.0	142.9	0.69	108.5	139.5	116.9	0.64
Days to 100% flowering	128.0	168.5	150.5	0.69	112.5	153.5	122.8	0.84
Days to first podding	129.0	169.5	151.4	0.69	113.5	154.5	123.8	0.84
Days to maturity	162.0	196.0	180.7	0.56	156.0	179.5	161.1	0.49
Plant height (cm)	22.5	100.0	66.9	1.13	10.0	90.0	53.3	2.04
No. of branches/plant	6.0	23.0	10.8	0.17	2.5	14.5	4.9	0.23
Seed yield (kg/ha)	511.1	2351.9	961.9	12.69	437.0	4981.5	2820.5	49.50

Table 10. Range of variability of six characters in a germplasm collections of Lathyrus sativus, L. ochrus and L. cicera accessions.

Characters	L. sativus				L. ochrus				L. cicera			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Days to germination	19.0	23.5	19.9	0.07	19.0	23.5	20.5	0.15	19.0	22.5	19.9	0.12
Days to flowering	108.0	137.0	119.0	0.23	108.5	126.0	110.4	0.43	110.0	124.5	114.2	0.38
Days to podding	125.5	156.0	140.5	0.43	114.5	133.5	117.2	0.44	117.0	129.5	121.0	0.40
Days to maturity	153.0	181.0	168.2	0.36	156.0	166.0	158.7	0.29	159.5	168.5	162.2	0.19
Plant height (cm)	17.0	40.0	27.0	0.27	15.0	29.5	20.3	0.60	14.5	28.5	23.3	0.40
Seed yield (kg/ha)	259.3	1074.1	397.5	5.89	246.9	1567.9	1247.9	14.60	253.1	1975.3	1312.4	18.30

Selection for forage plants based on the genetic diversity observed in these species would favour Vicia narbonensis and V. villosa. The mean values for vegetative and seed production were higher in these two species than for Lathyrus species which were evaluated concurrently. Vicia villosa accessions on the whole, were late flowering (mean = 135 days); however, it would be possible to select genotypes for early flowering traits if this character is considered desirable. The Lathyrus species were early flowering, early maturing and low in dry matter and seed production. These species could be usefully exploited when grown in a mixture with Vicia species. They could ensure early and a more uniform distribution and availability of forage throughout the production season. Additional information on regrowth characteristics and stress tolerance is needed.

6. Documentation of genetic resources

Information on the germplasm accessions are routinely added to the database to enable scientists to exploit the genetic diversity available in the germplasm collection. A comprehensive database can also assist in the identification of duplicate entries and geographic gaps in the collections.

The data bank was enlarged in 1986/87 to include:

(a) Collection and passport information for
- (i) 201 samples of cereal germplasm
- (ii) 182 food legume samples
- (iii) 766 medics accessions
- (iv) 902 lentil entries
- (v) 679 accessions of 27 Vicia species
- (vi) 71 accessions of Pisum species

(b) Evaluation data for
- (i) 2644 durum wheat accessions (14 traits)
- (ii) 1026 lentil entries (22 traits)
- (iii) 325 accessions of Vicia spp. (16 traits)

(iv) 325 entries of Lathyrus spp. (24 traits)

(v) 141 new chickpea accessions (5 traits)

(vi) 150 new lentil entries (7 traits)

In this exercise an extensive amount of information was collated, documented and edited (Tables 11,12). In addition, collection and passport information of forage germplasm collections at ICARDA was provided on magnetic tape to be included in the IBPGR forage database.

In 1987, a second volume of the barley germplasm catalog which includes passport and evaluation information for 4129 accessions, and a faba bean passport information catalog for 3265 accessions were prepared for publication.

Table 11. Documentation status of the germplasm passport and collection data at ICARDA.

	Collections		Documented in 1987		Documented to date	
Crop	No. of acc.	Descriptors to be documented	No. of acc.	No. of Descript./ crop	No. of acc.	No. of Descript./ crop
Barley	15942	21			12138	4-15
Durum wheat	20085	15			10207	3
Bread wheat	10419	15			637	10
Chickpea	6437	15	84	15	5810	15
Wild Cicer spp.	39	15			39	15
Lentil	6498	15	902	15	6427	15
Wild Lens spp.	195	15			186	15
Faba bean	2892	15			2737	15
Medics	4302	15	766	15	4302	15
Pisum spp.	3301	15	71	15	3301	15
Vicia spp.	3548	15	679	15	3548	15
Collection data	9131	24	383	15	9131	4-25

Table 12. Documentation status of the germplasm evaluation data at ICARDA.

Crop	Collections		Documented in 1987		Documented to date	
	No. of acc.	Descriptors to be documented	No. of acc.	No.of Descript./ crop	No. of acc.	No. of Descript./ crop
Barley	15942	24			12129	22
H. spontaneum	1208	25			1208	4
H. bulbosum	205		182	5	182	5
Durum wheat	20085	28	2644	14	13213	14/25
Bread wheat	10419	28			2780	25
Wheat relatives	1596	25			855	19
Chickpea (W) *	6437	29	141	5	4849	5/29
Chickpea (S) **	6437	29			3341	18
Wild Cicer spp.	39	29			24	6
Lentil	6498	26	1176	7/22	6343	7/22/26
Wild Lens spp.	195	26			114	8
Medics	4302	19			1778	17/34
Vicia spp.	3548	24	325	16	379	16/34
Lathyrus spp.	934	24	325	24	346	24/26
Other spp.	7780	24			1850	34

* (W) winter planted ** (S) spring planted

7. Electrophoresis studies

Prior to the 1986/1987 cropping season, esterase banding pattern was studied by electrophoresis in different legume germplasm to assess the genetic diversity in collected material. An extension of this work to include other enzyme systems and/or storage proteins would increase the scope of utilizing electrophoresis to analyze genetic diversity and in studying genetic and evolutionary relationships between crops and their wild relatives. A study was carried out in 1986/1987 to determine

the electrophoretic banding patterns of storage proteins in Triticum turgidum var. dicoccoides. The electrophoretic patterns of decoiled subunits (protomers) of storage proteins in chickpea and lentil and in related wild species were also studied.

7.1. Electrophoresis of gliadins in durum wheat

Standard polyacrylamide gel electrophoresis (PAGE) was applied, in acidic (pH 3.1) system to characterize the gliadin fraction of storage proteins in durum wheat and its wild progenitor, Triticum turgidum var. dicoccoides.

Special attention was given to a variant of gliadins (Rm 0.45), since it has been reported that this variant has an influence on the cooking quality of durum wheat. Variation was demonstrated in the pattern of protein bands both in the cultivated durum wheat and wild dicoccoides germplasm. Approximately 50% of the dicoccoides genotypes studied had an electrophoretic pattern which was associated with good cooking quality in durum wheat. This result would suggest that dicoccoides germplasm could be exploited to improve the cooking quality in durum wheat. Suitable wild genotypes can also be selected which have no detrimental effect on protein quality when the breeding aim is to improve other characters (e.g. drought tolerance, disease resistance) in durum wheat using dicoccoides germplasm.

7.2. SDS-PAGE of wild chickpea and lentil genotypes

The evolutionary potential of different crops is determined by the nature and extent of the genetic variability in the wild and domesticated forms which can hybridize freely with each other. The primary gene pool of chickpea comprises germplasm of the cultivated Cicer arietinum and two wild species, C. reticulatum and C. echinospermum. Cultivated lentil (Lens culinaris) is easily crossable with L. orientalis and L. odemensis although crossability barriers and varying degrees of sterility have been

reported depending on the genotypes used in hybridization studies. L. orientalis was known for some time, whereas the three other wild species, Cicer echinospermum, C. reticulatum and Lens odemensis were discovered and described only recently. Consequently, none of these latter wild species are represented adequately in germplasm collections and the genetic and evolutionary relationships between the cultigen and these closest related wild species are poorly understood.

It is assumed that the ability of the species within a genus to hybridize with each other is related to their evolutionary distance. Studying the polymorphism of storage protein is considered a useful tool for estimating the relative evolutionary distances among related species. These proteins are being utilized by the seedlings after hydrolysis and therefore their structure has no specific adaptive value and the different variants are not subjected directly to natural selection.

SDS-PAGE technique was applied to characterize the variation of decoiled protein subunits in wild Cicer and Lens species, since it has been reported that chickpea, lentil and their wild progenitors have identical banding patterns for intact storage proteins. Treatment of storage proteins with sodium-dodecyl-sulphate separates the subunits of complex protein molecules by breaking the -SH- and -SS- bonds. The structure of subunits closely reflects differences in the base sequence of the DNA encoding them. Relative mobility (Rm) of subunits mainly depends on their molecular weights. This technique has been successfully utilized for cultivar or genotype identification and for studying genetic relationships between related species.

Genotypes selected from 39 accessions of 8 annual wild Cicer species were studied. This study was designed to investigate the within species variation and to assist in the selection of distinct genotypes from populations. Each species showed characteristic profiles and within species variation was detected in 4 species. The SDS profiles of the 3 Cicer chorassanicum accessions originating from Afghanistan were identical. Only

quantitative differences were detected among single plant progenies of 4 Cicer bijugum accessions. Cicer pinnatifidum and C. judaicum samples were markedly different from each other and from the C. arietinum checks. Nine different profiles were identified in C. pinnatifidum germplasm (Fig. 1), and in some accessions (ILWC 9,20,22,29,33) more than one SDS profile was detected. The C. pinnatifidum accession (ILWC 49) collected in Syria in 1986 differed in banding pattern from the earlier introduced accessions.

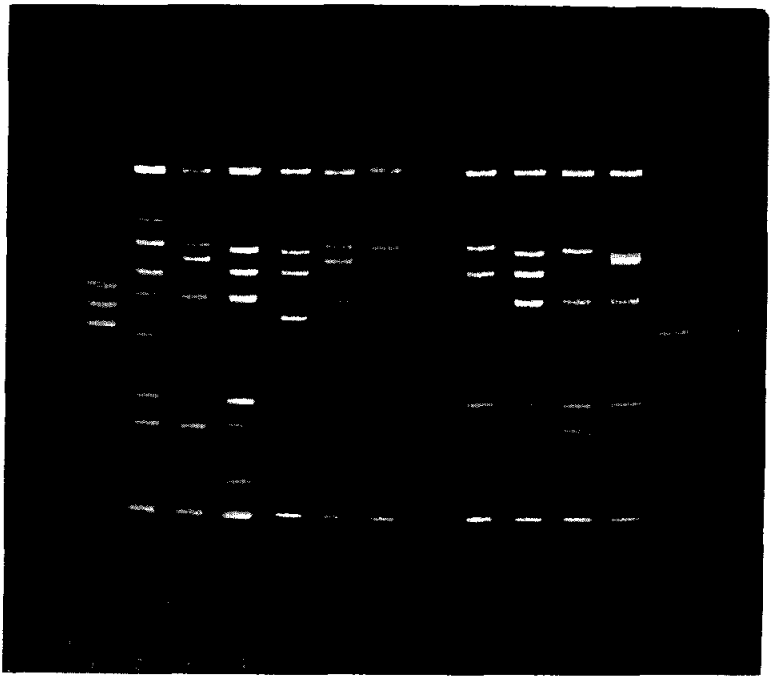

Fig. 1. SDS-PAGE storage protein profiles of 2 cultivated chickpea (No. 1: ILC 5711 and No. 13: ILC 482) and 11 Cicer pinnatifidum genotypes (Nos. 2 to 12: ILWC 8-2, 9-S-1, 9-S-2, 20-S-3, 20-S-6, 22-1, 22-2, 29-1, 29-S-3, 33-S-5 and 49-1, respectively).

Two C. echinospermum and 3 C. reticulatum genotypes were separated on the basis of differences in banding patterns, which differed from the electrophoretic profiles of the cultivated checks (ILC 482, 5711) in 3 to 6 bands. A comparison between an interspecific hybrid (F1, F2 seeds) and its parental lines (Cicer reticulatum ILWC 21 and Cicer arietinum ILC 1250) revealed that the parent genotypes differed in four bands; one of them (Rm 0.34) was present only in the wild species and three others (Rm 065, 0.70 and 0.88) only in the cultivated line. The bands were inherited codominantly in the hybrids. Interspecific hybrids between C. reticulatum and C. arietinum can non-destructively be detected by this technique which requires only small pieces of the cotyledons.

More detailed studies on the protomer patterns of genotypes comprising of the two main crossability groups within the genus Cicer (C. arietinum, C. reticulatum, C. echinospermum and C. pinnatifidum, C. judaicum, C. bijugum, C. cuneatum) would assist in understanding species relationships. The different genotypes separated on the basis of morphological characters and SDS protein profiles could be utilized in cytogenetic studies and in interspecific crosses as parents, or bridging genotypes to facilitate gene transfer from more distantly related species to the cultivated chickpea (e.g. cyst nematode resistance from C. bijugum).

The wild lentil germplasm consisting of 187 samples of the four Lens species (L. orientalis, L. odemensis, L. ervoides, L. nigricans) were studied by SDS electrophoresis to characterize within species genetic diversity and genetic relationships between species. Single plant selections from the landrace cultivars Syrian Local Small (SLS) and Syrian Local Large (SLL) were used as checks in each run. The checks SLS (4-3) and SLL (37-5) had 40 and 39 bands, respectively. Thirty four bands were common in the two lines, but an additional 5 bands (Rm 0.33, 0.43, 0.55, 0.71 and 0.87) were present only in the SLL and another 6 bands (Rm 0.14, 0.24, 0.32, 0.35, 0.36 and 0.95) were only present in the

SLS check. All the four species showed within species variation in SDS protein banding patterns. The banding patterns of the L. orientalis genotypes showed the greatest similarity to the profiles observed for the cultivated species, L. culinaris. Analysis of L. orientalis samples collected from the same site (Kala'at Sema'an) and, which differed only slightly in certain characters (flowering time, plant height, seed size and seed coat pattern) revealed 7 distinct genotypes with different SDS protein profiles (Fig. 2). This would suggest that genetic variation does exist within wild lentil populations grown in relatively confined areas.

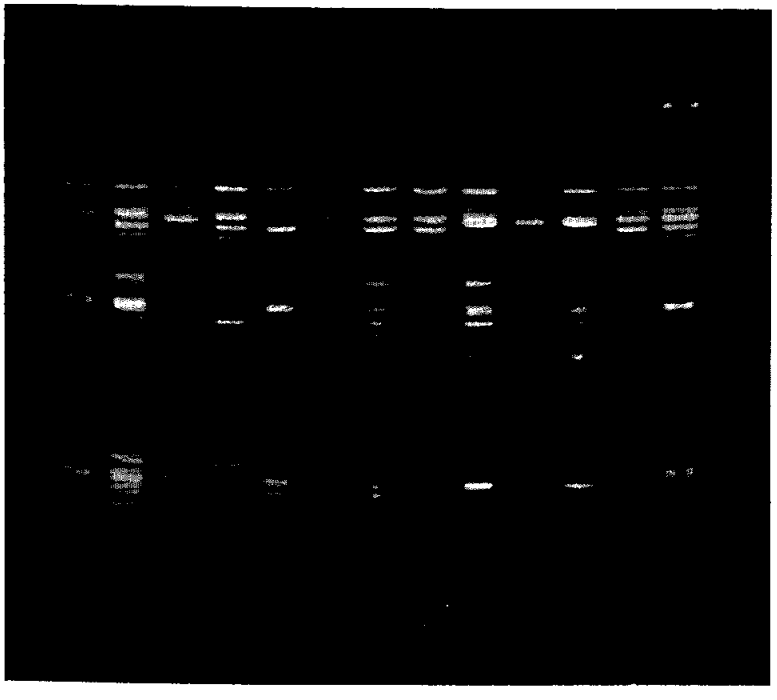

Fig. 2. SDS-PAGE storage protein profiles of 2 cultivated lentil orientalis genotypes (No. 2 to 12: ILWL 11, 120, 149-1, 149-2, 149-3, 194, 195, 96, 197, 198 and 199). The wild genotypes were collected near Kallat Seman, Syria, in 1982, 1986, 1986 and 1987.

The overall banding patterns of the 20 Lens odemensis accessions which included 15 samples collected in Syria, were similar to L. orientalis and L. culinaris, but all of them had a specific dark band (Rm 0.21) which clearly differentiates this species from L. orientalis and L. culinaris. L. odemensis has recently been suggested as conspecific with L. culinaris and L. orientalis. The specific band in L. odemensis was also present in L. ervoides but absent in the L. nigricans accessions studied. The banding patterns detected in L. nigricans were distinctly different from the other Lens species.

The evaluation of wild Lens species will continue for useful morphological characters and for resistance to biotic stresses (Orobanche spp. and vascular wilt caused by Fusarium oxysporum f. sp. lentis) in cooperation with the Food Legume Program.

8. Training in genetic resources

The training of technicians and scientists in genetic resources work has not gained momentum despite persistent requests from the national programs for such training. Adequately trained technicians and scientists are needed to sample accessions during collecting missions and to manage national collections in genebanks. ICARDA recognizes this need. In 1986/87 as in past years, the Program continued to host participants on an individual basis to provide training to the national programs.

Four trainees, two from Tunisia, one from Jordan, and another from Ethiopia spent from one to four weeks working alongside program staff in an effort to improve their competence and skills in aspects of germplasm work. In addition, four staff members of the Syrian National program particiapted in a joint cereal germplasm collecting mission and thereby gained additional experience in collecting germplasm and in the identification of various wild species and relatives of ICARDA's mandate crops.

9. Seed Health Laboratory

9.1. Seed shipments

In the 1986/87 season, the Seed Health Laboratory (SHL) continued to monitor the seed exchange activities at ICARDA. A total of 99 shipments from 35 countries were received.

ICARDA dispatched 542 seed consignments to 69 countries. These included the cereal and food legume international nurseries as well as shipments to meet individual requests for germplasm and breeder seed. Compared to the previous season, the number of outgoing shipments increased by 21%.

9.2. Field inspection

Incoming seeds are planted in an isolation area, and are frequently inspected to determine the incidence of pests and diseases. During the 1986/87 growing season, no exotic diseases were detected on plants grown in isolation. However, a high incidence of loose smut on bread wheat coming from Turkey was observed. About 43% of the accessions were infected. Although this is not a quarantine disease in Syria, infected heads were removed to avoid further spread of the pathogen, and seeds harvested from adjoining plots were discarded.

Fields where seeds were being increased for international nurseries, germplasm rejuvenation or for breeder seed production were carefully inspected for seedborne diseases.

Flag smut (Urocystis tritici) was detected at a low incidence on durum and bread wheat in one field. It was recommended that no wheat be planted in this field for the next five years to avoid further spread of the disease.

9.3. Laboratory seed health tests for incoming and outgoing seeds

After disinfection (to prevent the escape of live insects), all

Table 13. Seed health tests conducted on seed received at ICARDA in 1986/87.

Crop	Number of samples tested	clean	infected	Pathogens observed
Durum wheat	1175	1130	45	Tilletia caries and/or T. foetida
Bread wheat	2226	1970	256	Tilletia caries and/or T. foetida
Barley	139	72	37	Helminthosporium sp.
			19	Fusarium sp.
			11	Helminthosporium sp. and Fusarium sp.
Triticale	142	142	0	-
Lentil	51	38	12	Ascochyta lentis
			1	Ascochyta lentis, Fusarium sp., and Botrytis cinerea
Faba bean	28	25	1	Ascochyta fabae
			2	Fusarium sp.
Peas	32	23	9	Pseudomonas sp.
Total	3793	3400	393	

incoming seeds were inspected by eye for admixtures of soil, weed seeds, bunt balls, or for seeds with visible symptoms of infection. Table 13 indicates the results of additional health tests. The number of tests conducted increased considerably compared to 1985/86 (3793 against 817). In the 1986/87 season, no pathogen of quarantine significance was detected. Nevertheless, a rigid procedure is followed of planting all incoming material only in greenhouses or in the isolation area.

About 72% of the consignments received at ICARDA were not treated with fungicides. As an additional safeguard, those seeds, before planting, were treated at the Seed Health Laboratory with a broad spectrum fungicide i.e. Vitavax for cereals, and thiabendazole or benomyl for legumes. Pea seeds with Pseudomonas

sp. infection were also soaked in a 500 ppm Streptomycin solution for two hours as a precautionary measure.

All seeds dispatched from ICARDA were inspected visually in the laboratory for contamination by soil, weed seeds and any other undesirable materials. Random samples of seeds were tested using several specific seed health testing methods (Table 14). In general, the freezing blotter test proved to be a reliable and sensitive method for detecting Helminthosporium and Fusarium species in barley, and Fusarium and Ascochyta species in lentil and chickpea. In addition to the random samples, seeds harvested from the areas where flag smut had been detected, were specifically tested for contamination with Urocystis tritici spores.

Unless specific requests are made by the recipient for untreated seed, for example for laboratory analysis or germplasm for long-term storage, only seeds treated with fungicides are dispatched. Legume seeds are also routinely fumigated. Random samples are tested for germination to make sure the viability is not affected. For all shipments Phytosanitary Certificates which met the requirements of the importing countries were prepared, and sent with the seeds.

Table 14. Seed health tests conducted on seeds dispatched from ICARDA, 1987.

Crop	Centrifuge wash test	Freezing blotter test	Agar media test	Ditylenchus dipsaci test	Fluoresence media test
Durum wheat	171				
Bread wheat	171				
Barley		319	319		
Lentil		257	257		
Faba bean			84	57	
Chickpea		149	56		
Pea					20
Medic				14	
Total	342	725	716	71	20

9.4. Training in seed health testing

In 1987 a trainee from the Plant Genetic Resources Center in Ethiopia participated in laboratory seed health testing and field inspection for four weeks. A staff member of the Egytpian Central Administration for Seed was trained in seed health testing methodologies for two weeks. One participant from Tunisia and another from Ethiopia underwent short-term training in seed health testing techniques.

In the in-country arabic course for seed testing techniques which was organized by ICARDA and the General Organization for Seed Multiplication (GOSM), the SHL contributed lectures and practicals on seed health testing techniques.

10. Virology Laboratory

During 1987 the Virology Laboratory at ICARDA continued its activity in close cooperation with the Research Institute for Plant Protection (IPO), Wageningen, The Netherlands and with the Faculty of Agricultural and Food Sciences, American University of Beirut and the National Council for Scientific Research of Lebanon. Major emphasis in 1986/87, was on cereal and faba bean viruses. These included (i) screening for virus resistance (ii) virus survey in three countries in the region (iii) yield loss evaluation (iv) seed-transmission studies due to infection with a selected number of viruses. The staff of the Virology Laboratory also participated in training activities.

10.1. Viruses of food legumes

10.1.1. Screening for bean yellow mosaic virus (BYMV) resistance in faba bean

BYMV is a wide-spread virus which attacks faba bean in many countries of the region. The development of resistant cultivars

Table 15. Faba bean lines which showed the highest tolerance to bean yellow mosaic virus infection after mechanical inoculation in the plastic house (January, 1987).

Faba bean genotype	Disease Index*		
FLIP code	1st evaluation (4 weeks after inoc.)	2nd evaluation (6 weeks after inoc.)	Average
SNA5-2(2)	33.0	42.0	37.5
SE1-1(2)	33.0	69.0	51.0
SE1-4(1)	50.0	75.0	62.5
SE7-8(2)	36.0	42.0	39.0
SE14-7(1)	45.0	64.0	54.5
SE17-8(1)	00.0	00.0	00.0
SE1-4	35.0	59.0	47.0
7 SNA1-1	35.0	79.0	57.0
308 SP10-4	20.0	33.0	26.5
FLIP84-45 FB(S82083)	39.5	58.3	48.9
B9-1 SNA3-1(1) (Susceptible)	100.0	100.0	100.0

*Disease index (DI) for each genotype was determined as follows:

$$DI = \frac{[(n_0 \times 0) + (n_1 \times 1) + (n_2 \times 2) + (n_3 \times 3) + (n_4 \times 4)] \times 100}{N(n-1)}$$

where n_0, n_1, n_2, n_3 and n_4 represent number of plants with symptoms severity 0, 1, 2, 3 and 4, respectively.
N = total number of plants, n = number of symptoms classes.

could reduce considerably the losses caused by this virus. Seventy faba bean lines were tested for their reaction to BYMV at the ICARDA farm (Tel Hadya) using both mechanical and aphid inoculation techniques. Ten of the 70 lines evaluated showed different levels of resistance to BYMV infection (Table 15). Aphid inoculation produced higher incidence of BYMV infection. Although mechanical inoculation helped in screening a large number of faba bean genotypes, aphid inoculation gave a better indication

of genotype reaction in the field. In future studies more emphasis will be given to BYMV inoculation by aphids.

10.1.2. Screening for bean leaf roll virus (BLRV) resistance

Faba bean lines which originated as single plant selections were provided by the Food Legumes Improvement Program in the 1985-1986 season for inoculation with BLRV at the 2-3 leaf stage. A mixture of virulifereous Aphis fabae and Aphis craccivora (3-5 aphids per plant) was used. With this early infection none of the 270 faba bean lines tested produced seeds.

The results indicated that none of the faba bean lines tested has a high tolerance to BLRV infection. Further screening at lower infection pressure will be undertaken to confirm these results. In addition, a trial will be carried out next year to compare the effect of early and late BLRV infection.

10.1.3. Survey of viruses affecting faba bean

A survey to identify viruses affecting faba bean was continued for the third year. A total of 138 samples of faba bean with virus-like symptoms were collected from Morocco, Syria and Tunisia during April, 1987. The results obtained are presented in Table 16. Based on serological tests, bean yellow mosaic virus (BYMV), broad bean stain virus (BBSV) and broad bean mottle virus (BBMV) were the most common sap-transmissible viruses in the three countries surveyed. On the basis of field symptoms, bean leaf roll virus was the most spread (1-20%) in the three countries. During March and April the weather conditions in the three countries are favorable for the activity of the insect (aphids and beetles) vectors of these viruses. In the coastal area of Syria virus spread reached 100% and total crop loss was observed. In 1988 the survey will be extended to other faba bean producing countries such as Ethiopia.

Table 16. Viruses in faba bean samples with virus-like symptoms in field collections from Morocco, Syria and Tunisia during spring of 1987. Identification was based on serological reactions (ELISA).

Country	Number of plants tested	Number of plants infected with							
		BBSV	BBTMV	BBMV	BBWV	BYMV	PSbMW	CMV	PEMV
Morocco	8	3	1	0	1	2	2	2	2
Syria	62	28	1	10	16	27	5	19	7
Tunisia	68	46	3	52	19	41	8	34	8
Total	138	77	5	62	36	70	15	55	17

BBSV= broad bean stain virus; BBTMV= broad bean true mosaic virus;
BBMV= broad bean mottle virus; BBWV = broad bean wilt virus;
BYMV= bean yellow mosaic virus; PSbMV= pea seed-borne mosaic virus;
CMV = cucumber mosaic virus; PEMV = pea enation mosaic virus.

10.1.4. Yield loss evaluation

A field experiment was conducted to evaluate losses induced by each of three viruses BYMV, BBMV and BBSV and by a mixed infection of BYMV + BBMV. Inoculation was done at the preflowering stage, during flowering and during pod setting. All the viruses tested, produced significant losses when faba beans were inoculated 11 weeks after sowing (preflowering). BYMV, BBMV and BBSV induced 80, 55 and 84% yield losses, respectively. The mixed infection of BYMV and BBMV caused almost complete failure of the crop (Table 17). Faba bean plants inoculated with BYMV, BBMV and BBSV 15 weeks after sowing (flowering), suffered yield loss of 55, 84 and 18% respectively. Late inoculation at pod setting stage, with the three viruses caused 39, 38 and 19% yield loss respectively. Since virus vectors (aphids and beetles) are not active until March or April, the yield reduction induced by the late inoculation may be an indication of the actual yield losses in some countries.

Table 17. Faba bean yield[a] (cv. Syrian Local) following inoculation with bean yellow mosaic virus (BYMV), broad bean mottle virus (BBMV), BYMV plus BBMV and broad bean stain virus (BBSV) at three different plant growth stages, in 1986/87.

	Inoculation time (days after sowing)		
Virus	**76**	**107**	**140**
BYMV	404**	931**	1286**
BBMV	955**	335**	1311**
BYMV+BBMV	70**	186**	1339**
BBSV	339**	1727*	1713*
Healthy	2095	2095	2095

[a] Yield, grams per plot of 1.8 x 4 meter, replicated four times.
* Significantly different from healthy control at P= .05
** Significantly different from healthy control at P= .01

10.1.5. Seed-borne viruses

(a) Testing for seed-borne viruses

Faba bean increases were monitored for seed borne viruses in collaboration with the seed health laboratory. Field plots were rogued twice to eliminate all infected plants. Seeds obtained from such plots were then tested in the laboratory for the presence of five seed-borne viruses, namely BYMV, BBSV, BBTMV, CMV and BBMV. Seed lots which were found to contain seed-borne infection were identified.

(b) Seed-transmission studies

Seed transmission rates of BBSV, BBMV, BYMV in infected faba bean using three inoculation times were evaluated. In addition seed-transmissibility of BBMV in plants with mixed infection of BBMV and BYMV were also evaluated. BBSV was seed-transmitted at rates of 24, 10 and 2.8% when plants were inoculated in February 1(pre-flowering), March 3 (flowering)

and April 5 (pod setting), respectively. BYMV was seed-transmitted at the rate of 7.9, 4.4 and 2.4% at the three inoculation times, respectively. BBMV was seed-transmitted in plants co-infected with BYMV at the rate of 2.4% when the plants were inoculated during pod setting (April 5). Since mixed infection of BBMV + BYMV is common in the region, BBMV should be regarded as a seed-borne virus for quarantine purposes.

10.2. Cereal viruses

10.2.1. Virus survey

A survey for barley yellow dwarf virus was conducted in 1987 (spring) in the Gezireh and Ghab areas of Syria. Random samples were collected from wheat and barley fields. Based on serological tests, the type of BYDV which is transmitted effectively by the aphids Rhopalosiphum padi and Sitobion avenae (PAV) was the most common in the 31 cereal fields surveyed. In the Gezireh area, BYDV incidence varied from 1.6% to 6.7% in wheat fields and from 3.0% to 30.5% in barley fields. In the Ghab area, BYDV incidence in cereal fields varied between 0.62 and 10.72%.

10.2.2. Screening for BYDV resistance

Altogether 300 barley lines (BKL), 250 durum lines (DKL) and 169 bread wheat line (WCB) which were provided by the Cereal Improvement Program were screened for BYDV resistance in 1987. In addition about 60 lines of barley, durum wheat and bread wheat which proved to have some BYDV tolerance during testing in 1986 were also included.

Tolerance to BYDV was observed in 16 barley lines (Table 18), 23 durum wheat lines (Table 19) and 16 bread wheat lines (Table 20). These lines will be subjected to further testing next year to confirm these observations.

Table 18. Selected barley lines showing tolerance to infection with barley yellow dwarf virus. Inoculation with the virus was done artifically with aphids, 1986/87.

Genotype	Symptoms index[a] (1 - 9)	Grain weight[b] (g)	Harvest index
BKL 87- 56	4	81.32	0.34
BKL 87- 92	4	95.36	0.35
BKL 87-115	3	111.20	0.42
BKL 87-134	4	59.65	0.26
BKL 87-244	3	37.97	0.25
BKL 87-250	4	30.91	0.24
BKL 87-256	3	66.46	0.26
BKL 87-264	4	45.69	0.24
BKL 87-267	4	70.76	0.36
BKL 87-138	5	81.73	0.43
BKL 86- 35	6	36.45	0.42
BKL 87- 52	6	53.79	0.37
BKL 86-121	5	67.23	0.37
CIMMYT-BYDV 86- 15	2	75.79	0.34
CIMMYT-BYDV 86- 84	3	45.03	0.27
CIMMYT-BYDV 86-141	3	29.84	0.21

[a] Symptoms index was based on 0 = no symptoms and 9 = severe yellowing and stunting of the plants with no grain yield.

[b] per 30 cm row.

10.2.3. Testing for the seed-borne barley stripe mosaic virus (BSMV) in cereal seeds

A total of 1440 seed samples from different accessions of barley, 197 of bread wheat and 448 of durum wheat were tested for the presence of BSMV. For each sample 200 seeds were tested. The results indicated that 108 (7.5%) of the barley and 4 (2%) of the bread wheat seed lots contained BBSV. None of the durum wheat

Table 19. Selected durum wheat lines showing tolerance to infection with barley yellow dwarf virus. Inoculation with the virus was done artificially with aphids, 1986/87.

Entry	Symptoms index[a] (0 - 9)	Grain weight[b] (g)	Harvest index
DKL 87- 8	4	39.63	0.36
DKL 87- 10	4	59.42	0.29
DKL 87- 25	3	37.39	0.40
DKL 87- 32	4	70.52	0.32
DKL 87- 38	4	63.35	0.36
DKL 87- 81	3	17.44	0.30
DKL 87- 82	4	54.77	0.29
DKL 87- 85	4	50.10	0.30
DKL 87-103	4	29.30	0.25
DKL 87-123	4	66.39	0.33
DKL 87-145	4	79.14	0.33
DKL 87-161	4	56.23	0.30
DKL 87-184	4	72.24	0.39
DKL 87-194	4	77.84	0.35
DKL 87-209	4	42.30	0.30
DKL 87-221	4	43.07	0.24
DKL 87-231	3	68.52	0.34
DKL 87-235	4	49.86	0.27
DKL 87-250	4	36.76	0.24
DKL 87- 2	5	54.14	0.44
DKL 87- 33	6	45.74	0.46
DON-LR 86-25	6	53.48	0.46

[a] Symptoms index was based on 0 = no symptoms and 9 = severe yellowing and stunting of the plants with no grain yeild.

[b] per 30 cm row.

seed samples contained BBSV. A plan in cooperation with Cereal Improvement Program was developed to eliminate BSMV from all infected barley entries at ICARDA by eliminating infected plants during the growing season based on observation of symptoms and serological testing.

Table 20. Selected bread wheat lines showing tolerance to infection with barley dwarf virus. Inoculation with the virus was done artificially with aphids, 1986/87.

Entry	Symptoms index[a] (0 - 9)	Grain weight[b] (g)	Harvest index
WCB 87- 1	3	35.57	0.27
WCB 87- 81	4	21.62	0.45
WCB 87- 96	4	14.60	0.23
WCB 87- 98	4	46.60	0.21
WCB 87-105	3	25.88	0.23
WCB 87-168	4	11.44	0.20
WCB 87- 41	6	23.47	0.30
WCB 87- 49	6	28.90	0.32
WCB 87- 61	6	27.34	0.31
WCB 87- 62	6	23.95	0.32
WCB 87-119	5	38.53	0.30
WCB 87-135	6	27.01	0.34
WCB 87-147	5	31.92	0.37
WCB 87-148	7	20.36	0.30
WCB 87-153	5	34.86	0.34
WACB86- 22	6	41.08	0.52

[a] Symptoms index was based on 0 = no symptoms and 9 = severe yellowing and stunting of the plants with no grain yield.

[b] per 30 cm row.

10.3. Training in Virology

A graduate student from the Faculty of Agriculture, University of Damascus completed his M.Sc. thesis research, working in the Virology Laboratory. His work focused on the efficiency of aphid transmission of barley yellow dwarf virus, bean leaf roll virus and bean yellow mosaic virus by their respective vectors.

Two trainees, one from Morocco and one from Tunisia spent 4-6 weeks in the Virology Laboratory working on serological detection of BYDV. They were supported by an IDRC grant.

11. Publications

Makkouk, K.M., Bos, L., Azzam, O.I., Katul, L., and Rizkallah, A., 1987. Broad bean stain virus: identification, detectability with ELISA in faba bean leaves and seeds, occurrence in West Asia and North Africa, and possible wild hosts. Netherlands Journal of Plant Pathology 93: 97-106.

Makkouk, K.M., Azzam, O.I., Katul, L., Rizkallah A., and Koumari, S., 1986. Seed transmission of broad bean stain virus in the wild legume Vicia palaestina Boiss. FABIS 16 (2): 40-41.

Makkouk, K.M. and Azzam, O.I., 1986. Detection of broad bean stain virus in lentil seed groups. LENS 13 (2): 37-38.

Makkouk, K.M., Azzam, O.I. and Katul, L. 1987. Sensitivity of dot-ELISA on nitrocellulose membranes in comparison with ELISA on polystryrene plates for the detection of four plant viruses. Lebanese Science Bulletin 3: 29-36.

12. Conference Papers

Diekmann, M. 1987. Seed Pathology Program in ICARDA. Presented in the FAO/DANIDA Regional Workshop on Seed Pathology, Bangkok, Thailand, March 2-13.

Diekmann, M. 1987. Production of Healthy Cereal and Legume Germplasm at the International Center for Agricultural Research in the Dry Areas (ICARDA). Presented in the VII Congress of the Mediterranean Phytopathological Union, Granada, Spain, September 20-26.

Diekmann, M. 1987. Treatment of Experimental Seed. Proceedings of a Regional Conference "Mechanization of Field Experiments in Semi-Arid Areas, Aleppo, Syria, May 23-27.

Holly, L. 1987. The Principles of Genetic Maintenance of Germplasm Accessions during Rejuvenation for Self-and Open-Pollinated Forage and Food Legumes. Presented in the ICARDA International Workshop on Genetic Resources of Cool Season Pasture, Forage and Food Legumes for Semi-Arid Temperate Environments, Cairo, Egypt, June 19-24.

Makkouk, K.M., Azzam, O.I. and Skaf, J. 1987. Situation review of barley yellow dwarf virus in West Asia and North Africa. Barley yellow dwarf workshop, Udine, Italy, July 5-11.

Makkouk, K.M., Barker, I., Azzam, O.I., Skaf, J. and Forde, S. 1987. Serological variability among BYDV isolates from some countries of the Middle East and North Africa. Seventh International Virology Congress, Edmonton, Canada, August 9-14.

Makkouk, K.M., Azzam, O.I., Bos, L. and Katul, L. 1987. Variability among broad bean mottle virus isolates collected from infected faba bean from a number of Mediterranean countries. Seventh Congress of the Mediterranean Phytopathological Union, Granada, Spain, September 20-26.

Somaroo, B.H. and Holly, L. 1987. The Significance of Plant Genetic Resources for Crop Improvement at ICARDA with Special Reference to Ethiopian Barley and Lentil Germplasm. Submitted for the Proceedings of the Symposium on "Conservation and Utilization of Ethiopian Germplasm", Addis Ababa, Ethiopia, 13-16 October, 1986.

13. GRP Staff List in 1987

B. H. Somaroo	Program Leader

Genetic Resources

Laszlo Holly	Genetic Resources Scientist
Yawooz Adham	Assistant GRP Scientist
Anne Elings	Associate Expert-Genetic Resources
Bilal Humeid	Research Associate I
Hasan Mashlab**	Research Assistant II
Ghada Abiad	Research Assistant I
Ali Shehadeh	Research Assistant I
Ali Abdullah Ismail	Research Assistant I
Sameh Rajab**	Lab Technician
Isam Abou Meizar**	Research Technician I
Andreas Antypas**	Data Assistant
Zakieh Ariss*	Secretary II
Mayssa Aintabi	Secretary II
Micheline Sandouk**	Secretary I
Mohamed Hamran	Asst. Technician/Driver

Seed Health Laboratory

Marlene Diekmann	Seed Pathologist
Siham Asa'ad	Research Assistant II
Mohamed Sekheita	Research Technician II
Mohamed Ahmad Hayani	Research Technician I

Virology Laboratory

Khaled Makkouk	Plant Virologist
Osmat Azzam*	Research Assistant I
Ziad Moudarres*	Research Assistant I
Widad Ghoulam**	Senior Technician
Walid Radwan**	Senior Technician
Safaa Koumari**	Technician

---

* Left during 1987

** Joined during 1987

المركز الدولي للبحوث الزراعية في المناطق الجافة
ايكاردا
ص. ب. 5466 ، حلب ، سورية

INTERNATIONAL CENTER FOR AGRICULTURAL
RESEARCH IN THE DRY AREAS
Box 5466, Aleppo, Syria

1988