GENETIC RESOURCES UNIT

Annual Report for 1989

ICARDA

GENETIC RESOURCES UNIT

ANNUAL REPORT FOR 1989

The International Center for Agricultural
Research in the Dry Areas

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1. Genetic Resources Activities

1.1. Introduction

Germplasm exploration, preservation and utilization have been drawing attention of the international community in the last two decades. The growing interest in genebanks shown by national authorities throughout the world was recently reflected in the inauguration of the FAO Commission on Plant Genetic Resources in 1985. At its annual meeting held in October 1988, the CGIAR (Consultative Group on International Agricultural Research) adopted a policy statement on plant genetic resources. Subsequently, ICARDA developed its position paper on genetic resources availability which was approved by the Program Committee Meeting in October 1989.

The objectives and strategic guidelines have been clearly formulated in the ICARDA's Medium-term plan 1990-1994:

The main objective of the Genetic Resources Unit is to explore, safeguard and enhance the utilization of diverse germplasm collections of crops for which ICARDA has either a global or regional responsibility. The WANA (West Asia and North Africa) region includes the primary centers of diversity of its mandated crops - wheat, barley, chickpea, lentil, faba bean and a number of forage species. The genetic resources originating from the region have a global importance for crop improvement and related research as well as for providing basic material for the development of improved germplasm adapted to the farming systems in the region.

According to its Medium-term plan ICARDA is extending its activities into the lower rainfall areas and marginal lands and also to the highlands. In these environments new germplasm tolerant to severe abiotic stresses is needed but resistance to diseases and pests is equally important.

The modern high-yielding varieties have proved to be mostly unadapted to the low-input farming systems of the rainfed agriculture in West Asia and North Africa (WANA region). Consequently, new types of germplasm have to be developed with extensive use of locally adapted landraces, primitive forms and wild relatives. This indigenous gene pool has accumulated a number of genes for tolerance to environmental stresses during millenia of its existense in the region, where agriculture based on ICARDA mandated crops (barley, wheat and food legumes) originated some 10,000 years ago.

Therefore, collecting of the adapted germplasm in un- or underexplored regions of WANA or related environments continued to receive high priority in 1989 (Table 1). The total of 1488 new entries indicates a considerable exploration of indigenous germplasm adapted to WANA region agroecological conditions. These resources will be multiplied, characterized, evaluated and preserved for their use in crop improvement programs.

In addition to the germplasm collected during GRU/ICARDA collecting missions, 1676 cereals, 658 food legume and 585 forage germplasm accessions were received from other institutions in 1988/89 (Table 1).

The total number of new accessions, collected or obtained from other sources, was 4407, i.e. more than 5% potential increase of GRU germplasm collections. On the other hand GRU/ICARDA provided 16 535 samples to breeders at ICARDA, to NARSs and other bona fide users worldwide.

Germplasm multiplication and characterization remained the main genetic resources activities as in the previous years (Table 2).

Agronomic and in depth evaluation were made in close collaboration with crop improvement program scientists and NARS.

In May 1989 GRU obtained a new building donated by the Italian government with excellent facilities for medium- and long-term storage of active and base collections, respectively. The storage facilities provide space of 366 m^3 for the active collections at 0-2^oC, 20-24% R.H. and 266 m^3 area at -22^oC for the base collections.

Most of the seed samples of the current active collections have already been transferred to the new cold store.

Germplasm information system provides collecting, passport and

Table 1. Germplasm collected or received in 1988/89.

Genus/ Crop group	Collected by GRU	Received	New acquisitions (total)
Barley	61	64	125
Wild barley	24	16	40
Durum wheat	42	1527	1569
Bread wheat	24	69	93
Wheat wild species	473	-	473
Cereals - subtotal	624	1676	2300
Chickpea	21	412	433
Wild *Cicer* spp.	-	10	10
Lentil	23	205	228
Wild *Lens* spp.	2	22	24
Faba bean	15	9	24
Food legumes - subtotal	61	658	719
Medicago spp.	172	85	257
Vicia spp.	99	218	317
Pisum spp.	17	21	38
Lathyrus spp.	21	103	124
Other forages	494	158	652
Forage species - subtotal	803	585	1388
Grand total	1488	2919	4407

characterization data on request to the users, and information on the new accessions was entered into the GRU database as well as additional data on older accessions.

Training of the national program staff was an important component of GRU activities in 1989.

Six trainees from WANA region joined GRU for individual training in genetic resources work.

Table 2. Germplasm multiplication, characterization and evaluation in 1988/89.

Genus/ Crop group	**Multiplied (No. of acc.)**	**Characterized or/and evaluated (No. of acc.)**	**(No. of traits)**
Barley	266	2058	10
	-	175	16
Wild barley	39	-	-
Durum wheat	474	2420	18
Bread wheat	83	-	-
Wheat wild species	236	356	16
	-	80	25
Cereals - subtotal	1098	5089	-
Chickpea	923	6224	4
		323	15
Wild *Cicer* spp.	164	164	6
Lentil	445	136	14
Wild *Lens* spp.	143	143	8
Faba bean	78	-	-
Food legumes - subtotal	1753	6990	-
Medicago spp.	384	506	21
Vicia spp.	693	-	-
Pisum spp.	1434	-	-
Lathyrus spp.	718	-	-
Forage legumes - subtotal	3229	506	-
Grand total	6080	12585	-

In agreement with ICARDA strategy and External Programme Review recommendations, GRU established consultations with IBPGR to avoid overlapping and duplication of activities in ICARDA mandated crops. In addition to this, joint IBPGR and GRU/ICARDA activities were agreed on e.g. in research, germplasm collecting and exploration, training and networking.

High priority was given to the collaboration with NARSs especially in germplasm collecting and training activities.

Two laboratories are attached to GRU: (i) the Seed Health Laboratory, which safeguards seed movement at ICARDA by minimizing the risk of spreading pests and pathogens during seed distribution and exchange. There was a considerable increase in the seed movement in the last season. The total number of outgoing shipments increased by 24% and the number of incoming consignments increased by 25% compared to the previous period. (ii) The Virology Laboratory carries out research on important viruses of cereals and food legumes and the work concentrates on screening for virus diseases resistance, yield loss evaluation in response to infection with selected viruses and testing for seed borne viruses. During the past season some basic studies on selected viruses were also carried out. **J. Valkoun**

1.2. New germplasm introduced in 1988/89

Expanding ICARDA's germplasm collections through plant exploration and the acquisition of desirable genetic material from other genebanks and scientific institutions is one of the major activities of the Genetic Resources Unit at ICARDA.

The collection missions strongly focus on landraces and wild related species of the ICARDA mandated crops because scientists at ICARDA and in other institutions are becoming more and more interested in this locally adapted germplasm. However, these genetic resources are being threatened by expansion of modern crop cultivars, changes in land use, desertification and the disappearance of natural vegetation in vast areas.

Consequently, the Genetic Resources Unit is paying special attention to collect and safeguard them in GRU genebank for current and future use in plant improvement programs. Collection missions were undertaken in Egypt, Syria, Algeria, Jordan, Cyprus, Turkey and Bulgaria.

1.2.1. Egypt collection mission

High priority is given by GRU to enrich barley collection with material collected from well known drought areas. The Genetic Resources Unit (GRU) at ICARDA and the Genetic Resources Section ARC, Bahteem, Egypt, organized a mission to collect barley landraces (second year) and Aegilops spp. (first year) in northwestern and northeastern deserts at regions of Egypt.

In the northwestern coastal area, stretching from Alexandria to Marsa Matrouh, soils are more heterogeneous than in north Sinai area, with soil types ranging from sandy-loam to sandy, whereas the soil is relatively homogeneous in north Sinai, consisting of sand only. Annual rainfall follows a gradient ranging from 50-100mm (Siwa Oasis), 100-150mm (El Arish) to 200-250mm (Rafah) in north Sinai. The Siwa Oasis, located 300 km southwest of Marsa Matrouh province close to the Libyian border, is characterized by harsh environmental conditions and highly saline soils. Collection sites of the mission ranged in altitude from below sea level (-5m, Siwa Oasis) to 50m above sea level.

In total 63 sites were sampled and the majority of the collected material came from areas that are characterized by stress conditions (drought, heat and salinity). Altogether 455 single head samples of barley, 38 of H. spontaneum, 174 of T. aestivum, 20 population samples of Aegilops spp., 7 of H. murimum, 5 of Medicago spp., 10 of Lathyrus spp. one sample of Astragalus sp. and one sample of Trigonella sp. were collected (Table 3). **B. Humeid, M. van Slageren**

1.2.2. Barley collecting mission in Syria

In May, 1989, 620 paired samples of barley landraces and the wild progenitor H. spontaneum were collected on four sites that were identified in 1988 for its combined occurrence. Especially the sites in Palmyra and Lattakia will facilitate the study of the genetic composition of the landraces and the extent of gene flow between the wild and cultivated types in their natural habitat. **B. Humeid and M. Hamran**

Table 3. Accessions of cereals collected in 1989.

Crop	Number of accessions				
	Algeria	Cyprus	Egypt	Syria	Total
Cultivated barley					
bulk	53	-	-	8	61
single head	907	-	455	356	1718
Wild barley					
bulk	13	4	7	-	24
single head	-	-	38	264	302
Durum wheat					
bulk	42	-	-	-	42
single head	208	-	-	-	208
Bread wheat					
bulk	24	-	-	-	24
single head	176	-	174	-	350
Grand total bulk					151
Grand total single head					2578

1.2.3. Collection mission to Algeria

A joint germplasm collection mission was undertaken in Algeria from 3 to 25 June, with the participation of scientists from ICARDA/GRU, NARC, Japan and ITGC, Algeria. Algeria had been poorly represented in ICARDA's germplasm collections (16 barley, 30 wheat, 29 chickpea, 14 lentil and 33 faba bean accessions), and high priority was assigned to the systematic exploration and collection of locally adapted cereal and legume germplasm and their wild relatives in this country. This first mission with ICARDA's participation in Algeria covered the north-eastern part of the country and eastern areas of the Saharian Atlas mountains.

In the northern regions large scale cereal production in monoculture using government seeds (improved cultivars) has become predominant over the last 15 years. As a consequence few landraces were found. Collections from this area mainly comprise of Aegilops species and few food legume (mainly faba bean) samples. In the central drier regions (around Batna, Tebessa, Biskra, Bou Saada and Djelfa) with an average annual rainfall less than 250 mm, the traditional subsistance agricultural system still predominates and landraces of barley and wheat are widely grown by farmers. Both bulk population and single spike samples were collected in this area. The mission visited remote areas far from the main roads to ensure a maximum coverage of this region.

A total of 225 population and 1291 single spike samples were collected during the mission (Table 4). Only 27 food legume samples were obtained, as these crops have almost completely been replaced by cereals even in some of the traditional food legume growing areas like around Tiaret. Lentil and chickpea fields visited were often planted with seeds imported from Argentina and Turkey or Morocco, respectively. The intensive genetic erosion noticed in food legumes urges to undertake additional collecting missions in the western and southern parts of Algeria to collect landraces before they will disappear completely. **L. Holly and B. Humeid**

1.2.4. Ecogeographic survey and collection of native pasture and forage legumes in Jordan

An ecogeographic survey and collection mission was organized and undertaken jointly with PFLP and NCARTT in Jordan to explore native pasture and forage legumes with potential for the improvement of livestock feed production. The first mission (16 June - 12 July, 1989) covered the southern and central parts of the country. The survey will be completed for the northern part of Jordan in 1990.

Table 4. Number of samples collected in Algeria, 1989.

Species	**Number of samples collected** Bulk	Single head
Aegilops ovata	23	-
Aegilops kotschyi	2	-
Aegilops ventricosa	24	-
Aegilops triuncialis	1	-
Hordeum vulgare	53	907
Hordeum murinum	13	-
Triticum durum	42	208
Triticum aestivum	24	176
Trifolium sp.	1	-
Vicia spp.	5	-
Pisum sativum	5	-
Trigonella sp.	1	-
Onobrychis sp.	1	-
Agropyron sp.	1	-
Avena sp.	1	-
Lupin	1	-
Lentil	3	-
Chickpea	13	-
Faba bean	11	-
Total	225	1291

Sixty one sites were visited during the mission and a total of 685 samples were collected along with detailed collection information. Soil samples were also collected from each site for isolation of Rhizobia and for chemical analyses and physical characterization. Due to the exceptionally dry season and the heavy overgrazing, it was not possible to collect seed samples in the Aqaba area and in the Eastern desert. These areas should be visited and surveyed again in a wetter year.

The average annual rainfall in the collection sites varied from 100 mm (Karak region) up to 600 mm (Balqa'a area). The collection sites also represent a wide range of altitudes from -100 m below sea level near the Dead Sea to 1500 m above sea level in the Tafilah - Ma'an regions. Annual Medicago and Trifolium as well as Astragalus and Trigonella were the most commonly found pasture and forage species in the surveyed area (Table 5). In addition, two samples of wild lentils (Lens orientalis and L. odemensis) were also collected from the southern edge of the distribution areas of these species.

The site information and evaluation data will be analyzed to describe the distribution of pasture and forage legumes and their diversity in Jordan. **A. Shehadeh, M. El Turk and L. Holly**

1.2.5. Collecting of rare species of Vicieae and food legumes in Syria

A four-day collection mission was conducted in Syria during the visit of a team of scientists specialised in Vicieae from the Southampton University, U.K. The aim of this short mission was to relocate sites and collect additional samples of rare Vicieae species which were first explored by the joint Southampton University/ICARDA/IBPGR mission in 1986.

Three areas were visited including sites around Tel Kalakh, Kasab and Afrin. A total of 127 samples were collected from 17 sites (Table 5). From the collected material, 5 samples of Vicia hyaeniscyamus and 3 additional samples of the new Vicia species (Vicia kalakhensis) discovered during the 1986 mission are of

Table 5. New food and forage germplasm collected in Jordan, Syria and Algeria in 1989.

	Number of accessions		
Genus	**Jordan**	**Syria**	**Algeria**
Medicago	140	32	-
Vicia	36	51	16
Trifolium	118	24	1
Astragalus	135	-	-
Trigonella	60	-	1
Onobrychis	49	2	1
Hymenocarpus	27	1	-
Hippocrepis	33	-	-
Coronilla	13	-	-
Scorpiurus	17	-	-
Ononis	17	-	-
Lathyrus	9	12	-
Pisum	9	3	5
Ornithopus	7	-	-
Biserrula	4	-	-
Lotus	4	-	-
Anthyllis	1	-	-
Lolium	1	-	-
Lupinus	-	6	1
Agropyron	-	-	1
Avena	-	-	1
Cicer	2	6	13
Lens	3	19	3
Total	685	156	43

special interest. The populations of V. hyaeniscyamus were composed of large plants occasionally grazed by cattle. It might have a potential as a forage plant in the moderate rainfall (400-600 mm/year) areas of ICARDA mandate region. These two rare Vicia species are also close relatives of faba bean within the Faba section of the genus. Vicia noeana was relocated near Afrin. It is a robust plant and is being used as a forage in mixture with a Trifolium species in its distribution area.

A separate short mission was also undertaken jointly with the GRU/ARC at Douma, Syria to collect food legume germplasm in the north-eastern part of Syria, a region not yet explored for food legume landraces. A total of 29 accessions, 4 faba bean, 6 chickpea and 19 lentil, was obtained from Raqqa, Deir Ez Zor and Hassake provinces. **N. Maxted (Southampton University), A. Shehadeh, Ali Ismail and L. Holly**

1.2.6. Collecting of wild relatives of wheat

In the framework of the special project "Collection and characterization of germplasm of the wild relatives of wheat", funded by the government of the Netherlands, collection trips have been made to Egypt, Cyprus, Turkey, Bulgaria and within Syria. These were joint missions with the respective national programs: the Genetic Resources Section of the Agricultural Research Centre Bahteem, Egypt, the Agricultural Research Institute of the Ministry of Agriculture and Natural Resources at Nicosia, Cyprus, the Plant Genetic Resources Research Institute at Izmir, Turkey, and the Genetic Resources Unit of the Directorate of Agricultural Scientific Research at Douma, Syria. The mission in Bulgaria followed the agreement between ICARDA and the Institute of Introduction and Plant Genetic Resources "K. Malkov" at Sadovo, Bulgaria. Priority was given to the species of Aegilops and the wild species of Triticum while recording pertinent environmental data.

In Egypt a total of 20 samples of Aegilops was collected representing 4 species and 1 subspecies of Aegilops. In spite of the reported seven species, Egypt proved rather poor for Aegilops. The genus was only found along the coast. Three species are apparently very limited in their presence as they were not found during the collecting mission. The reported presence of Ae. crassa in the Flora of Egypt is not supported by seed samples or collections in the visited herbaria, and is therefore considered doubtful.

From 4-11 June a collection mission was held in Cyprus with the assistance of the United Nations Development Program (UNDP) and accompanied by Mr. L. Guarino, IBPGR collector for the WANA region. The northern part of the island was visited for the first time. A total of 63 accessions was collected, representing 6 species and 1 subspecies of Aegilops, with, in addition, Hordeum spontaneum and H. bulbosum, especially from locations with saline soils. Most significant has been the first record from Cyprus of Ae. comosa ssp. comosa, a species from Greece and Turkey. The rare Ae. bicornis was found several times; its habitat appears to be well defined and restricted to sandy soils near the coastline. Other remarkable features were the frequent presence of Ae. peregrina ssp. cylindrostachys and the abundant occurrence of hybrids between Ae. ovata and Ae. peregrina.

A short collection mission was held in July in Syria. The areas west of Homs and northwest of Aleppo were visited and a number of common Aegilops species were collected.

Two areas of Turkey were visited. In the second half of June the area around the Sea of Marmora and the northwestern corner of the country was covered, partly because no previous missions had been there, partly to search for two rare species of Aegilops: Ae. comosa and Ae. uniaristata. Of these, unfortunately, only one immature plant of Ae. comosa ssp. heldreichii was found. The locations of Ae. uniaristata, known from the Flora of Turkey, were visited but were found to be converted into suburbs of Istanbul. Probably the species is almost extinct now in Turkey. Besides 18 accessions of wild diploid Triticum, 132 accessions of Aegilops, representing 7 species were obtained.

A collection mission covering most of the Anatolian highlands in Turkey was held in the first half of August. This area has not been covered well before and Ae. mutica, of which ICARDA's germplasm collection has only 15 samples, is endemic here. Four additional populations of this species were sampled, all of them at great distances from each other. A total of 102 accessions, representing 10 species and 1 subspecies of Aegilops was obtained.

Most surprising was the absence of the common Ae. ovata in this region. Both varieties of Ae. speltoides were found growing together in the Elazig province. This contradicts previous reports, which stated that these varieties occupy separate habitats in Turkey (G. Waines at the ICARDA wheat symposium of May, 1989). At several locations natural hybrids were found between Ae. cylindrica and bread wheat. Besides these interesting results Turkey proved to be by far the richest country for Aegilops. Intermingled growth of five to six species was not uncommon.

The collection mission in Bulgaria of mid July covered the southeastern, eastern and northeastern parts of the country. Total accession number was 64 for Aegilops and 4 for Triticum monococcum subsp. boeoticum. The most ubiquitous species proved to be Ae. cylindrica, a species that is rare to absent in West Asia and North Africa but more widespread in southern Europe. Special attention was paid to several Aegilops species that are in Bulgaria at the limits of their distribution areas: Ae. caudata, Ae. speltoides, Ae. umbellulata, Ae. columnaris. The latter two are only recently reported from Bulgaria by Dr. S. Kozuharov from the botanical Institute, Sofia. Unfortunately none was found, partly because it was impossible to visit their reported locations. The presence of Ae. caudata and Ae. speltoides, however, was confirmed by herbarium material in Sofia and Plovdiv.

During June, 49 Aegilops samples, which represent a part of the collected materials, were obtained from a collecting mission in Algeria conducted jointly with NARC, Japan, and ITGC. The visited areas differed greatly in edaphic conditions, soil type and rainfall (100 - 700 mm). Four Aegilops species were collected: Ae. ovata, Ae. ventricosa, Ae. kotschyi and Ae. triuncialis. In addition, natural hybrids of Ae. ovata and bread wheat, described in the past as Ae. triticoides, were found in Constantina province at 630 m elevation, but plants were immature at the collecting time. Ae. ovata and Ae. ventricosa were the most frequent species in a wide range of altitudes (240-1750 m), and were found in in a wide range of altitudes (240-1750 m), and were found in larger quantities in most of the collecting sites than Ae. kotschyi and Ae. triuncialis. At higher altitudes the plants were still green in June, but Ae. ovata showed early maturity in all visited sites.

Table 6 shows the newly acquired accessions by country and species.

The total of Aegilops accessions in ICARDA's genebank increased considerably during 1989: from 997 at the end of the last year to 1441. The current holdings of Aegilops in numbers and percentage is presented in Table 7. **M. van Slageren**

1.2.7. Summary of germplasm acquisitions in 1988/89

In addition to the germplasm collected during GRU/ICARDA collecting missions, 1676 cereal, 658 food legume and 585 forage germplasm accessions were received from other institutions in 1988/89 (Table 1).

The same table shows the final results of the GRU collecting effort. A total of 1488 new entries is indicating a considerable exploration of indigenous germplasm adapted to WANA region agroecological conditions. These resources will be multiplied, characterized, evaluated and preserved for their use in crop improvement programs.

The total number of new accessions, collected or obtained from other sources, was 4407, i.e. more than 5% potential increase of GRU germplasm collections. **GRU Staff**

1.3. Germplasm multiplication, characterization and evaluation

1.3.1. Characterization of durum wheat collection

A wide range of genotypes (2420 entries) obtained from a collecting mission in Turkey were multiplied in 1987-1988 and were fully characterized in 1988/1989 jointly with Cereal Program

Table 6. New accessions of Aegilops and wild Triticum resulting from 1989 collections missions.

Aegilops/Triticum Species	Algeria*	Bulgaria	Cyprus	Egypt	Syria	Turkey	Total
Ae. bicornis	–	–	5	5	–	–	10
biuncialis	–	8	12	–	5	24	49
caudata	–	–	–	–	–	15	15
columnaris	–	–	–	–	2	3	5
comosa	–	–	1	–	–	–	1
cylindrica	–	27	–	–	–	34	61
kotschyi	2	–	–	12	–	–	14
ovata	22	9	12	–	4	33	80
peregrina cylindro.	–	–	5	1	–	–	6
peregrina	–	–	4	1	3	–	8
speltoides ligus.	–	–	–	–	2	1	3
spelt.	–	–	–	–	3	3	6
triaristata	–	4	–	–	–	38	42
triuncialis	1	16	11	–	1	60	89
umbellulata	–	–	–	–	–	12	12
ventricosa	24	–	–	1	–	–	25
Ae. mutica	–	–	–	–	–	4	4
T. monococcum boeoticum	–	4	–	–	–	39	43
Grand total							473

* = from a mission of L. Holly and B. Humeid.

The objective of the current work is to evaluate this wide range of durum wheat genotypes under Tel Hadya conditions. The main features of the environments under consideration may be summarized as follows:

i) low and variable winter rainfall associated to low temperature

Table 7. Number of accessions and frequency distribution of *Aegilops* germplasm at ICARDA.

Species	accessions	percentage
triuncialis	266	18.45
ovata	210	14.57
squarrosa	147	10.20
biuncialis	138	9.57
cylindrica	110	7.63
peregrina	104	7.21
triaristata	84	5.82
speltoides	74	5.13
umbellulata	52	3.60
vavilovii	39	2.70
kotschyi	39	2.70
columnaris	34	2.35
searsii	30	2.08
ventricosa	28	1.94
caudata	20	1.38
mutica	19	1.31
bicornis	17	1.17
crassa	13	0.90
uniaristata	5	0.34
comosa	5	0.34
longissima	5	0.34
sharonensis	2	0.13
Total	1441	100.00

ii) high probability of early and terminal drought stress

iii) low temperature during canopy development with the danger of frost

vi) high temperature during grain filling

In this study an augmented design with five checks (Haurani, Cham-1, Cham-3, Stork and Gezera-17) was used, plots were of four rows each 3 m long and 37 cm apart. The soil was fertilized with preplanting doses of 40 kg of nitrogen/ha in the form of ammonium sulphate and 50 kg of P_2O_5/ha in the form of triple

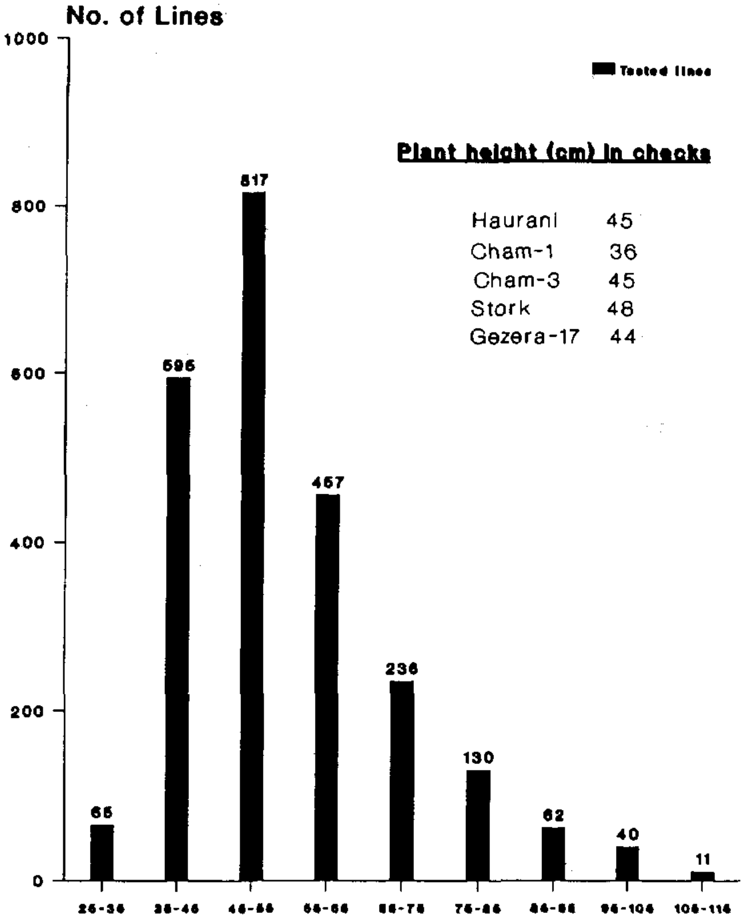

Figure 1. Plant height (cm) for 2420 durum wheat lines compared with 5 checks in 1988/89 season.

superphosphate. Nine quantitative characters (number of days to heading, number of days to maturity, plant height, peduncle length, spike length, awn length, number of spikelets/spike, grain filling duration and 1000-KWT) as well as nine qualitative characters (growth habit, early vigor, leaf color, waxiness, flag leaf width and length, glume color, glume hairiness, stem solidness, drought susceptibility) were scored.

Plant height is an important trait under moisture-stressed conditions. Figure 1 shows that the tested lines produced taller

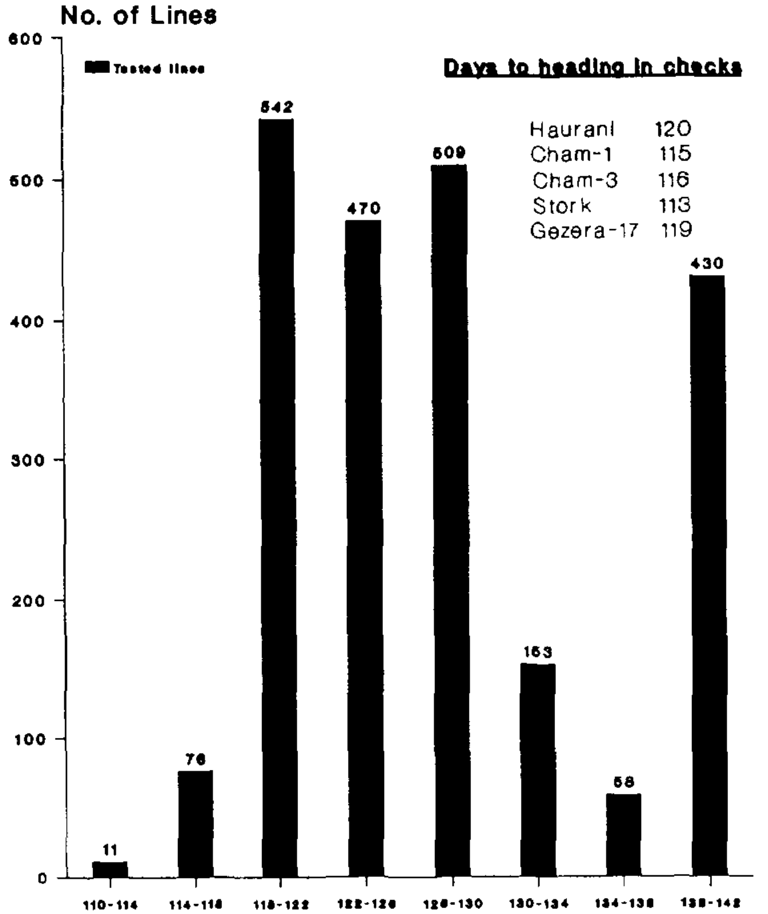

Figure 2. Days to heading for 2420 durum wheat lines originated from Turkey compared with 5 checks in 1988/89 season.

plants than Cham-1 and varied for this trait from 25-115 cm, while the checks (Haurani, Cham-1, Cham-3, Stork and Gezera-17) produced shorter plants with a range of 25-75 cm.

The data on number of days to heading are given in Figure 2. The average values over all tested lines ranged from 110 to 142 days, 11 lines headed as early as the earliest check Stork, 110-118 days. One thousand and eighty eight lines took the same time to heading as Haurani, Cham-1, Cham-3, and Gezera-17 checks. The other entries took comparatively more time to heading.

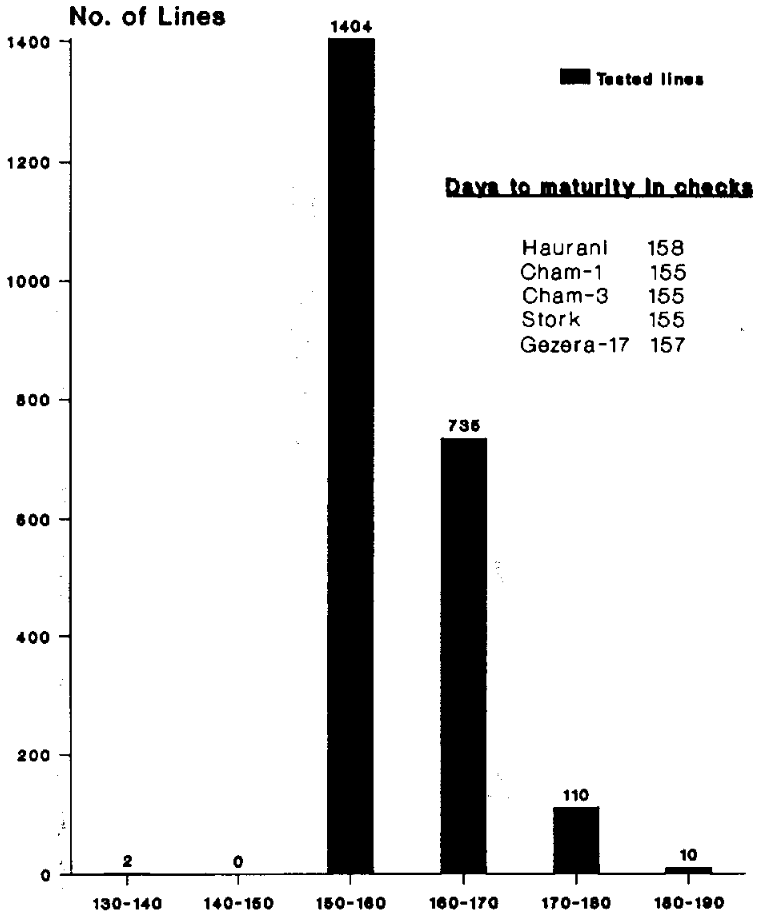

Figure 3. Days to maturity for 2420 durum wheat lines originated from Turkey compared with 5 checks in 1988/89 season.

The time to maturity (Figure 3) almost followed the same pattern as that of time to heading. The range for this character was of the order of 150-190 days. The variation for time to maturity among the genotypes was relatively small. The majority of the tested lines matured later than the checks (from 150-160 days), this narrow range of genotypic differences could be due to the drought occuring at the maturity stage. **B. Humeid and M. Nachit (CP)**

1.3.2. Evaluation and characterization of T. turgidum ssp. dicoccoides

In an evaluation experiment to study the morphological variation in T. dicoccoides populations, 80 population samples, representing many collection sites from Jordan and collected over the years 1984-1988, were planted in a randomized block design that was suitable for nearest neighboring analysis (NNA).

Twenty six characters (Table 8) were evaluated in this experiment on single row basis within each plot and on three randomly chosen plants from each row. The number of rows in each plot varied from 4-7.

Table 8. Characters evaluated in 1989 for T. dicoccoides

Quantitative characters	Qualitative characters
- No. of days to heading	- Growth habit
- No. of days to maturity	- Early vigor
- Tillering capacity	- Growth class
- No. of productive tillers	- Leaf shape
- Plant height	- Leaf position
- Spike length	- Flag leaf position
- No. of spikelets/spike	- Resistance to yellow rust
- Leaf length	- Waxiness
- Leaf width	- Awn length
- Peduncle length	- Spike density
	- Lodging
	- Glume color
	- Glume shoulder shape
	- Glume hairiness
	- Fertility of basal floret
	- Awn color

The data obtained from this joint experiment with the Jordan University of Science and Technology (JUST) will be analysed at JUST where the computer software for NNA is available. **B. Humeid and A.A. Jaradat (Jordan)**

1.3.3. Preliminary characterization of barley collection

A total of 2058 seed samples of barley landraces and <u>H. spontaneum</u>, collected as single heads from different sites in Syria (Palmyra and coastal areas) were planted jointly with barley breeders of the Cereal Improvement Program to study the natural effect of wild progenitor on cultivated type. The entries were screened for frost damage, number of days to heading, number of days to maturity, spike length, awn roughness, awn length, peduncle length, peduncle extrusion, number of spikelets/spike and rachis brittleness. Part of the evaluation data were computerized. **B. Humeid, S. Ceccarelli (CP) and S. Grando (CP).**

To assist scientists in the national programs to manage their own germplasm resources, joint characterization of 173 barley landraces took place in 1988-1989 growing season. The materials were planted in augmented design at ICARDA's Tel-Hadya station in plots of four rows each, three meter long. Sixteen quantitative and qualitative traits were scored. Data were computerized and statistically analysed.

The data on plant height, number of days to heading and number of days to maturity are presented in Fig. 4,5 and 6.

The average values for plant height over the tested entries ranged from 29-55 cm, and from 32-53 cm for the checks. The time to maturity followed pattern as time to heading, the tested entries varied from 112-150 days whereas checks matured in 134-146 days.

Due to severe drought at maturity last season, the results of statistical analysis were unsatisfactory. Therefore, the experiment will be repeated next growing season. **B. Humeid and K. Obari (ARC/Douma)**

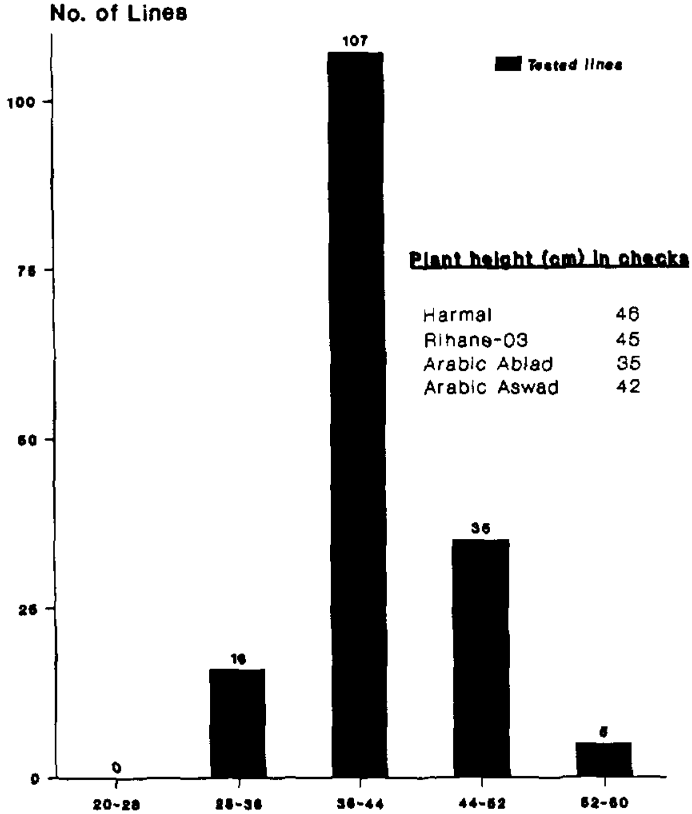

Figure 4. Plant height for 175 barley landraces originated from Syria compared with 4 checks in 1988/89 season.

1.3.4. Evaluation and multiplication of *Aegilops* germplasm

A set of 356 accessions of *Aegilops* germplasm, collected in the period of May-July 1988 in Jordan, Lebanon and Syria, was planted in an unreplicated nursery trial with three systematically repeated checks. Materials from Lebanon were included through collaboration of ICARDA's outreach station in Terbol in the Beqa'a valley. Three species of *Aegilops*, *Ae. searsii*, *Ae. triuncialis* and *Ae. vavilovii*, were used as checks.

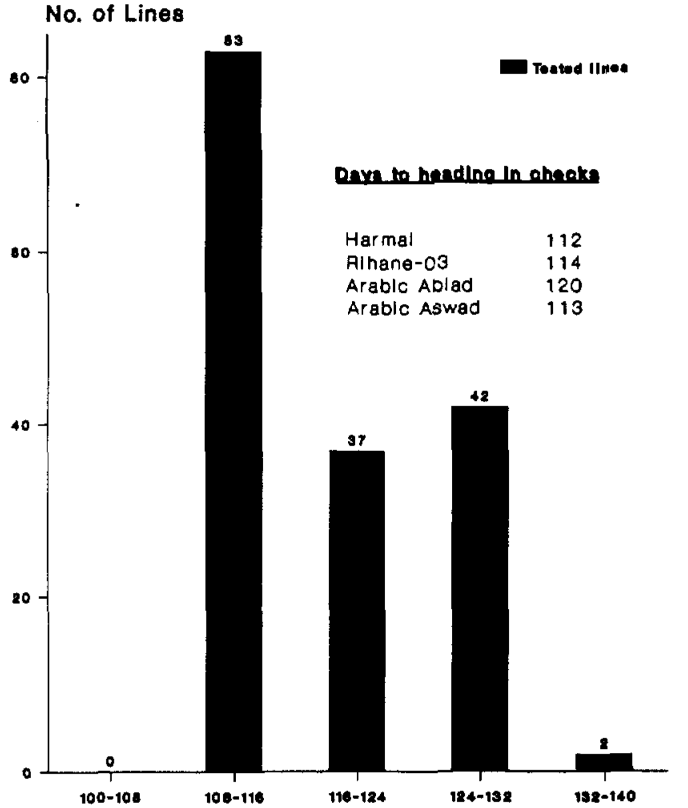

Figure 5. Days to heading for 175 barley landraces originated from Syria compared with 4 checks in 1988/89 season.

Qualitative and quantitative characters were evaluated on plot basis according to the IBPGR wheat descriptor list. Qualitative characters included early vigor, juvenile growth habit, growth class, leaf shape, leaf position, flag leaf position and waxiness of the plants. The Aegilops trial was not protected against yellow rust, in spite of the adjacent durum wheat trial, which had a spreader for this disease in the margin of its field. The very dry season prevented rust damage to the plots. Nine quantitative characters were evaluated on three single plants

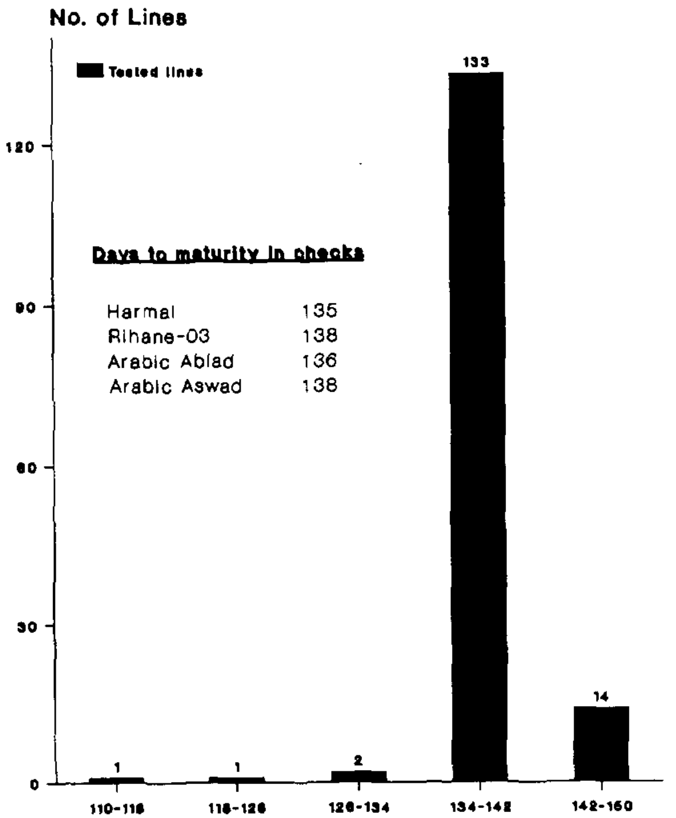

Figure 6. Days to maturity for 175 barley landraces originated from Syria compared with 4 checks in 1988/89 season.

selected randomly from each plot. They included: number of tillers per plant, number of productive tillers per plant, plant height (average of 3 readings per individual plants), spike length (average of 3 readings per individual plants), number of spikelets per spike, flag leaf length and flag leaf width. In addition the number of days to heading and days to maturity were calculated starting from the day of the first effective rain after planting (29 November 1988). Data on 3 quantitative characters are shown in Table 9.

Table 9. **Minimum, maximum, mean and standard deviation for 3 characters in Aegilops germplasm (1989 evaluation).**

Aegilops Species	No. of tested acc.	Plant Height (cm)				Number of days to heading				Number of spiklet/group per spike			
		Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD
Ae. biuncialis	41	24.0	52.0	36.73	5.00	118.0	139.0	128.09	6.07	2.0	6.0	2.7	0.46
Ae. columnaris	19	27.0	52.0	37.33	5.16	122.0	139.0	128.68	6.96	3.0	9.0	5.1	1.26
Ae. kotschyi	20	25.0	46.0	33.69	3.35	114.0	124.0	119.1	3.47	3.0	7.0	5.19	0.57
Ae. ovata	58	23.0	49.0	35.11	5.09	111.0	135.0	122.93	6.10	2.0	5.0	3.51	0.50
Ae. peregrina	66	25.0	62.0	43.90	5.53	114.0	149.0	126.3	7.47	3.0	7.0	4.7	0.57
Ae. searsii	28	37.0	67.0	52.82	5.29	118.0	128.0	123.71	1.91	9.0	16.0	12.89	1.10
Ae. speltoides	23	31.0	78.0	56.02	7.93	135.0	165.0	153.47	8.51	6.0	14.0	12.69	1.81
Ae. triuncialis	29	33.3	59.0	44.57	5.30	130.0	149.0	140.68	6.68	3.0	8.0	5.63	0.98
Ae. vavilovii	31	32.0	64.0	49.50	6.02	114.0	129.0	121.96	3.89	5.0	12.0	9.80	1.67
Ae. vavilovii (check I)		44.0	65.0	55.45	4.41	122.0	124.0	122.8	0.55	6.0	11.0	9.95	0.82
Ae. triuncialis (check II)		36.0	55.0	47.36	2.45	129.0	134.0	130.69	1.25	5.0	7.0	5.98	0.35
Ae. searsii (check III)		42.0	62.0	52.0	3.31	123.0	125.0	123.45	0.68	10.0	15.0	12.29	0.86

In addition to the field trial a total of 101 accessions was multiplied separately in the isolation area at ICARDA's Tel Hadya station, whereas a total of 72 critically small collections was multiplied in the plastic house. **M. van Slageren and F. Swaid**

1.3.5. Multiplication and characterization of food and forage legume germplasm

A total of 537 new food legume accessions were planted in the isolation area for multiplication, health inspection and preliminary characterization. The planted material included 323 chickpea, 136 lentil and 78 faba bean population samples. The faba bean populations were planted in two screen houses and flowers were tripped to enhance seed setting. The new chickpea and lentil germplasm was characterized for 15 and 14 characters, respectively. Accessions which yielded sufficient amount of seed for further evaluation and preservation are processed for medium- and long-term seed storage. Subsamples of this germplasm have been provided to FLIP scientists for the evaluation of agronomic traits.

A total of 839 new forage legume accessions were planted for multiplication, characterization and taxonomic identification in 1988/89. Depending on the seed quantities available, the accessions were planted only in a plastic house or also in the field in plots of one or three rows. All the samples planted in the field were duplicated in the plastic house for safety and to ease the taxonomic identification and verification of the new germplasm (Table 10).

Dr. Nigel Maxted from Southampton University, UK, visited the GRU from 2 to 12 May to provide assistance to the GRU staff in the identification of the Vicieae accessions planted this year. His visit was scheduled to coincide with flowering of the germplasm. Herbarium specimens were collected from the few earlier flowered accessions to facilitate their proper identification. All but one accessions were identified, the exception was a sample originally

Table 10. New forage legume germplasms planted for characterization and identification in 1988/1989.

Species	In the field	In plastic house
Medics	20	20
Vicia spp.	96	445
Lathyrus spp.	62	351
Pisum spp.	3	33
Total	181	839

collected as Lathyrus basalticus in Syria in 1986. This accession showed characteristics outside the range of L. basalticus and could not be identified as belonging to a currently recognised species. It may be described as a new species within Lathyrus, section Lathyrus, and is closely allied to L. basalticus and L. cicera. Further studies are needed to assess the economic value of this new species.

In addition to the new germplasm, a total of 909 food legume and 2380 forage legume accessions were planted for multiplication to obtain sufficient amount of good quality seed for conservation, further evaluation and distribution (Table 11). A total of 307 samples of wild Cicer and Lens species was also planted for multiplication and taxonomic studies in the field and in a plastic house. The material included both population samples and single plant progenies separated on the basis of morphological traits and protein banding patterns obtained by electrophoresis. **L. Holly, A. Ismail, A. Shehadeh and N. Maxted (Southampton University)**

Table 11. Food and forage legume germplasm accessions multiplied and regenerated in 1988/1989.

Species	In the field	In plastic house	Total
Pisum spp.	1309	92	1401
Vicia spp.	213	35	248
Lathyrus spp.	333	34	367
Medics	297	67	364
Chickpea	589	11	600
Lentil	281	28	309
Wild *Lens* spp.	79	64	143
Wild *Cicer* spp.	133	31	164
Total	3234	362	3596

1.3.6. Evaluation of food and forage legume germplasm

Chickpea germplasm

In an evaluation trial conducted jointly with the Food Legume Improvement Program, 6224 chickpea accessions were planted in 1987/88. Following the field evaluation of 7 traits, the seed characterization for the same accessions was completed in the laboratory during 1988/89. Seed shape, seed colour, seed roughness and 100-seed weight were scored. A wide range of variation was recorded for 100-seed weight as illustrated in Fig 7.

The evaluation and passport information will be published jointly with FLIP in form of a winter planting chickpea catalog. It will also include information on important agronomic characters like protein content, seed shattering and reaction to different biotic and abiotic stresses.

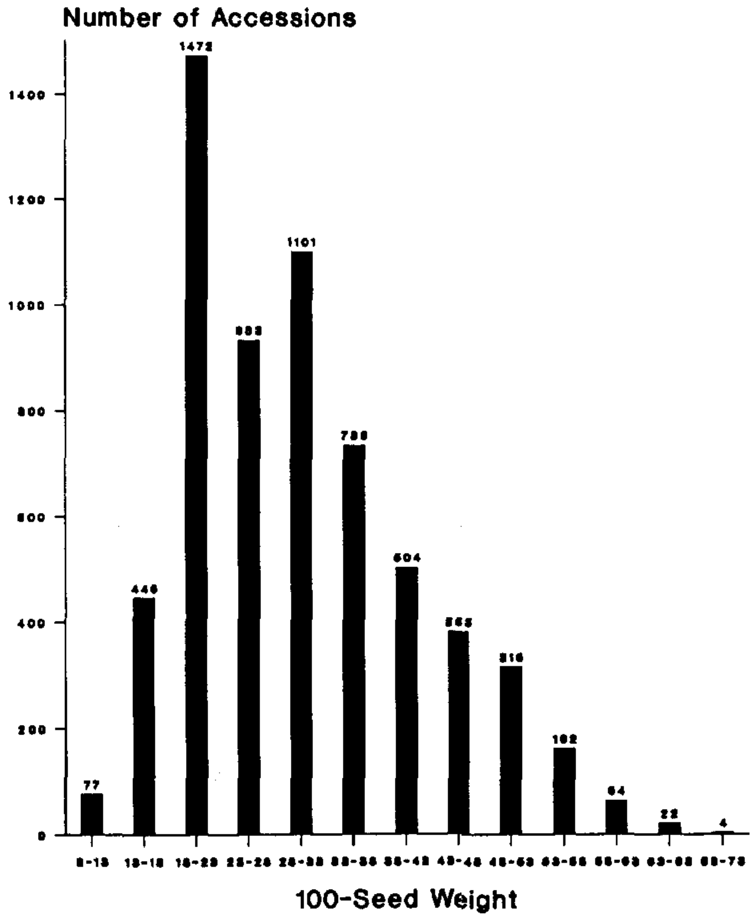

Figure 7. Variation for 100-seed weight in 6224 chickpea accessions.

Wild chickpea

Evaluation of wild chickpea populations and selected genotypes was continued in collaboration with FLIP scientists. Lines with resistance to biotic and abiotic stresses were identified in some of the wild species studied (see details in FLIP Annual Report, 1989). The intraspecific variation detected in wild Cicer species for agronomic characters further stresses the importance of selecting distinct genotypes from heterogenous populations for the evaluation of these traits.

Annual medics

In the 1987/88 growing season, evaluation of annual medics collections was continued. One hundred and thirty three additional accessions of Medicago polymorpha originating from 10 countries and 373 accessions of M. orbicularis from 15 countries were evaluated for 21 descriptors. The experimental layout of the trials was an augmented design with repeated checks. The evaluated characters and checks were the same as in the earlier trials (see details in GRP Annual Report, 1988). The evaluation data are being analyzed and a comparison will be made between Medicago polymorpha accessions evaluated in 1987/88 and 1988/89 on the basis of the performance of the same checks. **L. Holly, A. Ismail and A. Shehadeh**

1.4. Ecogeographical study of durum wheat landraces

1.4.1. Multilocational evaluation

The overall goal of the research project "Agronomic characterization of germplasm collections on the basis of information on the environment in the regions of collection and evaluation data" is to reveal patterns between agro-ecological characteristics of the region of collection and the agronomic performance of the collected population under various growing conditions. The complete data set will comprise climatic conditions and physiological and phenological crop characteristics for two seasons. Detailed interpretation may enable understanding of the growth and development of landraces originating from various agro-ecological regions. This may be used in pre-selection for traits, without necessarily having to evaluate a complete collection under specific conditions.

From the '87 durum wheat landrace collection (see GRP Annual Report 1987), 49 accessions were selected on basis of their origin: only accessions that, according to the farmers, originated from the same farm or village as collected from. These were evaluated for agronomic performance during 1988-1989 season.

Evaluation was carried out at three locations:

- Breda (195 mm precipitation during 88/89 season),
- Homs (275 mm),
- Izra'a (188 mm).

Per site, the landraces were sown in a RCB design with two replications, with landrace and fertilizer as the two factors. Two types of fertilizer were applied: nitrateammonium (33.5%) and triplesuperphosphate (46%). Nitrogen was given at sowing and at shooting stage, in Homs and Izra'a 30 + 30 kg/ha, and in Breda 20 + 20 kg/ha. Phosphorus was given once, 40 kg/ha for all sites at sowing.

The season was dry and short. Only in December, at all sites precipitation was relatively high. During tillering, rainfall was low, to increase only at shooting stage.

In Breda, emergence was poor, and not compensated by high tillering afterwards, possibly due to the combination of low temperature and limited water availability. At both other sites, crop establishment was good. Populations in Homs performed generally well, with high tiller densities and plant heights. Both Breda and Izra'a showed low plant height, in Izra'a in combination with a reasonably good tiller density.

Observations were made on yield (seed, straw), yield components (spike density, seeds per spike, 1000 seed weight), phenological stages, growth vigour, plant height, leaf rolling and flag leaf yellowing.

Table 12 presents a summarized analysis of variance for seed yield. When sites were assumed to be random, then site effect proved to be significant. The ANOVA further showed significant effects for landrace, for fertilizer application, and for the interactions of site with landrace and with fertilizer application. There were no significant effects for the landrace fertilizer interaction and for the triple interaction of site landrace fertilizer, which means that a landrace effect was modified only by choice of the site, not by fertilizer application or combination of the latter two.

Table 12. 1989 Multilocational evaluation of durum wheat landraces. ANOVA for seed yield (summarized).

Source of variation	d.f.	MS	F
Replication	3	1220.2	
Site	2	$2.0x10^6$	2768.93*
Landrace	37	1581.9	2.19*
Fertilizer	1	7080.9	9.80*
L * F	37	887.9	1.23
L * S	74	1875.9	2.60*
F * S	2	9910.8	13.72*
L * F * S	74	863.5	1.20
Error	225	722.3	

* = $P < 0.01$, otherwise $P > 0.2$

This is illustrated by four landraces, randomly chosen from selected regions with distinct ecological characteristics (Table 13). The accessions of Haurani, Shihani, Suweidi and Baladi originate from sites with increasing annual rainfall. In Table 14, seed yield and harvest index (HI) are presented for these four landraces and for two checks, Haurani 27 and Cham 3. Breda generally gave lowest yields, followed by Izra'a, although the annual rainfall at this site was lower. The higher yields could be related to the better crop establishment after winter. Highest yields were found in Homs, where the more moderate climate proved favourable. The ranking of annual rainfall at the collection

Table 13. Passport and collection information of four durum wheat landraces from Syria.

Descriptor	Haurani	Shihani	Suweidi	Baladi
Collection number	ID 54	ID 167	ID 209	ID 277
Accession number	ICDW 19521	ICDW 19576	ICDW 19587	ICDW 19641
Province of origin	Suweida	Hassake	Idleb	Tartous
Annual rainfall (mm)	275	400	500	1000
Altitude (m)	1220	540	610	50
Mean max. Aug. temp. (°C)	32	39.5	35	36.5
Mean min. Jan. temp. (°C)	1	2	3	2
Potential evaporation (mm)	1750	2350	1650	1700
Soil organic matter (%)	0.87	1.45	2.02	2.5
Soil nitrogen (ppm)	556	975	1346	1368
Soil phosphorus (ppm)	4.5	4.5	16.5	16.2

Table 14. Seed yield (ton/ha) and harvest index of four landraces evaluated in '88–'89 at three locations.

		Izra'a		Breda		Homs	
Landrace	**Ferti-lizer***	**Seed yield**	**HI**	**Seed yield**	**HI**	**Seed yield**	**HI**
Haurani	–	0.23	0.19	0.13	0.12	3.10	0.30
	+	0.20	0.14	0.23	0.14	3.12	0.46
Shihani	–	0.12	0.10	0.14	0.12	1.87	0.27
	+	0.07	0.06	0.18	0.14	2.74	0.33
Suweidi	–	0.18	0.16	0.14	0.14	2.13	0.34
	+	0.19	0.15	0.17	0.15	2.74	0.30
Baladi	–	0.15	0.10	0.13	0.14	2.16	0.24
	+	0.16	0.10	0.13	0.08	1.66	0.24
Haurani 27 (check)	–	0.28	0.22	0.16	0.16	1.91	0.32
	+	0.20	0.16	0.13	0.13	2.18	0.29
Cham 3 (check)	–	0.17	0.14	0.18	0.20	2.18	0.34
	+	0.16	0.11	0.20	0.17	3.08	0.37

*: – = no fertilizer application
+ = fertilizer application

sites reflected in the ranking of seed yield: landraces from the driest and wettest sites, gave at all sites highest and lowest yields, respectively. The Baladi landrace from Tartous has probably not been cultivated under dry conditions, whereas the other three landraces may have evolved under variation in annual rainfall. This could partly explain the suggested broader adaptive capacity of this germplasm originating from arid zones, when compared with the accession from a high rainfall region.

None of the yield components (not tabulated) was stable among sites; all were highest in Homs, no. tillers/m^2 ranked second in Izra'a, 1000 seed weight ranked second in Breda, and no. seeds/tiller showed a population site interaction.

Harvest index was highest in Homs for each landrace, while Baladi showed the lowest value. At Izra'a and Breda, HI's did not exceed 0.2, and were equal, when averaging over all four landraces (0.13). Interactions masked main effects.

These observations are based on few landraces and on one year's experiment, and therefore are insufficient for analysis of the effects and interactions. Important is, however, the fact that effects and interactions exist, not only when comparing relatively favourable sites with relatively unfavourable sites, but as well among unfavourable sites, as this indicates variation among landraces in adaptive capacities. **A. Elings, M. Nachit**

1.4.2. Disease evaluation

The same 49 landraces were evaluated for resistance to fungal diseases. Septoria tritici blotch resistance was evaluated at the Lattakia station, resistance to yellow rust (Puccinia striiformis) at Tel Hadya in the field, leaf rust (P. recondita) and stem rust (P. graminis) resistance at Tel Hadya in plastic houses, and common bunt (Tilletia spp.) at Tel Hadya in the isolation area. In all experiments, artificial inoculation through susceptible spreader lines was used.

Landraces are heterogeneous and consist of plants varying in reaction to diseases. One may expect genotypes with high resistance, others with high susceptibility or intermediate levels of resistance within the same population. Although subpopulation or individual lines with uniform, high resistance may be isolated, on population level absolute resistance may not be found.

Leaf rust and stem rust resistance were not detected on population level; infection rate generally reached 50-60% and 70%, respectively. Resistance to the other three diseases showed differentiation among regions and landrace groups that can be morphologically distinguished. Yellow rust resistance was only noticed in Baladi landraces originating from the province of Idleb and the mountains between Lattakia and Tartous. Resistance to blotch was found in Baladi landraces from the same western mountains and from Damascus, in Shihani from the northeastern part of Syria, in Bayadi from Idleb, Hama and Homs, and in Sheirieh from the northeast. Common bunt resistance was detected in landraces originating from areas where the disease naturally occurs, viz. Idleb (Baladi, Bayadi, Hamari), the northeast (Shihani, Sheirieh), Damascus (Haurani) and Quneitra (Haurani). Common bunt resistance was also found in landraces originating from regions where the disease is not prevalent: Hamari from Tartous, Bayadi from Hama, and Haurani from Homs and the Hauran. It is interesting to note that the Haurani landraces gave detectable resistance only to common bunt, implying that other landrace groups are useful sources of resistance as well. **A. Elings, O. Mamluk**

1.5. Taxonomic and genetic studies in wild relatives of wheat, lentil and chickpea

1.5.1. Taxonomic study of the genus Aegilops

In the framework of the taxonomic revision of Aegilops the herbaria of the following institutions were visited, mainly in conjunction with collection missions (number of inspected herbarium sheets between brackets): the Agricultural Research Institute (43), Nicosia, Cyprus; the Forestry Department of the Ministry of Agriculture and Natural Resources (30), Nicosia, Cyprus; the Department of Botany, Cairo University (126); the Department of Flora and Phytotaxonomy Researches of the Ministry of Agriculture (62), Cairo, Egypt; the Botanical Institute of the Bulgarian Academy of Sciences (129), Sofia, Bulgaria; the Institute of Introduction and Plant Genetic Resources (18), Sadovo, Bulgaria; the Higher Agricultural Institute (55), Plovdiv, Bulgaria; the Ministry of Agriculture and Agrarian Reform (29), Douma, Syria; the Arab Center for Studies of the Arid Zones and Dry Lands (ACSAD) (25), Douma, Syria; the University of Ankara (187), Turkey; the Hacetepe University of Ankara (27), Turkey.

During a stay in the Netherlands additional material was studied from the herbaria of Berlin (15), Edinburgh (4), Jena (511) and Vienna (157) that was received on loan by the Laboratory for Plant Taxonomy and Plant Geography of the Agricultural University at Wageningen.

As a result of this work the distribution of several Aegilops species became much better known. A notable example of this is Ae. bicornis, hitherto known only from Libya, Egypt and S. Palestine. Collection work as well as herbarium samples indicated an additional presence in Cyprus and central Syria (Palmyra - Deir-Ez-Zor region). Also areas like Armenia and Turkmenia in the USSR were identified as being rich in Aegilops species. **M. van Slageren**

1.5.2. Studies on odemensis type wild lentils

The Near East and European types of Lens nigricans in spite of sharing a common character of semihastate dentate stipule are not crossable with each other. Stipule orientation has been suggested as the main discriminating morphological character between the two groups. It was also reported in the literature that in addition to L. orientalis only the Near East type of L. nigricans having horizontal stipules is crossable with cultivated lentils. A subspecies status has recently been suggested for this group within Lens culinaris (L. culinaris subsp. odemensis) according to the biological species concept.

As a result of several surveys of wild lentils in Syria and Turkey, 17 new odemensis type samples have recently been collected in addition to the five accessions which were received earlier from the USDA collection. Three of the new genotypes (ILWL 116, LR 129, LR 158) collected in Syria have vertical or semi-vertical stipules similar to European type L. nigricans plants, making the distinction between the two groups difficult on the basis of the accepted discriminating character. All the 22 odemensis genotypes available so far at ICARDA's wild lentil collection were planted along with samples of L. culinaris, L. orientalis, L. ervoides and L. nigricans in 1988/89 to identify additional suitable characters for discriminating among these taxa. Most of the characters studied (stipule shape, stipule orientation, cotyledon colour, flower colour, length of calyx teeth) were polymorphic in the odemensis type accessions and overlapped with other accessions belonging to different species. Two characters were however specific to L. odemensis: i) a dark inverse w-shaped mark on the seed coat near the hilum and ii) the narrow, elongated shape of the leaflets of the first bifoliate leaves. The length/width ratio of these leaflets in the odemensis genotypes (>3.0) was distinctly different from the values obtained for L. nigricans (1.3 - 1.8) and L. ervoides (1.9 - 2.3) but overlapped with L. orientalis (2.5 - 4.3) and L. culinaris (2.1 - 4.5) (Table 15 and Figure 8). The dark mark on the seed coat was only present in the odemensis accessions. These two characters appear to be useful for distinguishing between L. odemensis and L. nigricans. **L. Holly and A. Ismail**

Table 15. Variation in leaflet size of the first bifoliate leaf in different *Lens* species.

Species	Leaflet of the first bifoliate leaf: Length (mm) Mean	Range	Width (mm) Mean	Range	L/W Ratio Mean	Range
Lens orientalis	9.8	6.8 - 15.0	3.2	2.0 - 4.5	3.2	2.5 - 4.3
Lens nigricans	7.5	5.9 - 9.0	4.8	3.8 - 6.0	1.6	1.3 - 1.8
Lens odemensis	10.2	8.5 - 13.0	2.7	1.8 - 3.7	3.9	3.0 - 5.2
Lens ervoides	7.2	4.0 - 9.0	3.5	2.0 - 4.8	2.1	1.9 - 2.3
Lens culinaris	16.1	12.0 - 21.0	5.4	3.6 - 8.9	3.1	2.1 - 4.5

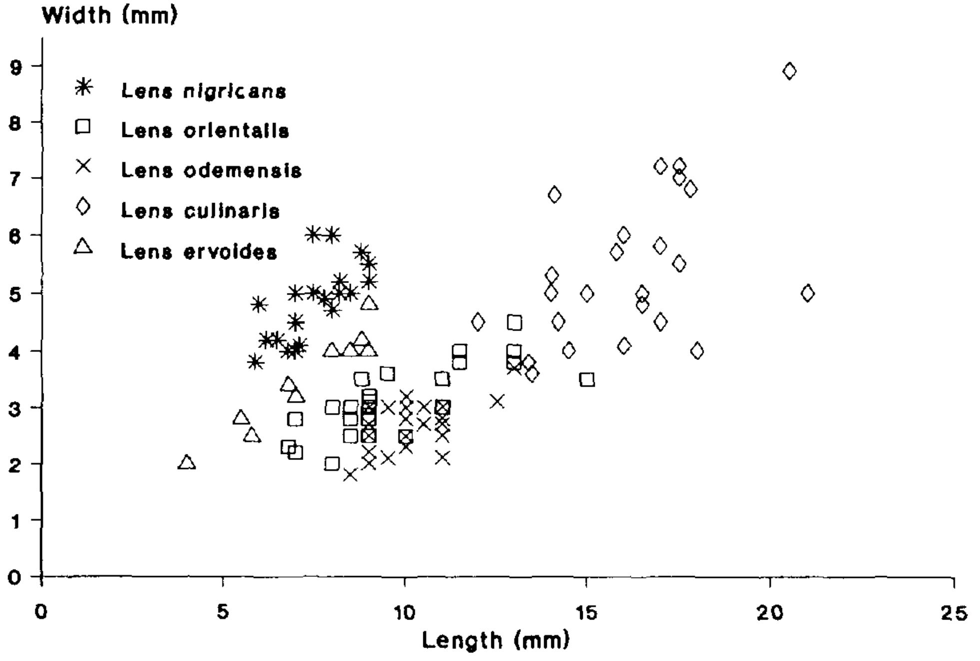

Figure 8. Scatter diagram of leaflet sizes on the first bifoliate leaf in different lentil species.

1.5.3. Fertility and segregation for selected characters in a cross Cicer arietinum x C. reticulatum

The most probable wild progenitor of cultivated chickpea, Cicer reticulatum, was first found and described from southeast Turkey in 1974. Early studies on the cytogenetic relationship between C. reticulatum and cultivated chickpea revealed that crosses involving pink-flowered cultivars of C. arietinum yielded fertile hybrids. In contrast, when a white-flowered (kabuli) cultivar was crossed with C. reticulatum the F1 hybrids failed to produce seeds. Since C. reticulatum should be considered as an important source of genes for the improvement of frost tolerance in winter planted kabuli chickpea and possibly of other characters as well, it is important to obtain additional information on the compatibility of the two species. As a first attempt, crosses were made between a simple leaf mutant of kabuli chickpea (ILC 1250) and Cicer reticulatum (ILWC 21) in 1985/86, using the cultivated genotype as female parent. (see GRP Annual Report, 1987).

Segregating filial generations (F_2, F_3) of this interspecific cross were evaluated in 1988/89. Eleven characters (flower colour, days to flowering, leaf type, growth habit, leaflet size, days to maturity, number of seeds/plant, 100-seed weight, seed type, testa colour and seed coat roughness) were scored or measured on each plant, and segregation for selected characters was analysed. Small pieces of the cotyledon were cut off from 40 F_2 seeds before planting and used for SDS-PAGE electrophoresis (for details see GRP Annual Report, 1987).

White flower colour and simple leaf character were found to inherit independently as recessive monogenic traits. In the F_2 generation, the observed frequencies of phenotypes (compound leaf/purple flower, compound leaf/white flower, simple leaf/purple flower, and simple leaf/white flower) did not differ significantly from the expected 9:3:3:1 ratio. In contrast to the F_1 generation where all plants were fully fertile, partial or complete sterility was observed in some of the F_2 plants. Five F_2 plants with compound leaves, four of them having purple and one having white flowers, were completely sterile.

In the F_3 generation, the number of plants with compound leaves was lower than expected. Only one of the F_3 family (F_{3-1}), where the F_2 parents were fully fertile, showed the expected segregation pattern (Table 16). The results indicate that the F_2 sterility in the three other cross combinations was associated with the compound (normal) leaf character inherited from the wild parent.

Table 16. Dihybrid segregation for flower colour and leaf type in the cross ILC 1250 (C. arietinum) x ILWC 21 (C. arietinum)

Parents/ generations		Phenotypes**				Chi^2	P value
		CP	CW	SP	SW		
ILC 1250					4		
ILWC 21		4					
F_1		4					
F_2	Observed	45	15	19	2	2.76	>0.30
	Expected	45.60	15.20	15.20	5.00		
F_{3-1}	Observed	46	21	12	6	1.93	>0.50
	Expected	40.2	22.2	16	6.50		
F_{3-2}	Observed	15	22	43	27	13.56	<0.01*
	Expected	20.2	32.2	39	15.50		
F_{3-3}	Observed	11	36	27	16	7.26	>0.05
	Expected	20.80	35.40	22	11.80		
F_{3-4}	Observed	8	1	43	15	12.66	<0.05*
	Expected	16.70	5.60	34.50	10.20		
$F_{3\ (1-4)}$	Observed	80	80	125	64	16.56	<0.01*
	Expected	98	95.50	111.50	44		

* Observed segregation significantly differs at P<0.05 level from expected

** Phenotypes: CP = Compound leaf/Purple flower
CW = Compound leaf/White flower
SP = Simple leaf/Purple flower
SW = Simple leaf/White flower

The differences in compatibility among genotypes from the same populations highlights the importance of using selected, fully interfertile genotypes for interspecific crosses, especially if the breeding aim is to transfer polygenic characters (e.g. cold tolerance in Cicer reticulatum) to cultivated chickpea.

The SDS protein band with 42 KD molecular weight was only present in the wild parent. In the F2 generation its presence was associated with purple flower colour, indicating a tight linkage between the two characters.

Seed size, seed type and seed coat roughness showed quantitative segregation and F_3 plants were intermediate between the two parents. The segregation for days to flowering, in accordance with earlier reports, was found to be transgressive, and plants both earlier and later flowering than parents appeared in the F_3 generation (Table 17). It confirms the value of C. reticulatum in breeding for earliness in chickpea. **L. Holly, K.B. Singh (FLIP), B. Ocampo (FLIP) and A. Ismail**

Table 17. Segregation for days to flowering and 100-seed weight in F2 and F3 generations of interspecific hybrids between Cicer arietinum (ILC 1250) and Cicer reticulatum (ILWC 21).

Generation	Days to flowering		100-seed weight (g)	
	Min.	Max.	Min.	Max.
P1 (ILC 1250)	111	115	50.6	60.5
P2 (ILWC 21)	118	129	10.7	14.1
F2	105	125	15.3	50.7
F3	93	147	14.0	59.0

1.6. Germplasm preservation and utilization

1.6.1. Germplasm preservation

The processing and storing of germplasm in controlled environment are ongoing activities of the GRU. In the 1988/89 season a total of 10058 entries (4330 bread wheat and 5728 durum wheat) were prepared and deposited in the medium-term storage facilities.

With the completion of the Genetic Resources Unit new building the transfer of active germplasm collections from the old to the new storage facilities was initiated. In total 31734 accessions have been transferred:

16084 accessions of barley
3600 accessions of bread wheat
6758 accessions of lentil
900 accessions of chickpea
4392 accessions of *Medicago* spp.

The total number of accessions held in GRU collections is presented in Table 18. Considering the origin of the materials representation of the ICARDA mandated region (WANA) is high in most of the crop collections. Barley has a low percentage of accessions originated in WANA region (36.6%) but the absolute value (5895 accessions) is high. However, the representation of the particular countries is uneven and this situation should be improved by targeted collecting missions and requests from other genebanks.

1.6.2. Germplasm utilization

The Genetic Resources Unit devoted considerable time to fulfill requests for germplasm, received from ICARDA's scientists or from other institutions.

Table 18. Distribution of ICARDA collections by region of origin (1.10.1989)

Crop	Number of accessions originated from						
	WANA		other countries		Unknown		Total
	No. of acc.	(%)	No. of acc.	(%)	No. of acc.	(%)	No. of acc.
Barley (cult.)	5895	(36.6)	9615	(59.6)	614	(3.8)	16124
Barley (wild)	290	(23.6)	59	(4.8)	880	(71.6)	1229
Durum wheat	7463	(41.4)	9725	(53.9)	845	(4.7)	18033
Bread wheat	4291	(69.6)	836	(13.6)	1033	(16.8)	6160
Triticum dicoccoides	836	(91.8)	24	(2.6)	51	(5.6)	911
Aegilops spp.	1203	(82.3)	228	(15.6)	31	(2.1)	1462
Cereals - subtotal	19978		20487		3454		43919
Cicer spp.	5915	(79.5)	1347	(18.1)	176	(2.4)	7438
Lens spp.	4131	(56.9)	3077	(42.4)	51	(0.7)	7259
Faba bean	1627	(39.8)	1804	(44.2)	654	(16.0)	4085
Food legumes-subtotal	11673		6228		881		18782
Medics	4428	(90.0)	334	(6.7)	160	(3.3)	4922
Vicia spp.	1731	(43.3)	1073	(26.8)	1194	(29.9)	3998
Pisum spp.	575	(17.6)	1545	(47.1)	1158	(35.3)	3278
Trifolium spp.	1779	(93.1)	93	(4.9)	39	(2.0)	1911
Lathyrus spp.	1031	(82.0)	221	(17.6)	5	(0.4)	121
Forage - subtotal	9544		3266		2556		15366
Other forages							7993
Grand total							86060

In 1988/1989 a total of 5471 entries were sent to scientists in 26 countries. In addition the GRU supplied seed samples from 11064 accessions to the commodity programs at ICARDA (Table 19, 20 and 21). **GRU Staff**

1.7. Documentation of Genetic Resources

After collecting, passport and collection (P & C) information is transferred to the accession book, from which it is added to the P & C data base. Whereas large parts of collections acquired from

Table 19. Number of cereal germplasm samples distributed to different countries.

Country	Barley	Wild Barley	Durum Wheat	Bread Wheat	Wheat wild species
Bulgaria	36	-	-	-	-
Canada	-	-	355	-	56
England	-	34	-	-	34
Holland	-	-	10	-	22
India	-	-	290	118	12
Iraq	20	-	20	-	-
Italy	-	-	-	-	33
Jordan	-	-	-	-	80
Morocco	219	-	1527	-	122
Nepal	56	10	-	-	10
USA	-	-	12	36	-
USSR	110	-	-	-	30
ICARDA	198	-	2140	1929	102
Total	639	44	4354	2083	501

Table 20. Number of food legume germplasm samples distributed to different countries.

Country	Chickpea	Lentil	Faba bean	Wild Cicer	Wild Lens
Australia	11	-	-	-	-
Canada	84	-	-	-	-
Ethiopia	-	-	43	-	-
FRG	-	-	6	-	-
India	157	31	-	5	-
Mexico	125	-	-	-	-
Morocco	10	-	-	-	-
Poland	10	-	20	-	-
Spain	10	-	-	-	-
Syria	50	73	-	3	-
USA	-	-	6	28	28
ICARDA	6337	41	1	154	16
Total	6794	145	70	190	44

Table 21. Number of forage germplasm samples distributed to different countries.

Country	Pisum spp.	Medicago spp.	Vicia spp.	Lathyrus spp.	Other species
Australia	500	14	–	–	–
Cyprus	–	–	–	–	40
Ethiopia	–	–	–	–	7
France	–	50	–	–	24
Hungary	–	–	–	–	135
Iran	5	–	5	5	–
Iraq	–	–	–	–	11
Italy	–	80	–	–	20
Kuwait	–	–	–	–	20
Morocco	–	45	–	–	–
New Zealand	–	–	–	86	–
Saudi Arabia	–	36	–	–	–
Spain	–	–	120	–	60
Syria	2	1	35	29	–
USA	–	134	20	30	11
ICARDA	11	135	–	–	–
Total	518	495	180	150	328

other institutions lack substantial P & C information, the GRU steadily builds up a collection originating from ICARDA's mandate region and characterized in detail by P & C information. The agro-ecological characteristics of the region of collection can be utilized in selecting germplasm and in interpreting evaluation results.

For the last two years, much attention has been paid to updating old files into the standardized GRU data base, that is suitable for documentation of all mandated crops, with the result that the GRU now possesses complete P & C files on bread wheat, barley, wild Triticum spp., Aegilops spp., wild Cicer spp., and wild Lens spp. The durum wheat file is nearly complete, the files on cultivated chickpea and lentil are currently in the process of updating, and the files on forage and pasture crops will need considerable attention in the future.

The total number of entered accessions in the period October 1988- September 1989 was 2389, including:

- 224 accessions of bread wheat
- 92 accessions of durum wheat
- 16 accessions of other cultivated Triticum spp.
- 65 accessions of T. boeoticum
- 455 accessions of Aegilops spp.
- 38 accessions of 2-row barley
- 170 accessions of 6-row barley
- 50 accessions of Hordeum spontaneum
- 326 accessions of cultivated chickpea
- 244 accessions of wild Cicer spp.
- 709 accessions of forage and pasture species.

Parallel to transferring seed samples to GRU's new stores, careful comparison is made between the documented accessions and the seed samples actually in possession. Any discrepancy is corrected.

In collaboration with FLIP, a winter planted chickpea catalogue is being prepared and has reached final stage of production. For this purpose, the complete set of evaluation data on agronomic traits has been added to the GRU data base, which enables the use of relevant information in selecting germplasm for specific growing conditions and breeding aims.

The preparation of a durum wheat catalogue has recently also started in collaboration with the CP, using passport and collection information and evaluation data compiled by GRU and CP.

Other tasks that have been carried out through the year are preparation of field books, documentation of characterization and evaluation results, preparation of summaries of P & C information to be sent along with seed shipment, and other support activities.
A. Elings, GRU Staff.

1.8. Training in genetic resources

In 1988/89, the Genetic Resources Unit continued to host individual trainees from national programs and provided training in different aspects of genetic resources work (Table 22).

Four staff members working for the Syrian genetic resources program received on-the-job training covering specific components of genetic resources management. Documentation of passport and collection information and statistical backgrounds of germplasm evaluation formed the topic of training provided to a staff member responsible for germplasm documentation at the GRU at Douma. Because of the differences in hard- and software availability at the two institutions, training was focused on general principles of data assessment, standardization, storage and retrieval, and statistical analyses.

Training in evaluation methodology, which was provided for two participants, was conducted by using Syrian landraces of barley,

Table 22. Participants of individual training in genetic resources in 1989.

Name	Country	Duration of training	Topic
Azeddine Lahlou	Morocco	4 weeks	Management of pasture and forage genetic resources
Ghaida Mir El Ali	Syria	6 weeks	Documentation of germplasm collections
Antoine Zarka	Syria	6 weeks	Evaluation of chickpea and lentil landraces
Rima Koedssie	Syria	6 weeks	Evaluation of barley landraces
Yousef M. Wajhani	Syria	2 months	Seed bank management
Liu Weiguo	China	1 month	Management of food legume germplasm collections

lentil and chickpea from the national gene bank collection. The evaluation information obtained as a result of the training can therefore be incorporated into the national program evaluation data base. Internationally accepted descriptor lists (IBPGR and IBPGR/ICARDA lists) and standard methodology were applied and practised by the trainees in these evaluation trials. The experiences gained by its staff members will help the national program in assessing the potential of native germplasms collected in previous years.

A staff member of the GRU at Douma, who is responsible for the preservation of germplasm collections, also spent two months at our Unit and got acquainted with the medium- and long-term seed storage facilities and technology. He obtained comprehensive experience in seed bank management, seed viability and moisture content determination, seed drying technology and documentation of data associated with the preservation of germplasm.

A research associate from INRA, Morocco, who is involved in ecogeographic surveys and subsequent evaluation and utilization of the collected native pasture and forage germplasm, received one month training in pasture and forage legume genetic resources work. He obtained information and experience in techniques concerning the handling, multiplication, maintenance and evaluation of wild legume germplasm collections. He also spent time with PFLP scientists and was familiarized with ICARDA's annual medics on farm trials and related extention activities.

The national program staff participating in the joint collecting missions in Algeria, Bulgaria, Egypt, Cyprus, Jordan, Syria and Turkey gained additional experience in the identification of wild species related to ICARDA's mandated crops and in collecting techniques.

Lectures were presented by the GRU staff to trainees in the residential training courses of the commodity programs. One participant of the FLIP residential training course from China also received one month practical training in food legume germplasm management at the GRU. **L. Holly and GRU Staff.**

2. Seed Health Laboratory

2.1. Activities on newly introduced seeds

From November 1988 to October 1989, 96 seed consignments from 38 countries were received after passing Syrian quarantine. This constitutes a 25% increase over the previous year. Each shipment usually consisted of several different genotypes, the range was between 1 and 4842.

2.1.1. Laboratory testing and treatment

Seeds received from abroad were first fumigated or treated at -18^{o}C for one week to control insect pests, then inspected for admixtures of soil, weed seeds, bunt balls, or for seeds with visible symptoms of infection. Table 23 indicates the results of additional health tests. In the 1988/89 season, no pathogen of quarantine significance was detected. Those seeds which were not treated by the sender (27%) were treated at the Seed Health Laboratory with a broad spectrum fungicide, i.e. Vitavax for cereals, and thiabendazole or benomyl for legumes, before planting.

2.1.2. Field inspection

As an additional safeguard against the inadvertent introduction of pests and pathogens all newly introduced material was planted in the isolation area, in the north-west corner of the station. The area in 1988/89 was approximately 10 ha, or 10,000 plots. In a careful field inspection no exotic diseases were detected on plants grown in isolation.

2.2. Activities on seeds dispatched internationally

In the past season 525 consignments were dispatched from ICARDA to

Table 23. Seed health tests conducted on newly introduced seeds in 1988/89.

Crop	Number of lines: tested	clean	infected	Tests carried out	Pathogens observed
durum wheat	1535	1369	166	centrifuge wash test	*Tilletia caries* and/or *T. foetida*
bread wheat	1218	784	434	centrifuge wash test	*Tilletia caries* and/or *T. foetida* (433) *Urocystis agropyri* (1)
wheat (not specified)	144	127	17	centrifuge wash test	*Tilletia caries* and/or *T. foetida*
barley	500	369	131	freezing blotter test	*Helminthosporium* spp. (9), *Fusarium* spp. (115) *Fusarium* spp. + *Helminthosporium* spp. (7)
triticale	78	76	2	centrifuge wash test	*Tilletia caries* and/or *T. foetida*
lentil	42	40	2	agar media test	*Fusarium* sp. (1), *Botrytis* sp. (1)
faba bean	17	13	4	agar media test	*Fusarium* spp. (2), *Ascochyta* sp. (1), *Botrytis* sp. and *Fusarium* sp. (1)
chickpea	120	118	2	agar media test	*Fusarium* sp. (1), *Ascochyta* sp. (1)
pea	59	37	22	test on *Pseudomonas* F agar	fluorescent *Pseudomonas* sp.
Total	3713	2933	780		

72 different 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 total number of outgoing shipments increased by 24%. Phytosanitary Certificates which met the requirements of the importing countries were issued by the Syrian authorities and sent with the seeds. To facilitate seed inspection, all consignments other than International Nurseries were packed and sealed by the Seed Health Lab.

2.2.1. Field inspection

The seed increases for International Nurseries were inspected plot by plot, on a total of about 100 ha. In addition 10 ha of germplasm multiplication for possible international distribution were checked. Potentially seed-borne pathogens detected were: Ascochyta fabae, Fusarium spp., Tilletia foetida and T. caries, Helminthosporium spp., Rhynchosporium secalis, Ustilago nuda, U. tritici, Orobanche spp. Plants suspected of virus infection were rogued.

Approximately 36 ha of seed multiplication fields (registered varieties of wheat, barley, chickpea and lentil) were inspected according to the OECD system (inspection of 10 randomly selected sample areas of 20 m^2 per variety). All these fields were free from seed-borne diseases.

2.2.2. Laboratory testing and treatment

Samples of seeds harvested from fields where disease symptoms were observed, as well as random samples, were tested in the laboratory (Table 24). The majority was found healthy or infected with non-quarantine pathogens such as Fusarium spp. or Tilletia spp. (common bunt). In some lines Urocystis agropyri or Xanthomonas campestris pv. translucens were detected. The incidence in the field was so low that infected plants were not observed. This

Table 24. Seed health tests conducted on seeds dispatched internationally from ICARDA, in 1988/89.

Crop	Number of lines tested	Number of lines clean	Number of lines infected	Tests carried out	Pathogens observed
durum wheat	669	314	355	centrifuge wash test	Tilletia caries and/or T. foetida (329), Urocystis agropyri (6), Tilletia spp. and U. agropyri (20)
bread wheat	479	233	246	centrifuge wash test	T. caries and/or T. foetida (195) U. agropyri (5) and Tilletia spp. and U. agropyri (46)
wheat wild relatives	52	50	2	centrifuge wash test	Tilletia caries
barley	381	186	195	centrifuge wash test freezing blotter test	Helminthosporium spp. (32) Fusarium spp.(123) Helminthosporium spp. and Fusarium spp. (40)
barley	72	45	27	XTS agar medium test	Xanthomonas campestris pv. translucens
lentil	271	195	76	freezing blotter test	Fusarium spp.
faba bean	482	447	35	freezing blotter test agar media test Orobanche test test for stem nematode	Botrytis spp. (3) Fusarium spp. (32)
chickpea	185	164	21	freezing blotter test agar media test	Fusarium spp.
pea	2	2	0	test on Pseudomonas F agar	-
medics	31	31	0	test for stem nematode	-
Total	2624	1667	957		

shows clearly that field inspection and laboratory testing are complementary activities. The lines contaminated with these pathogens, which are quarantined in some recipient countries, were eliminated from shipments.

Unless specific requests were made by the recipient for untreated seed, for example for laboratory analysis or germplasm for long-term storage, only seeds treated with fungicides were dispatched. Legumes seeds were also routinely fumigated.

In an effort to monitor the health status of the germplasm in long-term storage, 434 accessions of barley were tested. 39% were found contaminated/infected with Helminthosporium spp. and Fusarium spp. The presence of these pathogens is not alarming, because fungicides which control them are routinely applied to the seeds.

2.3. Training

Aspects of seed health were covered in lectures and practicals in seed processing, seed testing and cereal disease methodology training courses.

In individual training, two trainees from Syria, one from Ethiopia and one from Peru spent from two days to two weeks in the Seed Health Laboratory, working on seed health testing techniques as well as on field inspection.

3. Virology Laboratory

The Virology laboratory carried out research during 1988/1989 in close cooperation with the Cereals and Food Legumes Improvement Programs. Some work was also initiated on viruses affecting forage legumes. Work essentially concentrated on (i) screening for resistance to important virus diseases, (ii) yield loss evaluation in response to infection of selected viruses, and (iii) testing for seed-borne viruses. In addition, some basic studies on selected viruses were carried out.

3.1. Viruses of food legumes

3.1.1. Virus survey

A hundred and fourty four chickpea samples showing either yellowing alone or yellowing in addition to stunting were collected from Syria and Lebanon. Samples were tested against three antisera: beet western yellows virus (BWYV) and bean leaf roll virus (BLRV) antisera provided by R. Casper and L. Katul, BBA, Braunschweig, FRG, and chickpea stunt virus (CpSV) antiserum provided by D.V.R. Reddy, ICRISAT. 41 samples gave a positive reaction with BWYV antiserum, 39 positive with CpSV antiserum and none reacted with BLRV antiserum. These preliminary results indicated that much variability exists in what we commonly call chickpea stunt. Whether we have 2 or 3 distinct strains or different viruses requires further characterization, which is in progress. Proper characterization is essential before progress can be made in identifying sources of resistance.

3.1.2. Screening faba bean for bean yellow mosaic virus resistance

Seventy faba bean pure lines were evaluated for their reaction to bean yellow mosaic virus (BYMV), using aphid inoculation. Twelve lines showed a high level of BYMV tolerance with four lines not showing any symptoms (Disease Index = 0). However, none of the faba bean lines was immune to infection since the virus was detected in all inoculated lines by ELISA (Table 25). In addition, there was no difference in virus multiplication levels among the different lines, an indication that the tolerance mechanism in these lines is independent of virus multiplication levels.

Table 25. Performance of selected faba bean lines after artificial inoculation with bean yellow mosaic virus (BYMV) by aphids during the growing season (1988-1989).

Genotype		Disease* Index (D.I)	Virus detection by ELISA	Origin
BPL	1351	0.0	+	SUN
BPL	1363	0.0	+	ARG
BPL	1366	0.0	+	TUR
BPL	1371	0.0	+	TUR
BPL	1311	12.5	+	ESP
BPL	1314	12.5	+	AFG
BPL	1331	12.5	+	ZAF
BPL	1358	12.5	+	YUG
BPL	1362	12.5	+	ARG
BPL	1378	12.5	+	TUR
BPL	1303	16.6	+	IRQ
BPL	1330	18.7	+	ZAF
BPL	1324	93.7	+	AFG
BPL	1320	100.0	+	ITA
BPL	1339	100.0	+	AFG
BPL	1345	100.0	+	SUN

$$* \ DI = \frac{[(n0x0)+(n1x1)+(n2x2)+(n3x3)+(n4x4)]}{N(n-1)} \times 100 \text{ where:}$$

n0, n1, n2, n3 and n4 = Number of plant with symptom index of 0, 1, 2, 3 and 4, respectively. N = total number of plants used, n = total number of symptoms classes.

3.1.3. Screening for bean leaf roll virus (BLRV) resistance in faba bean

Two hundred faba bean pure lines were tested for their reaction to a local isolate of BLRV. None of the lines showed a high level of BLRV resistance since all tested lines produced symptoms of the disease. However, different levels of tolerance were noticed. Even though the majority of the tested lines did not produce seeds in response to the infection, few lines did. Accordingly, the lines BPL 1181, BPL 1246, BPL 756, BPL 758, BPL 1185 and BPL 1236 could be labelled as tolerant. In tests carried out in 1988, the faba bean pure lines BPL 756 and BPL 758 were also found tolerant to infection with bean yellow mosaic virus.

3.1.4. Yield loss evaluation

Experiments to evaluate potential faba bean yield losses due to infection with four viruses by applying two inoculation times were carried out. The second, late, inoculation (early podding), which is closer to what could happen naturally in the field, led to less damage than early inoculation (during flowering). Only 1.8% yield loss was recorded due to infection with broad bean wilt virus following second inoculation, whereas inoculation of bean yellow mosaic virus, broad bean stain virus or pea mosaic virus led to 25-30% reduction in yield. Lentil (cv. Syrian Local Large) yield loss due to inoculation at the podding stage with broad bean stain virus and bean yellow mosaic virus was 32 and 34%, respectively.

3.1.5. Seed transmission rates

The seed transmission rate of a number of seed-borne viruses affecting faba bean and lentil were determined. When plants were inoculated during flowering, seed transmission rate of broad bean stain virus was 1.5% in faba bean and 28% in lentil, whereas seed transmission rates of BYMV was low (< 1%) in both faba bean and lentil. Detailed results are summarized in Table 26.

Table 26. Transmission rate (%) through seeds of faba bean (cv. Syrian Local Large) and lentil (cv. Syrian Local Large) inoculated with different viruses at two different growth stages (flowering and early podding).

Virus inoculated	Inoculation time	Number of seeds tested	Percent transmission
Faba bean			
1. Broad bean wilt virus	1st	430	1.0
	2nd	370	0.6
2. Broad bean stain virus	1st	380	1.5
	2nd	330	0.4
3. Bean yellow mosaic virus	1st	180	0.0
	2nd	360	1.2
4. Pea mosaic virus	1st	160	0.0
	2nd	140	0.0
Lentil			
1. Broad bean stain virus	1st	190	28.2
	2nd	460	7.9
2. Bean yellow mosaic virus	1st	300	0.4
	2nd	580	0.2

3.1.6. Viruses of forage legumes

Pea mosaic virus (PMV) was identified from a forage pea sample. Two forage species *Pisum sativum* and *Lathyrus sativus* (cv. Syrian Local) were evaluated for their reaction to PMV. The two cultivars were infected with the virus, but the damage caused by the virus to the two forage species was different. No significant yield loss in total fresh weight or dry weight was observed when forage pea was inoculated, whereas *L. sativus* suffered 62 and 67% loss in fresh and dry weight, respectively. When natural conditions permit spreading of PMV it seems that *L. sativus* will be damaged far more by PMV infection than forage pea.

3.1.7. Roguing faba bean fields to eliminate seed-borne viruses

Faba bean increases for international nurseries were continuously inspected during the growing season. Roguing was exercised 3-4 times during February-April. Plants with symptoms suggestive of virus infection were eliminated. Seed lots harvested from these fields were subjected to laboratory testing for the seed-borne viruses BBSV, BYMV and BBMV. During the summer of 1989, 1450 seed lots were tested. Sixty eight seed lots did not pass the test and were consequently eliminated.

3.2. Cereal viruses

3.2.1. Screening for barley yellow dwarf virus (BYDV) resistance in cereal breeding lines

Around 2200 cereal breeding lines were evaluated for resistance to BYDV using artificial inoculation by aphids. Results are summarized in Table 27. and indicate that some lines carry tolerance to BYDV infection. Because of low rainfall during this growing season, the tested cereal lines suffered both from drought and BYDV infection. Accordingly the disease symptoms index was slightly higher than what it would have been if rainfall during the growing season was normal.

3.2.2. Evaluation of cereal wild relatives as possible sources of resistance to barley yellow dwarf virus

A total of 378 accessions of Aegilops spp., 13 accessions of Agropyron spp. and 24 accession of Hordeum spontaneum were tested in a plastic house as 50 cm rows and were inoculated with a PAV isolate of BYDV using the aphid vector Rhopalosiphum padi. Observations were made 6-8 weeks after inoculation. To confirm presence or absence of virus, leaf samples were collected from all accessions (whether or not they produced symptoms) and tested by ELISA using an antiserum against the PAV isolate of BYDV.

Table 27. Evaluation of the reaction of cereal breeding lines to artificial inoculation with barley yellow dwarf virus during the growing season 1988-1989.

Cereal nursery	Number of lines tested	Lines which showed tolerance to infection
Barley		
BKL 1989	400	53, 85, 143, 148, 154, 157, 240, 278, 279, 392
BON-HAA 1989	128	24, 41, 44, 45
BON-LRA 1989	91	5, 9, 24, 34, 53, 57, 61 62, 84, 87
BON-MRA 1989	84	4, 12, 40, 49, 67
C-YD-BA 1989	83	4, 16, 32, 41, 49
Durum wheat		
DKL 1989	240	92, 93, 117, 142, 146, 166, 183, 204
DCB 1989	73	7, 8, 18, 43, 56
C-YD-DW 1989	54	22, 41, 51, 52
Bread wheat		
WKL 1989	200	44, 97, 106, 107, 159
AP-CB 1989	238	6, 74, 76, 133, 134, 174, 185, 208, 238
WON-LRA 1989	109	17, 47, 59, 64, 66, 68, 70 77, 80, 88, 98, 104, 108
WCB 1989	173	6, 38, 71, 79, 135
C-YD-BW 1989	105	23, 35, 37, 73, 81, 82

Results obtained are summarized in Table 28. In this study 12 of the 13 Agropyron accessions tested were found immune, since neither symptoms were produced nor virus was detected by ELISA. Earlier reports, however, indicated that BYDV reaction in Agropyron spp. varied from apparent immunity to obvious symptoms (Bruehl and Toko, 1957). When Comeau (unpublished) tested a number of Aegilops species, all were found to produce symptoms, whereas in this study 35 accessions of the 378 tested were found to be apparently immune.

Table 28. Reaction of *Aegilops*, *Agropyron* and *Hordeum* species to infection with barley yellow dwarf virus.*

Plant species	Total number of accessions tested	Number of accessions found to be resistant
Aegilops triuncialis	119	22
Aegilops ovata	87	2
Aegilops biuncialis	43	2
Aegilops squarrosa	37	2
Aegilops speltoides	27	3
Aegilops triaristata	20	0
Aegilops umbellutata	15	3
Aegilops peregrina	7	0
Aegilops columnaris	5	0
Aegilops caudata	1	0
Aegilops crassa	1	0
Aegilops ventricosa	2	0
Aegilops cylindrica	1	0
Aegilops sharonensis	1	0
Aegilops mutica	3	0
Aegilops longissima	2	0
Aegilops uniaristata	4	0
Aegilops comosa	2	0
Aegilops kotschyi	1	1
Agropyron cristatum	3	3
Agropyron repens	1	1
Agropyron italian	1	1
Agropyron inerme	1	1
Agropyron intermedium	4	4
Agropyron elongatum	3	2
Hordeum spontaneum	24	0

* An accession was considered resistant when no symptoms were producted and no virus was detected by ELISA.

3.3. Training

Six national program scientists spent short term (2-6 weeks) training in the virology laboratory, working mainly on virus disease diagnostics. In addition, two graduate students are carrying out their thesis research on virus disease. One from Khartoum University working on an M.Sc. thesis on viruses affecting faba bean in the Sudan and the other working on her Ph.D. thesis on viruses affecting chickpea in Syria.

A workshop on barley yellow dwarf virus affecting cereal crops in the region was organized by the virology lab with support from IDRC. Twenty participants from Ethiopia, Egypt, Lybia, Tunisia, Algeria, Morocco, Jordan and Kenya joined the workshop which was held in Rabat, November 19-21, 1989. Invited speakers to the workshop were from Canada, USA, France, Chile in addition to scientists from ICARDA and CIMMYT.

4. Papers published in 1989

Comeau, A. and Makkouk, K.M. 1988. Recent Progress in barley yellow dwarf virus research: interactions with diseases and other stresses. RACHIS 7: 5-11.

Erskine, W., Adham, Y., Holly, L. 1989. Geographic distribution of variation in quantitative traits in a world lentil collection. Euphytica 43: 97-103.

Makkouk, K.M. and Kumari, S. 1989. Apion arrogans, a weevil vector of broad bean mottle virus. FABIS 25: 26-27.

Makkouk, K.M., Beck, D. and Diekmann, M. 1989. Applications of immuno and DNA hybridization diagnostics in research at ICARDA. Pages 399-412. In Strengthening Collaboration in Biotechnology: International Agricultural Research and the Private Sevtor. J.I. Cohen (Editor). Bureau of Science and Technology, AID, Washington D.C.

Pundir, R.P.S., Holly, L., Tahiri, A., 1989. Collection of chickpea Germplasm in Morocco. International Chickpea Newsletter, No. 20:9-11.

Skaf, J.S. and Makkouk, K.M. 1988. Resistance indicators to barley yellow dwarf virus in barley, durum wheat and bread wheat. RACHIS 7: 53-54.

M.W. van Slageren, A. Elings, L. Holly, B. Humeid, A.A. Jaradat and Kh. Obari. Recent collections of cereals, food legumes and their wild relatives in Syria and Jordan. FAO/IBPGR Plant Genetic Resources Newsletter (submitted).

Makkouk, K.M., Barker, I. and Skaf, J. 1989. Serotyping of barley yellow dwarf virus isolates on cereal crops in countries of West Asia and North Africa. Phytopathologia Mediterranean 28:164-168.

5. Papers presented in meetings during 1989

Jaradat, A.A. and Humeid, B.O. 1989. Morphological Variation in Triticum dicoccoides from Jordan. In: Proceedings of International Symposium "Evaluation and Utilization of Genetic Resources in Wheat Improvement", ICARDA, Aleppo, Syria, 18-22 May, 1989.

Makkouk, K.M. and Hanounik, S.B. 1989. Major faba bean diseases with special emphasis on virus diseases. Paper presented at the International Faba bean Symposium held in Hangzhou, China, May 24-26, 1989.

Mengesha, M.H., Holly, L., Pundir, R.P.S., Thomas, T.A. 1989. Chickpea Genetic Resources - Present and Future. Second International Chickpea Symposium, ICRISAT, December 4-8, 1989.

M.W. van Slageren. Significance of taxonomic methods in the handling of genetic diversity. In: Proceedings of International Symposium "Evaluation and Utilization of Genetic Resources in Wheat Improvement", ICARDA, Aleppo, Syria, 18-22 May, 1989 (In press).

6. GRU Staff List in 1989

Dr. Jan Valkoun**	Unit Head
Dr. K. Makkouk	Acting Unit Head (till 30 June 1989)

Genetic Resources

Dr. Laszlo Holly	Genetic Resources Scientist
Dr. M. van Slageren	Genetic Resources Scientist, Taxonomist
Mr. Anne Elings	Associate Expert
Mr. Bilal Humeid	Research Associate I
Mr. Hasan Mashlab*	Research Assistant II
Mr. Fawzi Sweid**	Research Assistant II
Mr. Ali Abdullah Ismail	Research Assistant II
Mr. Ali Shehadeh	Research Assistant I
Mr. Sameh Rajab*	Lab Technician
Mr. Isam Abou Meizar	Research Technician I
Mr. Andreas Antypas	Data Assistant
Ms. Mayssa Antabi	Secretary II
Ms. Micheline Sandouk	Secretary I
Mr. Mohamed Hamran	Asst. Technician/Driver

Seed Health Laboratory

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

Virology Laboratory

Dr. Khaled Makkouk	Plant Virologist
Mrs. Widad Ghoulam	Senior Technician
Mr. Walid Radwan	Senior Technician
Ms. Safaa Koumari	Technician

Visiting Scientists

Dr. Zakir Halikulov**	Wheat GR (VIR, USSR)
Mr. Kevin Powell**	Geographical surveys (IBPGR, Italy)
Mr. Matthew Daily-Hunt**	Geographical surveys (IBPGR, Italy)

* Left during 1989

** Joined during 1989

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J. Valkoun - Editor

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