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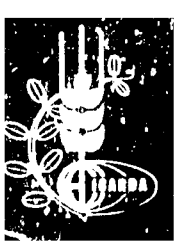
GENETIC RESOURCES PROGRAM

Annual Report for 1988



GENETIC RESOURCES PROGRAM

ANNUAL REPORT 1988

The International Center for Agricultural
Research in the Dry Areas

Aleppo, Syria

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1. Genetic Resources Activities

1.1. Introduction

The main goal of the Genetic Resources Unit is to explore, safeguard and enhance the utilization of diverse germplasm collections of crops and their wild relatives for which ICARDA has global or regional responsibility within the CGIAR system. ICARDA's region includes the primary centers of diversity of the mandated crops, therefore the exploration and preservation of landraces and wild progenitors of these species have a global importance for crop improvement and related research, in addition to the provision of basic material for the development of improved germplasm adapted to the farming systems in the region.

To achieve its overall objective, the Genetic Resources Unit, in addition to safeguarding the already existing collections, (i) undertook collecting missions jointly with the national programs in areas which were not yet adequately explored, (ii) requested and obtained germplasm from other genetic resources collections and institutions, (iii) characterized and evaluated germplasm jointly with scientists in the commodity programs and in NARSs, (iv) collated and documented information related to genetic resources, and (v) preserved additional germplasm samples in controlled environment. In order to assist the development of the required skill and competence of the national gene bank personnel and to assist the development of a genetic resources network in the region, training was also provided according to the expressed needs of the national programs.

Two other laboratories are attached to GRU, (i) a Seed Health Laboratory which safeguards seed movement at ICARDA by minimizing the risk of spreading pests and pathogens during seed distribution and exchange, and (ii) a Virology Laboratory which, in addition to

work on seed-borne viruses, conducts research on virus diseases of cereals, food and forage legumes.

Program highlights in 1988 were:

- A total of 751 population and 1930 single plant samples were collected from unexplored areas in Syria and Jordan jointly with National Program scientists. The collected material includes cultivated barley and Hordeum spontaneum, durum and bread wheat, wild Triticum and Aegilops species, chickpea, lentil and faba bean, wild Cicer and Lens species, and cultivated and wild forage legumes.
- New accessions of durum wheat (2958), bread wheat (5566), barley (328), Hordeum spontaneum (256), chickpea (501), lentil (298), faba bean (373), annual medics (324), Vicia species (15), Lathyrus species (19) and peas (4), collected or received in the previous year, were planted in the isolation area for multiplication and health inspection.
- A total of 3976 seed samples of food and forage legumes, temporarily stored in the cold store, were regenerated to obtain sufficient amount of good quality seeds for medium- and long-term preservation.
- Three to ten stable characters were recorded for 1534 food and forage legume accessions for preliminary characterization of the new germplasm during multiplication.
- A total of 10,022 entries were evaluated, partly in collaboration with crop program scientists, and multiplied, including 1200 barley (23 descriptors), 861 Triticum turgidum ssp. dicoccoides (22 descriptors), 651 Aegilops species (18 descriptors), 6224 chickpea (7 descriptors), 629 Medicago polymorpha (23 descriptors), 57 Medicago scutellata (23 descriptors) and 400 vetch (16 descriptors) accessions.
- In a collaborative evaluation project funded by the Italian Government, 3656 accessions of durum wheat were scored for 5 traits.
- In collaboration with the Cereal Improvement Program scientists,

1209 Ethiopian barley accessions were screened for scald (Rynchosporium secalis), and 200 Triticum turgidum ssp. dicoccoides samples of different origin were tested for yellow rust, leaf blotch and common bunt resistance.

- A selection of 64 durum wheat landraces from the collection trip in Syria was evaluated to characterize both within and between population variation for selected characters.
- The documentation system of Passport and Collection information has been updated and a new collecting form and matching accession books were introducted to facilitate the quick transfer of data into the computer.
- Collection and passport information and evaluation data were continously added to the data file. Information on a total of 9609 accessions was documented.
- The second volume of the Barley Germplasm Catalog was published, which includes passport and evaluation information for an additional 4.129 accessions.
- A total of 26197 seed samples were distributed, 9229 within and 16968 outside ICARDA, from the genetic resources collections.
- A joint IBPGR/ACSAD/ICARDA training course was held on forage and rangeland genetic resources with the participation of 10 trainees from 7 Arab countries.
- Four individual trainees from Syria and Ethiopia received training in genetic resources evaluation from 4 weeks to 6 months duration.

1.2. New germplasm in 1988

The development of comprehensive germplasm collections of ICARDA's mandated crops and their wild relatives continued in 1988. Several short collection missions were conducted in un- or underexplored areas of Syria and Jordan jointly with national program scientists. Considering the differences in maturity time among species and regions and the difficulties of collecting wild species (uneven maturity, seed shattering, dispersed distribution

etc.) each mission focused on collecting certain species in defined areas, but other species of interest to ICARDA, which were found in proper maturity stage were also collected.

A total of 584 population samples were collected in the northern, central and southern part of Syria and in the coastal region (Table 1). In addition, a total of 1930 single spike

Table 1. Germplasm samples collected in Syria in 1988.

Crop/Species	Collecting missions*				Total
	1	2	3	4	
Durum wheat	4	38	11	-	53
Bread wheat	7	10	-	2	19
Triticum & *Aegilops* spp.	16	37	88	16	157
Barley	64	13	-	7	84
Wild *Hordeum* spp.	16	11	-	14	41
Chickpea	-	1	-	85	86
Wild *Cicer* spp.	2	-	-	5	7
Lentil	7	3	-	31	41
Wild *Lens* spp.	-	-	-	10	10
Faba bean	-	-	-	4	4
Pisum spp.	2	-	-	2	4
Forage legumes	49	2	-	20	71
Avena spp.	-	3	-	1	4
Other species	-	2	-	1	3
Total	167	120	99	198	584

* Collecting missions focused on (1) Barley and vetches, (2) durum wheat and wheat wild relatives, (3) wheat wild relatives and on (4) chickpea, lentil and their wild relatives.

samples of cereal landraces and their wild relatives were also collected to facilitate studies on the genetic composition of local populations and on the extent of gene-flow between cereal crops and their wild progenitors in natural habitats.

1.2.1. Collection of wild relatives of wheat

In the frame work of the special project "Collection and characterization of the wild relatives of wheat" collection trips have been made to Jordan and within Syria. Regions to be visited were chosen following the IBPGR coordinated policy of priorities to fill gaps in the world collection of wild wheat relatives. These were joint missions with the respective national programs: the Jordan University of Science and Technology of Irbid (JUST) and the Genetic Resources Unit of the Agricultural Research Center at Douma, Syria. Priority was given to species of the genus Aegilops while recording pertinent environmental data.

In Jordan a total of 147 samples of Aegilops were collected representing 8 species and 1 subspecies of the genus: Aegilops bicornis (3), A. biuncialis (15), A. kotschyi (16), A. longissima (2), A. ovata (21), A. peregrina (45), A. peregrina ssp. cylindrostachys (1), A. searsii (23), A. vavilovii (21). Most conspicuous has been the occurrence of A. biuncialis, thought to be very rare in Jordan, and of A. bicornis, which is rare and confined to the southern part of the country where rainfall does not exceed 100 mm annually. Collecting has been most fruitful in the mountainous regions of central and NW Jordan. In addition, samples of single spikes of Triticum turgidum ssp. dicoccoides (10 sites) and of T. monococcum ssp. boeoticum (2 sites) were obtained, as well as 2 paired samples of single spikes of Hordeum vulgare (both two-rowed and six-rowed) and H. spontaneum.

In Syria two restricted regions were visited. In the south the provinces of Sweida and Dara' together with a short trip to NW of Damascus yielded 31 collections of Aegilops, representing 9 species: A. biuncialis (5), A. caudata (1), A. columnaris (3), A.

kotschyi (3), A. peregrina (4), A. ovata (3), A. searsii (4), A. triuncialis (4), A. vavilovii (4). Most conspicuous was the unexpectedly poor occurrence of Aegilops on the volcanic soils in the Sweida region. Next to the Aegilops collections Triticum turgidum ssp. dicoccoides was collected as single spikes on 7 sites, and, similarly, 7 populations of T. monococcum ssp. boeoticum were sampled. The new accessions of Triticum turgidum ssp. dicoccoides are of special interest since earlier studies revealed that most of the samples of this subspecies with combined resistance to yellow rust, leaf blotch and common bunt were originally collected in southern parts of Syria (see GRP Annual Report for 1987 and Cereal Improvement Program Report for 1988).

On a second trip the province of Lattakia and the western part of Idlib were visited, resulting in a total of 64 Aegilops collections. The species involved were: A. biuncialis (6), A. caudata (1), A. columnaris (3), A. peregrina (8), A. ovata (3), A. speltoides ssp. speltoides (13), A. speltoides ssp. ligustica (11), A. triaristata (9), A. triuncialis (10).

A marked difference with the Sweida region is the strong presence of A. speltoides and A. triuncialis. Although wild Triticum was also looked for, none was found.

In the frame work of the taxonomic research on Aegilops, herbarium material was studied during a 1 week visit at the British Museum (Natural History) in London, United Kingdom. In addition the herbaria of the Institute of Systematic Botany, Utrecht, and of the Laboratory for Plant Taxonomy and Plant Geography, Wageningen, both in The Netherlands, were visited. Data on 369 herbarium sheets were recorded and the accompanying plant material identified. – **M. van Slageren**

1.2.2. Collection of durum and bread wheat

To complement the collection of durum wheat landraces from the main durum wheat growing regions of Syria started last year, short collection trips were conducted in the central part of the country

(Raqqa - Palmyra) and in the mountainous coastal region. A total of 53 samples were collected, most of which are landraces grown for a long time at the place of collection. Soil samples, detailed information on cultivation practices and relevant environmental data were also obtained to facilitate research on evaluation and pre-screening methodology for agronomic traits based on agro-ecological data related to the collection sites.

A limited number of bread wheat landraces (19) was also collected mainly from very dry locations around Palmyra and at high elevation sites (1600 m) in the Anti-Lebanon mountains. This germplasm has been adapted to extreme stress conditions and may provide additional sources of drought and frost tolerance for the breeding programs. - **A. Elings, B. Humeid, L. Holly**

1.2.3. Collection of barley landraces and Hordeum spontaneum

A total of 84 barley landraces and 41 populations of Hordeum spontaneum were sampled during the collection missions, mainly in the central part of Syria (Homs - Palmyra) and in the Sweida region. Single spike samples of both cultivated barley and its wild progenitors were also collected whenever they were found at neighboring sites or as mixed stands. Evidences of intercrossing between the two species were noticed at several sites. The collected samples will be evaluated jointly with the barley group of the Cereal Improvement Program with emphasis on the identification of interspecific hybrids and stress tolerant genotypes. - **B. Humeid, L. Holly**

1.2.4. Collection of food legumes and their wild relatives

The food legume collection trip was undertaken jointly with the Genetic Resources Unit of the Agricultural Research Center at Douma, Syria and with the GRU of ICRISAT, and concentrated on the collection of chickpea landraces, especially from areas where the recently released winter planted chickpea cultivars (Ghab 1,

Ghab 2) are expected to replace native, spring planted varieties. A total of 86 chickpea samples was collected of which 22 landraces are of pure kabuli type. The remaining 64 kabuli chickpea samples contain also intermediate and desi type seeds from 0.2 to 48.2% with a 4.7% mean frequency. The hundred seed mass of the collected chickpea samples varied from 16.6 to 48.2 g.

In addition to the chickpea landraces, a total of 41 lentil samples were collected. Three species of wild lentil (Lens orientalis, L. odemensis and L. ervoides) and wild chickpea (Cicer bijugum, C. judaicum and C. pinnatifidum) are also represented in the collected germplasm.

An interesting area, where different crops (lentil, barley and durum wheat) and their wild progenitors (Lens orientalis, L. odemensis, Hordeum spontaneum and Triticum turgidum ssp. dicoccoides) grow side by side was found about 30 km east of Sweida on the plateau of Jebel El Arab at 1500-1600m above sea level. This area was identified as particularly suitable to study introgression between crops and their wild relatives and to conduct research on the environmental and genetic factors underlying the generation and maintenance of diversity in traditional farming systems in a center of crop origin and diversity. Such sites would also be suitable for dynamic, "in situ" preservation of genetic diversity in these crops and their progenitors.

A total of 71 forage samples, consisting mainly of cultivated Vicia and Lathyrus species, was also collected during the different missions.

In addition to the germplasm collected in Syria and Jordan, a total of 1302 seed samples were received from other institutions. A valuable part of this germplasm are the 890 Vicieae accessions collected by the Southampton University/IBPGR/ARARI team in Turkey in 1987 and 1988. – **L. Holly, R.P.S. Pundir (ICRISAT)**

1.3. Characterization of durum wheat landraces and durum wheat growing regions in Syria

Two collection missions for landraces of durum wheat (Triticum turgidum durum), conducted in 1987 and 1988 in Syria, resulted in a total of 189 populations originating from several provinces (see GRP annual reports for 1987 and 1988).

A part of this germplasm collection, viz. those landraces which origin was expected to be at or nearby the site of collection, forms the basis of the research project "Agronomic characterization of germplasm collections on the basis of information on the environment in the regions of collection and multilocational evaluation data".

1.3.1. Evaluation for genetic variation

From the 1987 collection, 64 landraces were evaluated for genetic variation within and between populations. In a randomized complete block design, 50 lines per landrace plus five check-lines (Sham 1, Jezira 17, Kurifla, Stork and Haurani) were randomly distributed within each block and were sown at Tel Hadya. The field had not received N or P fertilizer for a number of years, and contained 0.89% organic matter, 590 p.p.m. Kjeldahl - N and 2.43 p.p.m. P-Olsen.

Observations were made on: Zadoks development stages, dry matter content of the spike, yellowing of flag leaves (all weekly, on 5 lines per population), days to heading (all lines), flag leaf length and width and plant height (25 lines per population, 3 primary spikes per line).

The development stages, dry matter content of the spike and yellowing of the flag leaves were recorded for application in a crop growth simulation model. A strict linear relation was found between the dry matter content of a complete spike and of the kernels of this spike

On-going work in the laboratory deals with observations on a number of morphological spike characters, for which 5 primary spikes per line were cut off before harvest, including awn length, spike length, awn colour, spike colour, number of spikelets per spike and seed shrivelling.

Awaiting the full availability of the results, a preliminary representation of the variation is given in Table 2: the percentages of Triticum aestivum in T. durum landraces. In populations from the eastern and northeastern plains no bread wheat was found, while populations from the western mountains contained up to 54% bread wheat. Other regions were intermediate in this respect. Apparently, mixtures of durum and bread wheat is advantageous, either from agronomical, or from food preparation point of view.

Table 2. Percentages of Triticum aestivum in T. durum landrace populations, collected in 1987.

Region	No. populations	% T. aestivum range	% T. aestivum mean
1. Homs	4	0 - 2	1
2. Damascus	3	0 - 24	9
3. Sweida	12	0 - 14	5
4. Palmyra/Deir-Ez-Zor	8	0	0
5. Aleppo/Idlib/Hama	11	0 - 8	1
6. North East	8	0 - 28	7
7. Hassake	2	0	0
8. West, high altitude	5	12 - 54	43
9. West, low altitude	6	0 - 30	15

There is a clear correlation between the composition of the mixtures and the annual rainfall, which decreases from west to east, and which might be a reason for the absence of bread wheat in the dry regions of the country.

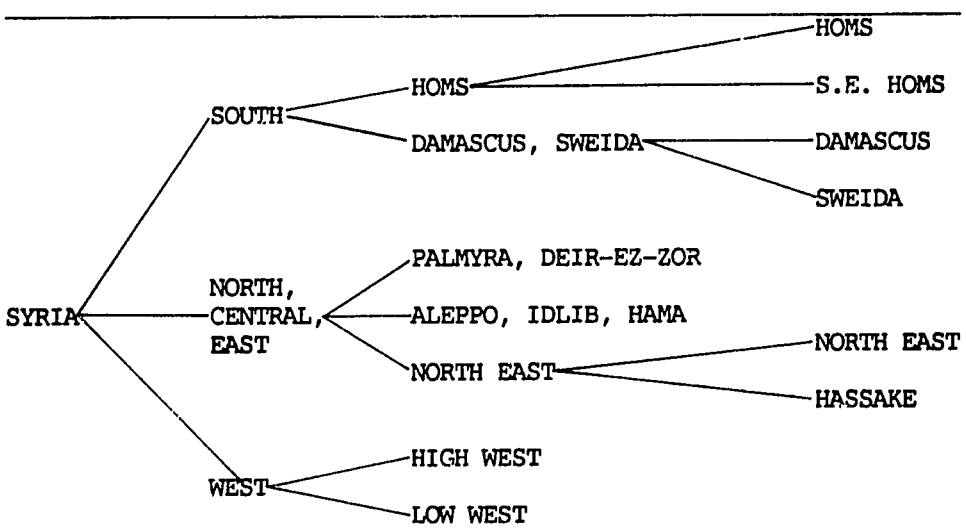
1.3.2. Eco-geographical characterization of durum wheat growing regions in Syria

The research project involves the ecogeographical zoning of the areas where durum wheat landraces have been collected. Not all regions of the country have been explored or sampled yet, therefore the zoning may be incomplete at this stage.

The K-means clustering technique was used to group the collection sites in such a way that the within group variation was minimized, while contrasts between groups were maximized. The basis for the clustering was a set of 27 variables of geographical, metereological, ecological and agronomical nature.

Initially, three clusters were formed, which were subdivided in subsequent steps. Finally, the 166 sites were grouped into ten distinct zones, as is represented in Figure 1.

Figure 1. Regions, based on K-means clustering of 166 collection sites of *T. durum* landraces in Syria (1987 + 1988).



A. Southern regions

The regions south of Homs are, compared with other parts of the country, characterized by moderate climatological variables (Table 3). Other discriminating characteristics include sowing rate (low), 1000 seed weight (low), soil organic matter and nitrogen contents (both low).

Table 3. Some characteristics of the 10 durum wheat landrace growing regions sampled in 1987 and 1988. Means of site values.

	Homs	S.E. Homs	Damascus	Sweida	Palmyra Deir-Ez-Zor
Rainfall (mm)	400	158	205	268	181
Evaporation (mm)	1525	1608	1933	1754	2389
Waterbalance (mm)	-1120	-1433	-1644	-1422	-2189
Max. temperature (°C)	34.0	32.1	34.9	33.6	38.9
Min. temperature (°C)	2.9	1.8	1.2	2.3	1.8
Altitude (m)	515	768	600	560	230
Normal grain yield (ton/ha)	0.9	1.1	4.5	1.7	1.8
Normal straw yield (ton/ha)	1.2	1.3	2.0	1.2	1.1

	Aleppo Idlib Hama	North East	Hassake	West, High	West, Low
Rainfall (mm)	409	384	302	1238	975
Evaporation (mm)	1745	2369	2258	1200	1321
Waterbalance (mm)	-1342	-2015	-2046	-116	-383
Max. temperature (°C)	35.6	39.6	39.7	27.3	30.0
Min. temperature (°C)	2.4	1.9	1.8	4.0	6.4
Altitude (m)	190	508	411	584	253
Normal grain yield (ton/ha)	1.8	1.1	1.4	1.3	0.9
Normal straw yield (ton/ha)	1.5	1.5	0.8	1.8	1.2

The four subregions (Homs, Southeast of Homs, Damascus and Sweida & Dara') are discriminated on the basis of variation in the

geographical and climatological variables, and in agricultural variables as sowing rate, frequency of input use, 1000 seed weight, no. of spikes/m^2, spike weight, and normal and maximum grain yield. Damascus is of special interest because of its high reported normal and maximum grain yields and high values of the other above mentioned agricultural variables, which could be related to the widely used practice of irrigation.

B. Northern, central and eastern regions

Around Aleppo, Idlib, Hama, Palmyra and Hassake the climate is generally characterized by low annual rainfall, high summer and low winter temperatures. Sowing rate, 1000 seed weight, and soil organic matter and nitrogen contents are all of medium value.

While the provinces of Aleppo, Idlib and Hama have a semi-continental climate, conditions towards the east become more extreme and turn to a continental climate. Discriminative variables between the regions are the degree of diversification of the rotation schemes, spike weight, maximum grain and straw yields, and soil organic matter content.

C. Western region

The mountainous regions in the west of Syria are characterized by high annual rainfall, low potential evaporation and low maximum and minimum temperatures, which are all due to the nearby presence of the Mediterranean. Sowing rate, 1000 seed weight, soil organic matter and nitrogen contents show high figures.

Subdivision of the western collection sites results in a group of high altitude and a group of low altitude. Also rainfall, temperatures, spike weight, no. of seeds per spike, stoniness and soil organic matter content influence this grouping.

The clustering has resulted in a comprehensive representation of a large number of collection sites. Only characteristic variables have been mentioned, excluding those which showed a high within region variation or which regional means do not differ significantly.

Future research has to clarify the importance of the different characteristics in relation to the agronomic potentials of the collected landraces. For this purpose, close collaboration with the Durum Wheat Improvement Project of the Cereal Improvement Program, a multilocational evaluation program has been scheduled for the two coming seasons. – **A. Elings**

1.4. Multiplication and characterization of new germplasm

New germplasm samples collected or obtained in the previous year were planted in an isolation area for multiplication. The health status of the new accessions was carefully monitored to prevent the introduction and spread of seed-borne pests and diseases. In order to minimize genetic changes in the variable populations, measures were taken to obtain sufficient quantities of good quality seed for immediate storage from the first cycle of multiplication. Relatively stable, selected descriptors were used for the preliminary characterization of the new accessions to obtain a basic description of the material which can be used later for the detection of accidental mixing of accessions and for a comparison of the genetic variation represented by the already available germplasm and the new accessions.

In 1987/88, new samples of durum wheat (2958), bread wheat (5566), barley (328), Hordeum spontaneum (256), chickpea (501), lentil (298), faba bean (373), annual medics (324), vetches (15), Lathyrus species (19) and peas (4) were planted in the isolation area. In addition to this, annual medics (116), vetches (27), Lathyrus species (9) and Pisum (2) accessions were planted in the plastic house. Three to ten stable characters were recorded for 1534 food and forage legume accessions. Seed yield was also measured for inclusion into the seed stock control system. The characters used for the preliminary characterization of food legume accessions are summarized in Table 4. – **L. Holly, GRP Staff**

Table 4. Preliminary characterization of food legume accessions.

List of selected characters		
Chickpea	**Lentil**	**Faba bean**
Days to 50% flowering	Days to 50% flowering	Days to 50% flowering
Days to maturity	Days to maturity	Days to maturity
Plant height	Plant height	Plant height
Number of seeds/pod	Number of seeds/pod	Number of seeds/pod
100-seed weight	100-seed weight	100-seed weight
Seed yield	Seed yield	Seed yield
Growth habit	First pod height	
Seed type	Testa colour	
	Cotyledon colour	
	Pattern of testa	
	Colour of pattern	

1.5. Germplasm regeneration, preservation and distribution

Regeneration of germplasm accessions with low seed viability and/or low seed supply continued in 1987/88. A total of 3976 seed samples of food and forage legumes, temporarily stored in the cold store, were planted to obtain sufficient amount of seeds with high viability for medium- and long-term preservation.

The processing and storing of seed samples in controlled environment (at 2°C and 20-25% RH) are ongoing activities. In 1987/88, a total of 9930 accessions were prepared and deposited in the medium-term store (Table 5). With this material, the total number of accessions stored with sufficient seed quantities has

increased to 52645. Preparation of subsamples for the Base Collections has also started. These samples are temporarily kept in the medium-term store, and they will be transferred to the long-term storage room in the new GRU building as soon as it becomes operational. Subsamples of 11700 durum wheat accessions were prepared for this purpose last year.

Table 5. Status of evaluation and conservation of genetic resources collections (1/10/1988).

Crop	Number of accessions				
	Total	Evaluated		Stored	
		in 1987/88	to date	in 1987/88	to date
Cereals					
Barley	15994	1200	13329	1200	13824
Durum wheat	20141	3656	15505	4700	11700
Bread wheat	10419	-	2780	660	3440
Wild species	3195	1512	2245	-	3191
Food Legumes					
Chickpea	6804	6223	6699	510	6437
Lentil	6758	283	6463	308	6498
Faba bean (ILB)	3077	373	373	183	183
Wild *Lens* spp.	199	-	185	-	195
Wild *Cicer* spp.	52	-	34	-	39
Forages					
Medics	4325	678	2498	940	1960
Vicia spp.	3582	400	787	395	1570
Lathyrus spp.	946	-	346	493	749
Other species	11099	-	1850	541	2859
Total	86591	14325	53094	9930	52645

ICARDA's germplasm is freely available for users all over the world. The Genetic Resources Unit has been devoting considerable resources and efforts to fulfill requests for germplasm samples received both from the commodity programs of ICARDA and from other institutions. In 1987/88, a total of 26197 seed samples were

distributed from the genetic resources collections (Table 6). This amount is about 70% larger than the number of germplasm samples supplied to users in 1986/87, indicating an increasing interest in and utilization of ICARDA's germplasm collections.
– L. Holly, GRP Staff

Table 6. Number of seed samples distributed from the genetic resources collections in 1987/88.

Crop	Number of samples distributed within ICARDA	Number of samples distributed outside ICARDA
Cereals		
Barley	236	4637
Durum wheat	3176	8426
Bread wheat	50	–
Wild species	2006	1365
Food legumes		
Chickpea	2979	523
Lentil	162	49
Faba bean	3	2
Wild species	313	71
Forages		
Medics	40	867
Vicia spp.	83	495
Lathyrus spp.	68	111
Trifolium spp.	–	189
Other species	113	233
Total	9229	16968

1.6. Evaluation of germplasm collections

1.6.1. Evaluation of barley germplasm

A total of 1200 accessions of barley originating from 7 countries (Egypt, Jordan, Morocco, Pakistan, Syria, Tunisia and Turkey) was

planted in augmented design for evaluation at Tel Hadya research station. Twenty three qualitative and quantitative characters were evaluated according to the IBPGR barley descriptor list. The evaluation data have been entered into the computer and analyzed in two different ways. Unadjusted data were used to calculate mean, range and standard deviation values for each quantitative character for accessions of different geographic origin. Wide range of variation was detected for the characters evaluated, with characteristic differences among germplasm originated from the different countries. The results of analyses for two selected characters are shown in Tables 7 and 8. Variation in days to heading was considerably higher in the landraces than among the four checks used in the experiments. The main source of this higher variation was the relatively large number of late heading accessions in the tested germplasm. The variation between plots of the same check was low, indicating a low micro-environmental influence on this character within the experiments. The range of

Table 7. Mean, range and standard deviation for days to heading in 1200 barley landraces (1988).

Country of origin	No. of accessions tested	Number of days to heading		
		Mean	Range	SD
Syria	82	135.0	130-145	2.42
Jordan	34	132.0	127-146	3.34
Turkey	9	137.1	129-149	7.62
Tunisia	372	135.8	127-149	4.09
Morocco 84 coll.	305	135.3	120-147	4.13
Morocco 85 coll.	167	137.2	125-149	4.75
Morocco 87 coll.	56	141.7	129-147	4.19
Egypt	104	132.7	127-147	3.38
Pakistan	71	132.4	125-143	3.44
Arabic white	(check)	133.1	132-134	0.95
Arabic black	(check)	133.7	132-134	0.61
Rihan	(check)	132.8	130-134	1.25
Harmal	(check)	127.6	127-129	0.75

Table 8. Mean, range and standard deviation for plant height in 1200 barley landraces (1988).

Country of origin	No. of tested accessions	Plant Height (cm)		
		Mean	Range	SD
Syria	82	106.2	93-126	6.17
Jordan	34	110.2	93-133	9.66
Turkey	9	113.0	106-120	5.17
Tunisia	372	114.9	91-135	6.72
Morocco 84 coll.	305	118.4	88-153	12.02
Morocco 85 coll.	167	119.0	90-141	7.98
Morocco 87 coll.	56	111.5	69-128	9.98
Egypt	104	94.6	59-140	12.14
Pakistan	71	112.0	85-130	9.67
Arabic white	(check)	94.4	74-105	8.67
Arabic black	(check)	100.9	94-109	5.05
Rihan	(check)	115.2	92-123	8.89
Harmal	(check)	103.0	85-115	8.72

variation for plant height was also wide in the tested germplasm but with a larger environmental component as indicated by the high standard deviation values obtained for the repeated checks.

The evaluation data were also analysed after their adjustment to the mean performance of the checks in each block, and accessions significantly different from each check at $P = 0.05$ level for the evaluated quantitative characters were identified. The number of accessions earlier and taller than checks in each of the three experiments is presented in Tables 9 and 10. A total of 12 landraces was earlier than the earliest heading check (Harmal). A considerable number (131) of tested entries exceeded in plant height the tallest check (Rihan).

The results of the evaluation trials will be used to characterize the barley accessions and to select populations with desired traits for further testing and utilization by breeders.

Table 9. Evaluation of barley landraces for earliness (1988).

	Number of days to heading					
	Exp. no. 1		Exp. no. 2		Exp. no. 3	
Checks	Mean	No. of Acc. earlier than check	Mean	No. of Acc. earlier than check	Mean	No. of Acc. earlier than check
Arabic white	132	42	133	98	134	61
Arabic black	133	70	134	108	134	61
Rihan	131	34	133	85	134	61
Harmal	127	5	127	3	128	4

Table 10. Evaluation of barley landraces for plant height (1988).

	Plant Height (cm)					
	Exp. no. 1		Exp. no. 2		Exp. no. 3	
Checks	Mean	No. of Acc. taller than check	Mean	No. of Acc. taller than check	Mean	No. of Acc. taller than check
Arabic white	96.4	467	99.6	353	85.3	37
Arabic black	102.6	390	103.6	260	95.5	10
Rihan	117.8	122	119.8	7	106.3	2
Harmal	103.0	388	110.4	94	94	14

A set of 1209 entries of barley germplasm originating from Ethiopia was evaluated for resistance to scald (Rhynchosporium secalis) by the barley pathologist of the Cereal Improvement Program. The nursery was planted at Tel Hadya and artificial inoculation was applied. About 95% of the tested material showed no symptoms in the nursery (for details see the Cereal Improvement Program Annual Report for 1988). – **B. Humeid, L. Holly, J. van Leur (CP)**

1.6.2. Evaluation of durum wheat germplasm

In a collaborative evaluation project funded by the Italian Government, a total of 3656 accessions of durum wheat germplasm

was planted at ICARDA Research Station. The experimental design used was modified augmented design. Five quantitative and qualitative traits were scored as a contribution of the GRU to this project. The evaluated data were computerized and are ready for analysis. – **B. Humeid, A.B. Damania (CP)**

1.6.3. Evaluation and multiplication of *Triticum turgidum* ssp. *dicoccoides*

A total of 805 accessions of wild emmer wheat was planted for multiplication and evaluation in 1987/88. Ten quantitative characters (number of days to heading, number of days to maturity, tillering capacity, number of productive tillers, plant height, spike length, number of spikelets/spike, leaf length, leaf width and peduncle length) were measured and 12 qualitative traits (growth habit, early vigor, growth class, leaf shape, leaf attitude, flag leaf attitude, yellow rust infection, waxiness, awn length, spike density, lodging and glume colour) were scored. Data on three quantitative characters are shown in Table 11. The standard deviation of each character for the repeated checks was used to assess the magnitude of environmental variation. Twelve descriptors were recorded also on single plants randomly chosen from each plot.

In another evaluation experiment, 56 population samples originated from Jordan and collected during four years, were planted in modified augmented design suitable for Nearest Neighboring Analyses (NNA). The same 22 characters were evaluated in this trial, partly on plot basis and in five randomly chosen plants. Preliminary statistical analysis showed that this collection exhibited a large amount of diversity for a number of important agronomic traits. Localized diversity was noticed for yellow rust resistance, especially in accessions collected from higher elevations.

A larger experiment was designed to study spatial and temporal variability in *T. dicoccoides* populations, from 15 locations

Table 11. Minimum, maximum, mean and standard deviation for 3 characters in germplasm of *T. turgidum* ssp. *dicoccoides* (1988).

Country of origin	No. of tested acc.	Number of days to heading				Number of spikelet groups/spike				Plant height (cm)			
		Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD
Jordan	373	142	165	153.6	4.53	11.89	21.78	17.33	1.69	35	77	56.78	6.48
Syria	156	154	167	163.70	2.39	14.00	41.33	33.42	4.63	37	92.33	67.92	9.36
Turkey	192	146	171	161.93	3.74	16.45	40.45	27.30	6.80	42.67	90	65.65	10.74
Sham-1	(check)	144	154	146.2	3.05	19.78	22.55	21.21	0.95	26.33	57.50	48.27	10.42
Sham-2	(check)	149	154	150.17	2.04	20.22	22.56	21.60	1.00	38.50	48.50	42.83	3.87
Bezostaya	(check)	146	154	149.80	2.10	21.33	23.45	22.33	0.79	56.00	67.08	61.29	3.42

Table 12. Minimum, maximum, mean and standard deviation for 3 characters in *Aegilops* germplasm (1988 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
A. ovata	86	25.0	62.8	39.0	6.86	129.0	166.0	149.4	7.81	2.7	5.3	3.7	0.49
A. triuncialis	129	23.3	61.3	44.9	6.13	136.0	209.0	158.9	7.93	3.0	7.3	5.9	0.70
A. umbellulata	35	22.0	40.2	30.8	4.95	133.0	170.0	154.0	9.19	3.9	5.4	4.7	0.40
A. cylindrica	51	38.3	81.5	56.1	6.18	153.0	166.0	159.0	2.65	5.2	12.2	10.5	1.02
A. squarrosa	136	27.8	84.5	46.5	8.58	134.0	194.0	151.7	9.95	3.9	12.8	9.6	1.62
A. biuncialis	46	23.0	51.0	36.9	5.87	127.0	164.0	148.6	6.99	2.3	6.2	3.2	0.83
A. speltoides	34	39.0	85.[illegible]	68.1	10.76	148.0	170.0	162.0	5.8	4.7	17.4	13.3	2.36
Sham-1	(check)	62.7	83.5	74.7	5.22	139.0	146.0	142.9	2.03	18.2	23.2	20.3	1.39
Sham-4	(check)	57.0	71.8	66.3	4.83	139.0	148.0	143.0	2.32	19.8	22.2	20.8	0.77
Haurani	(check)	76.3	107.2	94.2	7.72	144.0	148.0	145.3	1.76	20.2	23.2	22.2	0.92
Bezostaya	(check)	69.3	89.7	79.3	4.70	144.0	151.0	147.9	2.49	21.9	25.1	23.5	1.11
Mexipak	(check)	59.7	82.3	71.0	6.28	139.0	144.0	142.5	1.81	20.3	24.1	22.0	1.01

collected in Jordan over the years 1984-1988. The data obtained from this joint experiment with the Jordan University of Science and Technology (JUST), Jordan, will be analysed at JUST where the computer software for NNA is available. It is expected that NNA provides more reliable comparison of test entries by eliminating errors resulting from systematic environmental (soil) differences. If this expectation is justified, steps will be taken to introduce this experimental design and computer software on a wider scale in germplasm evaluation at ICARDA. Plans are made to study the population dynamics for certain morphological traits in order to learn more about the diversity exhibited by this wild wheat relative in Jordan.

An additional set of 200 entries of T. turgidum ssp. dicoccoides, was evaluated for resistance to yellow rust (Puccinia striiformis), leaf blotch (Mycosphaerella graminicola = Septoria tritici) and common bunt (Tilletia foetida and T. caries) jointly with the wheat pathologist of the Cereal Improvement Program. The nurseries were planted at two locations. The entries were screened for yellow rust and common bunt at Tel Hadya, and for leaf blotch at Lattakia. Accessions ranged from resistant (scored 0) to highly susceptible (scored 9). A wide range of variation in disease reaction was observed among the different genotypes for all the three diseases (for details see Cereal Improvement Program Annual Report for 1988). **- B. Humeid, O.F. Mamluk (CP), A.A. Jaradat (JUST), Jordan**

1.6.4. Evaluation and multiplication of Aegilops germplasm

A set of 651 accessions of Aegilops germplasm originating from several countries which had not been previously evaluated, was planted in an unreplicated nursery with 5 systematically repeated checks. Ten quantitative and qualitative characters were evaluated on plot basis using the IBPGR descriptor list. Characters evaluated include early vigor, juvenile growth habit,

growth class, leaf shape, days to heading, days to maturity, leaf attitude, flag leaf attitude, waxiness of plants and disease reaction. Eight quantitative characters were also evaluated on 3 single plants selected randomly from each plot. Characters evaluated on single plant basis are: number of tillers per plant, number of productive tillers per plant, plant height (average of two readings per individual plant), spike length (average of three spikes per individual plants), number of spikelet groups/spike, leaf length, leaf width and peduncle length. Data on three quantitative characters are shown in Table 12.

Separate from the evaluation of the 651 germplasm accessions all entries were checked taxonomically. To this number all material newly collected and identified during 1988 was added in order to get an overview of the current holdings of Aegilops at ICARDA. Table 13 represents the number of accessions and their percentage for each species available of this wheat wild relative as per 31 December 1988. – **B. Humeid, M. van Slageren**

1.6.5. Evaluation of winter planted kabuli chickpea germplasm

In an evaluation trial jointly conducted with the Food Legume Improvement Program, 6224 chickpea accessions were planted in an unreplicated experiment with two checks (Ghab 1 and Ghab 2) systematically repeated after each 10 test entries. Seven characters (growth habit, days to 50% flowering, plant height, days to 90% maturity, biological yield, seed yield and 100-seed mass) were evaluated by the GRP Staff, and harvest index values are being computed from the biological and seed yield data for each accession. The trials were also planted in the spring (March 19 to 23) and days to flowering, plant height and days to maturity were again evaluated to facilitate the selection of accessions suitable for both winter and spring planting. The passport information of the 6224 accessions has been updated and the information will be published in form of a catalog jointly with the Food Legume Improvement Program. – **L. Holly, A. Ismail**

Table 13. Number of accessions and frequency distribution of *Aegilops* at ICARDA per 31 December 1988.

Species	number of accessions	percentage
bicornis	7	.70
biuncialis	85	8.52
caudata	5	.50
columnaris	28	2.80
comosa	3	.30
crassa	13	1.30
cylindrica	48	4.81
kotschyi	25	2.50
longissima	5	.50
mutica	12	1.20
ovata	129	12.93
peregrina	90	9.02
searsii	30	3.00
sharonensis	2	.20
speltoides	64	6.41
squarrosa	147	14.74
triaristata	44	4.41
triuncialis	175	17.55
umbellulata	38	3.81
unistaristata	5	.50
vavilovii	39	3.91
ventricosa	3	.30

1.6.6. Evaluation of *Medicago polymorpha* from the Mediterranean Basin

During the 1987/1988 season, evaluation was conducted in collaboration with PFLP on 619 accessions of *Medicago polymorpha*; 52 accessions of *M. scutellata* were additionally evaluated. The experimental layout for each trial was an augmented design with repeated checks.

21 Characters were scored in all, including vegetative characters (branch length, branch architecture), reproductive traits (flowering time, seeds per pod, seed weight), and pod morphology. Of these 21 characters, architecture and size of plant

were positively correlated: the larger a plant the more complex were its patterns of branching. For reproductive characters, seed weight was positively correlated with number of seeds per pod. This indicates that both of these characters benefit in genotypes where there is a high allocation of resources to reproduction. Overall variability of accessions is shown in Table 14.

Table 14. Summary of statistics on 16 characters evaluated in 619 accessions of *M. polymorpha*.

Characters	Min.	Max.	Mean		S.D	
No. of days to flowering	104	137	118.5	(117.5)*	6.03	(2.12)*
No. of days to podding	110	145	125.4	(126.0)	7.20	(2.83)
No. of days to maturity	150	179	160.8	(164.0)	5.66	(0.00)
No. of branches/plant	2.6	11.8	5.19	(4.4)	1.11	(1.31)
Length of random branches	6.6	36	19.37	(17.35)	5.51	(8.84)
Length of longest branch	9.7	83.4	31.0	(24.9)	12.30	(12.16)
No. of secondary branches	3.5	17.6	8.55	(7.15)	2.08	(2.33)
Internode length (cm)	1	7.9	3.38	(3.5)	1.15	(0.14)
Petiol length (cm)	1	5.6	2.8	(2.87)	0.58	(0.64)
Leaf area (cm^2)	1.3	22	4.4	(5.10)	1.80	(0.57)
No. of nodes to first flower	0	7.2	2.18	(1.4)	1.10	(0.28)
No. of pods/inflorescence (2nd)	0.4	6.6	2.02	(1.9)	0.73	(0.14)
Weight of 100 pods (gram)	0.96	17.98	6.66	(3.67)	3.65	(0.12)
No. of seeds/100 pods	138	1062	569.30	(485.0)	157.23	(25.46)
Seed weight/100 pods (gram)	0.39	5.7	2.37	(1.49)	1.23	(0.27)
1000 seed weight (gram)	1	9.7	3.95	(3.05)	1.24	(0.40)

* Values in brackets refer to the check C.Vally.

The data were analyzed using principle components analysis (PCA), the first two axes accounting jointly for over 60% of the total variance. As shown in Fig. 2, flowering time and seed weight contribute strongly to the first axis; branch length (a measure of vegetative growth) and seed number per pod also contribute, though more weakly. These latter two quantities contributed most strongly to the second axis, with an additional (weaker) loading for seed weight.

If we display this information in the form of a 2-dimensional diagram, the resulting vector space can be split into four regions, each characterized by a different combination of reproductive and vegetative characters. This is shown in Fig. 3.

The geographical distribution of accessions in relation to the analysis is shown in Fig. 4, with the exception of Syria and Turkey which are shown in Fig. 5. Corner A is dominated by populations from Jordan. These accessions flower early, have little vegetative growth, and produce relatively large seeds. As demonstrated in the case of the Californian flora larger seeds may be of selective advantage in arid, unpredictable environments (as are typical of Jordan). This is due to the fact that large seeds have greater resources and hence can promote quicker seedling establishment. Populations from Tunisia are rather similar, though somewhat earlier flowering and showing better early growth. Both of these characteristics may reflect the fact that Tunisia has milder winters than Jordan. Corner D, by contrast, is dominated by accessions from Iraq and Iran. Here flowering is later, due presumably to the more northerly latitude and mountainous topography of these two countries. Populations also show a bushy growth habit. This may in part be related to competitive ability, and in part perhaps to frost tolerance. Reproductive capabilities appear to be constrained in these populations. Accessions from Morocco and Algeria, as expected, show intermediate characteristics between the Iraqi/Iranian populations and those from Tunisia. This is presumably due to the fact that though of a southerly latitude both countries have extensive mountainous areas.

If we consider accessions from Turkey and Syria (Fig. 5) we notice that they are more diffuse in their distribution than is the case for other countries. As regards Turkey this may reflect the huge ecological and environmental diversity of that country. Populations from Syria are even more widely dispersed than those from Turkey, however, Syria is certainly very varied in terms of climate and plant associations.

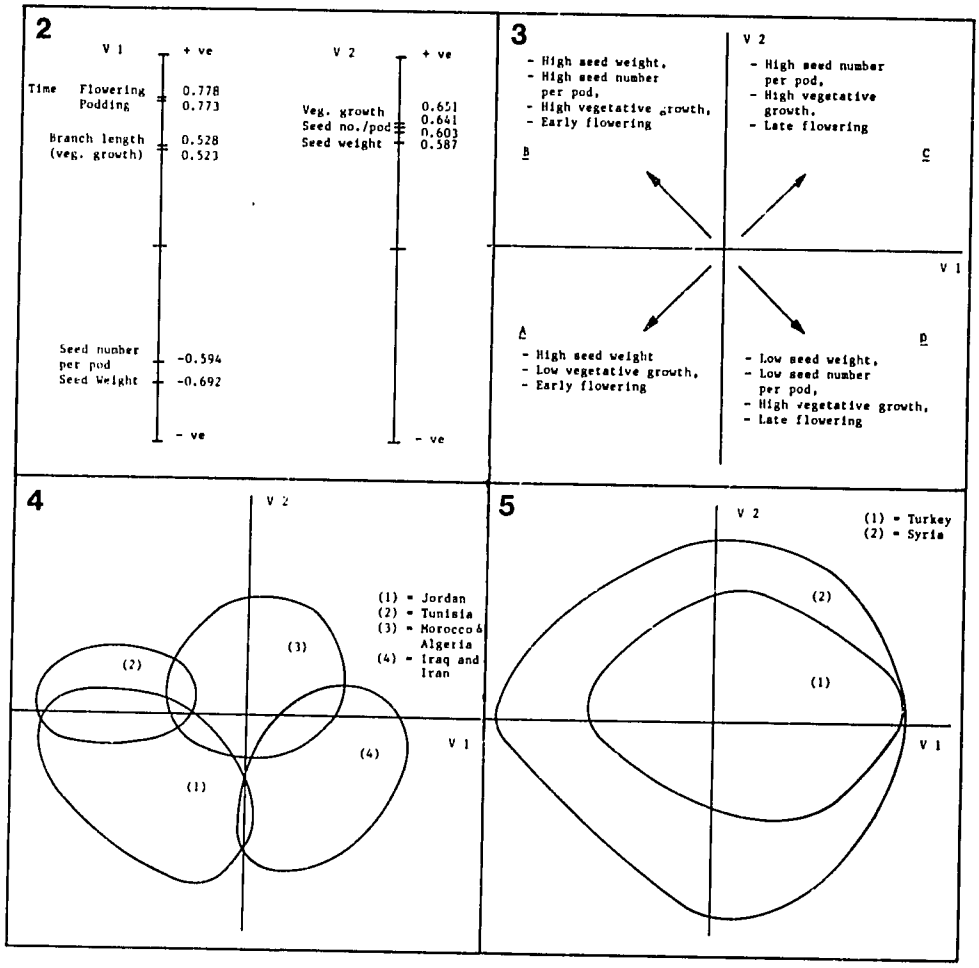


Fig. 2-5. Fig. 2. Loading of original variables on first two axes of principle component analysis; Fig. 3. Vegetative and reproductive characteristics of accessions; Fig. 4. distribution of accessions in relation to first two axes of PCA; Fig. 5. Distribution of accessions from Syria and Turkey in relation to the first two axes of PCA.

The diversity found in Syrian accessions may equally reflect the fact that M. polymorpha has been extensively sampled from every part of the country - to a much greater extent than is the case for any other country. Whatever is the reason, the high level

of diversity found among Syrian accessions suggests that they may prove particularly useful in selecting material for a wide range of environmental conditions. – **T. Ehman (University College London), A. Shehadeh**

1.7. Documentation of genetic resources

Passport and collection information related to newly collected or acquired accessions has been continuously added to the data base. As still not all the information on seed samples already in possession had been documented, a considerable amount of time has been spent to fulfill this task.

Collection and passport information of 9609 accessions was entered into the data base, including:

- 1204 accessions of bread wheat
- 640 accessions of durum wheat
- 1045 accessions of other Triticum spp.
- 975 accessions of Aegilops spp.
- 74 accessions of 2-row barley
- 489 accessions of 6-row barley
- 1248 accessions of other Hordeum spp.
- 3582 accessions of Cicer spp.
- 39 accessions of Lens spp.
- 37 accessions of Vicia spp.
- 142 accessions of medics
- 8 accessions of Lathyrus spp.
- 126 accessions of other pasture & forage legumes.

The results of the characterization and evaluation trials, recorded in field books, were documented as well.

The second volume of the barley germplasm catalogue has been published. This catalogue contains passport information and

evaluation data of 4129 accessions obtained from the U.S. Department of Agriculture, for which evaluation has been carried out at Tel Hadya.

New collecting forms and accession books, both standardized to match each other, have been developed and introduced. The collecting forms are suited to record per site a high number of ecological and other characteristics, as well as the related passport and collection information for each sample. After this information has been transferred to the corresponding accession book it can now be entered directly to the matching data file.
- A. Elings, GRP Staff

1.8. Training in genetic resources

Training in different genetic resources activities is essential for the emerging national programs to build up their capability to explore and conserve the native crop germplasm resources and to develop efficient collaboration in genetic resources work within ICARDA's region. Several national genetic resources programs already have the basic gene bank equipment mainly as donations from the IBPGR. In 1987/88, the Genetic Resources Unit continued to host individual trainees from the national programs and jointly organized a training course with IBPGR and ACSAD in forage and rangeland genetic resources. Ten trainees from seven Arab countries participating in the joint IBPGR/ACSAD/ICARDA training course stayed at ICARDA for one week and attended lectures and gained experience in forage genetic resources exploration, collection, conservation and utilization.

Two scientists from the Syrian National Program obtained training in germplasm evaluation methodology. Their training focused on the use of internationally standardized (IBPGR) descriptor lists, on the selection of suitable characters for preliminary characterization of germplasm accessions, on the evaluation of different characters in the field and in the laboratory and on the documentation and interpretation of the collected data.

Two trainees from the Plant Genetic Resources Center of Ethiopia received 3 and 6 months on job training in the evaluation of cereal and food legume genetic resources, respectively. The trainees took part in the characterization and evaluation of land races and obtained experiences in the taxonomic identification of wild progenitors and other species closely related to barley, wheat, chickpea and lentil.

Lectures were presented by the GRP Staff to trainees in the residential training courses of the commodity programs. The national program staff participating in the joint germplasm collecting missions gained additional experiences in the identification of wild species related to cereals and food legumes and in collecting techniques.

The GRU intends to pay increased attention to the extention of its training activities in order to further strengthen the technical competence of the national programs staff and facilitate the development of an effective genetic resources network in ICARDA's region. – **L. Holly, GRP Staff**

2. Seed Health Laboratory

2.1. Seed movements

In the 1987/88 season, the Seed Health Laboratory (SHL) continued to monitor the seed exchange activities at ICARDA. A total of 77 shipments from 39 countries were received.

The number of seed consignments dispatched was 421, most of them to countries in the region. 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 decreased by 20% and is back to the level of 1985/86.

2.2. Field inspection

Incoming seeds are planted in an isolation area, and are frequently inspected to determine the incidence of pests and diseases. During the 1987/88 growing season the area was approximately 14 ha, or about 10,000 plots. No exotic diseases were detected on plants grown in isolation.

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).

In addition, 66 ha of germplasm multiplication for possible international distribution were checked. Each plot was inspected individually, a total of about 6000 plots. Seeds harvested from infected plots were carefully tested in the laboratory.Potentially seed-borne pathogens detected were: Ascochyta fabae, A. rabiei, Botrytis fabae, Fusarium spp., Urocystis agropyri, Tilletia foetida and T. caries, Helminthosporium spp., Rhynchosporium secalis, Ustilago hordei, U. nuda, U. tritici, Xanthomonas translucens, Orobanche spp.

2.3. Laboratory testing and treatment of outgoing and incoming seed

Samples of seeds harvested from fields where disease symptoms were observed, as well as random samples, were tested in the laboratory (Table 15). The majority was found healthy or infected with non-quarantine pathogens such as Fusarium spp. or Tilletia spp. (common bunt). Lines contaminated with flag smut (Urocystis agropyri) were eliminated from shipments and seed destroyed.

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. Legume seeds were also routinely fumigated. Random samples were tested for germination to ensure that viability is not affected. For all shipments Phytosanitary Certificates which met the requirements of the importing countries were prepared, and sent with the seeds.

Incoming seeds were first fumigated or treated with cold to control insect pests, then inspected for admixtures of soil, weed seeds, bunt balls, or for seeds with visible symptoms of infection. Table 16 indicates the results of additional health tests. In the 1987/88 season, no pathogen of quarantine significance was detected. Nevertheless, a rigid procedure is followed of planting all incoming material only in greenhouses or in the isolation area. The majority of the consignments received at ICARDA were not treated with fungicides. As an additional safeguard, those seeds, before planting, were treated at the Seed Health Laboratory with a broad spectrum fungicide, i.e. Vitavax for cereals, and thiabendazole or benomyl for legumes.

2.4. Training

Aspects of seed health were covered in the in-country training courses on seed production in Yemen Arab Republic and on seed certification in Egypt, as well as in the course on barley disease methodology in Aleppo, and seed quality control in Aleppo.

Table 15. Seed health tests on conducted seed dispatched from ICARDA, in 1987/88.

Crop	Number of samples tested	clean	infected	Tests carried out	Pathogens observed
durum wheat	250	155	95	centrifuge wash test	*Tilletia caries* and/or *T. foetida* (94), *Urocystis agropyri* (1)
bread wheat	318	198	120	centrifuge wash test	*Tilletia caries* and/or *T. foetida* (119) *U. agropyri* and *T. caries* or *T. foetida* (1)
wheat wild relatives	10	7	3	centrifuge wash test	*Tilletia caries* and/or *T. foetida*
barley	284	182	102	centrifuge wash test freezing blotter test	*Helminthosporium* spp. (12) *Fusarium* spp.(80) *Helminthosporium* spp. and *Fusarium* spp. (10)
barley	10	10	0	centrifuge wash test	–
lentil	264	256	8	freezing blotter test	*Fusarium* spp.
faba bean	179	149	30	test for stem nematode freezing blotter test agar media test *Orobanche* test	*Ascochyta* spp. (3) *Fusarium* spp. (27)
chickpea	77	66	11	agar media test freezing blotter test	*Fusarium* spp.
pea	6	4	2	test on King's B medium	*Pseudomonas* spp.
medics	7	7	0	test for stem nematode	–
Total	1405	1034	371		

Table 16. Seed health tests conducted on seed received at ICARDA in 1987/88.

Crop	Number of samples tested	clean	infected	Tests carried out	Pathogens observed
durum wheat	167	142	25	centrifuge wash test	*Tilletia caries* and/or *T. foetida*
bread wheat	566	408	158	centrifuge wash test	*Tilletia caries* and/or *T. foetida*
wheat	392	315	77	centrifuge wash test	*Tilletia caries* and/or *T. foetida*
barley	46	25	21	freezing blotter test	*Helminthosporium* spp. (2), *Fusarium* spp. (11) *Fusarium* spp. + *Helminthosporium* spp. (8)
maize	17	8	9	agar media test	*Fusarium* spp.
lentil	15	10	5	freezing blotter test agar media test	*Fusarium* spp. (1), *Botrytis* spp. (3) *Fusarium* spp. and *Botrytis* spp. (1)
faba bean	58	35	23	freezing blotter test agar media test	*Fusarium* spp. (16), *Ascochyta* spp. (5), *Botrytis* spp. (2)
chickpea	75	75	0	freezing blotter test agar media test	-
pea	7	6	1	test on King's B medium	*Pseudomonas* sp.
Phaseolus bean	65	62	3	agar media test	*Fusarium* spp.
medics	1	1	0	test for stem nematode freezing blotter test	-
Brassica	1	1	0	freezing blotter test agar media test	-
Total	1410	1088	322		

In cooperation with the Ethiopian Seed Corporation a first in-country seed health training course was organized in Addis Ababa, Ethiopia, which was attended by 25 participants. A regional workshop on the same topic preceeded the training course and was attended by representatives from organizations envolved in seed production and seed exchange.

In addition, staff from Aleppo University (4), General Organisation for Seed Multiplication (2), Gezira Seed Station (1), from Syria, and Seed Multiplication Project Dhamar, YAR (1), were trained for a few days. – **M. Diekmann**

3. Virology Laboratory

During 1988 the virology lab of ICARDA continued its activity in close cooperation with the Research Institute for Plant Protection (IPO), Wageningen the Netherlands. Work on viruses of food legumes and cereals in 1988 included the following: (i) virus surveys in Turkey, Ethiopia, Egypt, Sudan and Syria, (ii) screening for virus disease resistance, (iii) yield loss evaluation due to infection with selected viruses and (iv) testing for seed-borne viruses.

3.1. Viruses of food legumes

3.1.1. Virus survey

379 faba bean samples with symptoms suggestive of virus infection were collected from Egypt, Ethiopia, Sudan and Syria. Samples were tested serologically for the presence of a number of sap transmissible viruses, and results obtained are summarized in Table 17. It was evident that bean yellow mosaic virus was the most commonly detected virus followed by broad bean mottle and broad bean wilt viruses. Table 17 also indicates that in 54 of the samples tested it was not possible to identify the virus involved.

Chickpea stunt virus was observed in a low incidence in Syria and Turkey chickpea fields (1-2 % on the average) whereas in the summer nurseries in Terbol, Lebanon the incidence reached 30-40 %. When lentil samples collected at random from a lentil field in the Erzerum Research Station, Turkey, were tested serologically broad bean stain virus (BBSV) incidence was found to be 15-20%. Since BBSV is a seed-borne virus in lentils, more attention should be excersised for producing BBSV-free lentil seeds in many countries of the WANA region. Pea mosaic virus was identified in few forage pea samples from Syria.

Table 17. Viruses in faba bean samples with virus-like symptoms collected from Egypt, Sudan and Syria during spring of 1988. Identification was based on serological reaction (ELISA).

Country	No. of tested plants with virus-like symptoms	Number of plants infected with							No. of plants with single infection	No. of plants with mixed infection	No. of plants with negative reaction by ELISA
		BBSV	BBTMV	BBMV	BBWV	BYMV	PSbMV	CMV			
Egypt	50	2	9	0	4	45	5	4	28	17	5
Sudan	240	6	4	57	38	166	13	28	141	81	18
Syria	48	14	1	17	17	34	3	1	14	29	5
Ethiopia	41	7	9	0	1	3	7	2	7	8	26
Total	379	29	23	74	60	248	28	35	190	135	54

BBSV = broad bean stain virus;
BBMV = broad bean mottle virus;
BYMV = bean yellow mosaic virus;
CMV = cucumber mosaic virus;

BBTMV = broad bean true mosaic virus
BBWV = broad bean wilt virus
PSbMV = pea seed-borne mosaic virus
PEMV = pea enation mosaic virus

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

Over 100 faba bean pure lines were screened for BYMV resistance using artificial aphid inoculation. Four BPL's (756, 757, 758 and 769) all from Afghanistan showed low Disease Index. The symptom development in these lines was extremely slow (40 days as compared to 10-12 days in susceptible lines). Results obtained are summarized in Table 18.

Table 18. Performance of selected faba bean lines after artificial inoculation with bean yellow mosaic virus (BYMV) during the growing season (1987-1988).

Genotype	Percentage of infection	Disease index (D.I)*	Origin
BPL 756	40.00	6.25	AFG
BPL 757	40.00	6.25	AFG
BPL 758	57.14	14.28	AFG
BPL 769	75.00	28.12	AFG
BPL 734	75.00	34.37	AFG
BPL 752	87.50	50.00	ETH
BPL 755	87.50	31.25	AFG
BPL 761	75.00	34.37	AFG
BPL 726	100.00	83.30	ETH
BPL 727	100.00	92.85	ETH
BPL 735	100.00	85.71	ETH
BPL 749	100.00	87.50	ETH

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

Around 300 faba bean pure lines (BPL) were screened for resistance to BLRV. None of the tested lines showed high level of resistance to the virus. However, few lines were able to tolerate infection and produce some yield (Table 19) as compared with no yield in susceptible lines. Three cultivars known to be resistant to BLRV in the Netherlands (Minica, Futura and Optica) were susceptible to BLRV in Syria. The work in progress on etiology of BLRV in Syria indicates that it is possibly distinct from BLRV in the Netherlands. More work is required in this area before a precise conclusion can be made.

Table 19. Performance of selected faba bean lines after artificial inoculatin with bean leaf roll virus (BLRV) during the growing season (1987-1988).

Code	No. of plants infected total	No. of plants harvested	Total no. of seeds harvested	Total yield (grams)	Yield per plant (grams)	Origin
BPL 1023	8/8	5	286	63.8	12.7	AFG
BPL 1027	6/9	7	385	84.7	12.1	AFG
Reina blanca	47/50	20	311	170.4	8.5	ESP
BPL 1002	9/9	7	96	47.1	6.7	IRQ
ILB 1814	50/50	21	64	121.0	5.7	SYR
GIZA 402	50/50	20	295	105.6	5.2	EGY
BPL 1065	8/8	5	80	46.5	4.7	TUR
Minica	140/140	5	11	4.1	0.8	NLD
Futura	80/80	8	18	5.4	0.6	NLD
Optica	100/100	4	4	0.6	0.2	NLD
BPL 849	10/10	0	0	0.0	0.0	CAN
BPL 885	10/10	0	0	0.0	0.0	CAN
Syrian local	50/50	2	3	1.6	0.8	SYR

3.1.4. Screening for chickpea stunt virus (= BLRV) in chickpea

Fourty three chickpea lines from ICRISAT were screened for chickpea stunt virus resistance using artificial inoculation by aphids. Results obtained indicated that the procedures followed were not good enough to produce 100% infection in susceptible chickpea. Consequently, results obtained were not conclusive and tests will be repeated during the 1988/89 growing season.

3.1.5. Yield loss evaluation

A field experiment was conducted to evaluate faba bean yield losses induced by infection with three viruses, at three different inoculation times. Results obtained (Table 20) indicated that even late infections (during pod filling) could induce a 17-30 % yield loss depending on the virus involved. Such losses could

Table 20. Faba bean CV. Syrian Local yield+ in experimental plots inoculated with three faba bean viruses at three different growth stages (1987-1988). Values between parenthesis are percent yield as compared to healthy control.

	Inoculation time (day after sowing)		
Virus	**76**	**115**	**155**
BYMV	53.75**(6.2)	715.0* (82.9)	645.0** (74.8)
BBMV	470.0** (54.5)	492.5 (91.9)	716.25* (83.2)
BBMV+BYMV	87.5** (10.1)	588.75**(68.3)	668.75** (77.6)
BBSV	57.5** (6.6)	452.5** (52.5)	607.5** (70.5)
Healthy	861.5	861.5	861.5

+ Yield in grams per plot of 3.5 x 1.2 meters replicated four times.
* Significant at P = 0.05 when compared with the healthy control.
** Significant at P = 0.01 when compared with the healthy control.

represent actual losses in a country like Sudan where in some locations a 100 % infection with viruses, late in the growing season, is common. The results obtained this year were close to the yield loss values obtained in the previous year using the same viruses.

3.1.6. Roguing seed-borne infections in faba bean

Faba bean increases for international nurseries were continuously inspected during the growing season 1987/88. Roguing was excersised three times during the growing season (February - April 1988). Any plant with symptoms suggestive of virus infection was eliminated. Seed lots harvested from these fields were subjected to serological detection of seed-borne viruses (BBSV, BYMV, BBMV). In 1988, 1223 seed lots were tested and 37 lots were eliminated due to seed-borne infection. Rejection was based on detection of at least one seed infection in a sample of 100 seeds per seed lot. The number of rejected seed lots was three fold less in 1988 than in the previous year (1987).

3.2. Cereal viruses

3.2.1. Survey for BYDV

In 1988 a survey for barley yellow dwarf virus was carried out in the highlands of Ethiopia, 250 km radius from Addis in all directions. Around 20 barley, wheat and oat fields were inspected and samples suggestive of BYDV infection or nutrients deficiency were collected. In many fields water-logging because of excess rain was a serious problem which contributed to the weak growth of cereals in many fields. Collected samples were tested for BYDV by ELISA, and results obtained are summarized in Table 21. BYDV was detected in 19 out of the 20 fields surveyed, an indication of the

wide prevalence of BYDV in Ethiopia. Results obtained indicated that the PAV strain of BYDV was the most common in the fields surveyed. More extensive surveys need to be carried out by local workers to establish the importance of BYDV on cereals in Ethiopia.

Table 21. Serological detection of barley yellow dwarf virus in groups (of five) cereal leaves collected from Ethiopia during September-October 1988 and by employing the ELISA test.

			Number of groups positive for BYDV with	
Location	**Crop**	**No. of leaf groups tested**	**Indirect ELISA coating NS1 IgG Detection MC32-41[a] (PAV, MAV & SGV)**	**Direct ELISA PAV (B)[b]**
Ambo (SPL)	barley	2	2	1
10km from Ambo	wheat	5	0	0
Altufa (16 km from Ambo)	wheat	3	3	3
Chacha	barley	10	6	7
	oat	5	3	0
Dodotaa	wheat	5	4	5
Negela (Asasa)	wheat	5	2	2
Kulumsa	wheat	5	4	5
Majo	wheat	2	2	2
Sagure	wheat	5	3	0
Anagero	wheat	5	4	0
Bekoji	wheat	5	5	5
Sheno	barley	5	4	1
Sululta	barley	5	5	5
	oat	4	2	0
Warabi	barley	5	5	5
Kasochangi	barley	4	1	4
Debrazeit	barley	5	0	3
Asasa	barley	3	0	3
Shancho	barley	3	3	3

a Monoclonal antibodies provided by Dr. S. Wyatt, WSU, Pullman, USA.
b Polyclonal antibodies from Bioreba, Basel, Switzerland.

3.2.2. Screening for BYDV resistance

Screening for BYDV resistance in 1988 included barley lines, durum lines and bread wheat lines. Around 60 lines of barley, durum and bread wheat which proved to have BYDV tolerance from previous year testing were also included. In addition a CIMMYT BYDV nursery was planted in the isolation area for BYDV screening. 22 barley lines (Table 22), 23 durum lines (Table 23) and 27 bread wheat lines (Table 24) proved to have useful BYDV tolerance. These lines will be subjected to further testing during 1988/89.

Table 22. Reaction of selected Barley lines to infection with barley yellow dwarf virus during season 1987/1988.

Genotype	Symptoms index (0 - 9)	Biomass (g)	Grain yield (g)	Harvest index
BKL 88-15	4	293.64	126.43	0.43
BKL 88-28	4	201.20	80.12	0.40
BKL 88-56	3	275.29	88.82	0.32
BKL 88-158	4	242.41	108.84	0.45
BKL 88-276	4	210.31	70.73	0.34
BKL 88-292	4	319.04	101.64	0.32
BKL 88-319	4	260.83	112.91	0.43
BKL 88-341	4	188.24	92.37	0.49
BKL 88-349	4	228.53	101.82	0.45
BKL 88-379	4	244.35	102.13	0.42
BKL 88-397	4	233.56	110.09	0.47
BCB 88-3	5	151.18	75.58	0.50
BCB 88-13	5	138.35	69.80	0.51
BCB 88-18	4	133.36	56.65	0.43
BCB 88-25	4	246.75	104.83	0.43
BCB 88-45	4	183.32	71.55	0.39
C-YD-BA-88-3	3	104.02	41.07	0.40
C-YD-BA-88-22	3	92.20	43.80	0.48
C-YD-BA-88-32	3	109.61	47.76	0.44
C-YD-BA-88-46	4	92.75	32.27	0.35
C-YD-BA-88-65	4	98.63	37.99	0.39
C-YD-BA-88-79	3	162.30	51.09	0.32

Table 23. Reaction of selected Durum wheat lines to infection with barley yellow dwarf virus during the growing season 1987/1988.

Genotype	Symptoms index[a] (0 - 9)	Biomass (g)	Grain yield[a] (g)	Harvest index
DKL-88-65	5	165.47	48.41	0.29
DKL-88-95	5	177.88	57.64	0.32
DKL-88- 117	4	187.44	53.89	0.29
DKL-88- 119	5	189.69	55.92	0.29
DKL-88- 122	5	167.62	49.52	0.30
DKL-88- 131	5	174.19	57.59	0.33
DKL-88- 132	4	194.35	59.85	0.31
DKL-88- 142	5	170.47	52.32	0.31
DKL-88- 143	5	166.03	49.95	0.30
DKL-88- 162	5	178.85	53.56	0.30
DKL-88- 166	5	152.91	50.22	0.33
DYT-LRA-88- 9	4	169.23	45.35	0.27
DYT-LRA-88- 21	5	132.48	48.11	0.36
DYT-MRA-88- 5	5	143.34	40.84	0.28
DYT-MRA-88- 7	5	143.26	36.52	0.25
DYT-MRA-88- 14	5	144.21	46.73	0.33
DYT-MRA-88- 21	5	139.99	46.10	0.33
C-YD-DW-88- 32	5	96.92	25.12	0.26

a Symptoms index was based on 0 = no symptoms and 9 = severe yellowing and stunting of the plants with no grain yield.
b Per 30 cm row.

When selected BYDV tolerant cereals were tested in a number of locations in Syria (Tel Hadya and Lattakia) for a number of years (1986-1988) and also in Morocco during 1988 it was evident that BYDV tolerance is expressed in most cases and no conflicting results were obtained (Table 25).

Table 24. Reaction of selected bread wheat lines to infection with barley yellow dwarf virus during the growing season 1987/1988.

Bread wheat line	Symptoms index (0 - 9)	Biomass (g)	Grain yield (g)	Harvest index
WKL 88-4	4	161.98	54.24	0.33
WKL 88-17	4	169.62	55.03	0.32
WKL 88-29	5	192.91	70.41	0.36
WKL 88-33	5	191.08	62.32	0.33
WKL 88-45	5	168.74	54.86	0.33
WKL 88-46	5	177.02	62.49	0.35
WKL 88-63	5	171.59	58.13	0.34
WKL 88-65	5	158.65	50.23	0.32
WKL 88-96	5	167.04	54.64	0.33
WKL 88-178	4	198.35	63.00	0.32
WKL 88-204	4	178.37	56.07	0.32
WKL 88-205	4	159.53	55.94	0.35
WKL 88-207	4	169.81	54.64	0.33
WYT-LRA -88-2	4	120.16	36.43	0.31
WYT-LRA -88-3	4	119.61	29.88	0.25
WYT-LRA -88-5	5	165.64	40.25	0.25
WYT-LRA -88-8	4	144.17	36.44	0.26
WYT-MRA -88-7	5	140.57	46.30	0.33
WYT-MRA -88-8	4	148.21	36.75	0.25
WYT-MRA -88-10	4	152.12	39.36	0.26
C-YD-BW-88-48	5	79.53	27.06	0.34

3.2.3. Correlation between BYDV symptoms index and BYDV concentration as measured by ELISA

When BYDV content in around 20 breeding lines of each of barley, bread wheat and durum wheat were measured at 4, 5, 6 and 7 weeks after BYDV inoculation by using ELISA, the correlation between the average ELISA values and symptoms index was only significant in barley but not in bread wheat or durum wheat (Table 26). Almost the same results were also obtained in tests carried out in the previous year (1987). Such results suggest that virus

Table 25. Selection of barley, durum wheat and bread wheat lines which showed relatively more tolerance to infection with barley yellow dwarf virus during 3 years and different location.

	Symptoms index (Based on 0-9 scale)				
	Syria trials				Morocco trial
Line or cultivars	Tel Hadya 1986	Tel Hadya 1987	Tel Hadya 1988	Lattakia 1988	Morocco 1988
Barley					
BKL 87-115	-	3	6	3.5	3
BKL 87-255	-	3	5	4	3
BKL 87-264	-	4	5	6	4
BKL 87-138	-	5	6	3.5	4
BKL 86-35	3.0	6	4	4	4
BKL 86-121	3.0	5	4	5	6
C-BYDV-86-15	3.5	2	5	5.5	3
C-BYDV-86-141	2.0	3	5	5.5	-
C-BYDV-86-84	3.0	3	6	5.5	6
Tedmor	-	-	6	6	-
BKL 88-373 (Susc. Check)			9		
Durum Wheat					
DKL-87-10	-	4	6	6	5
DKL-87-32	-	4	5	5.5	4
DKL-78-38	-	4	6	5	5
DKL-87-145	-	4	5	5	3
DKL-87-161	-	4	6	5.5	5
DKL-87-184	-	4	5	6	5
DKL 88-156 (Susc. Check)			7		
Bread Wheat					
WCB-87-96	-	4	6	4.5	3
WCB-87-98	-	4	6	4.5	2
WCB-87-41	-	6	6	5	5
WCB-87-49	-	6	6	5.5	4
WCB-87-147	-	5	6	6.0	5
WCB-87-153	-	5	5	5.5	4
Sham 2	-	-	6	6	-
WKL 88-161 (Susc. Check)			7		

concentration profile as measured by ELISA could be useful in selecting BYDV-tolerant barley lines. Further testing is required, and with more barley lines to establish the significance of the above results.

Table 26. The correlation between symptom index and ELISA values (A405) obtained at 4, 5, 6 and 7 weeks after BYDV-inoculation and the averge of these values when several cereal genotypes were inoculated in the field.

Crop	A405 at (weeks)				Average
	4	5	6	7	
Barley	0.4936*	0.1478	0.4801	0.3447	0.5476**
Bread wheat	0.4744**	-0.1154	0.0713	-0.5298**	0.1961
Durum wheat	0.1773	0.2670	0.1744	-0.0822	0.2511

* Significant correlation at P < 5%
** Significant correlation at P < 1%

3.2.4. Testing for seed-borne barley stripe mosaic virus

33 barley lines (BKL) which from a previous year's testing were found to contain a low incidence of the seed-borne barley stripe mosaic virus (BSMV), were followed up this year to produce from them virus-free seed lots. Twelve 1m barley rows were tested separately for each barley line, and whenever BSMV was detected (Table 27, the 1m row containing a single (or more) infection was eliminated (rogued). Testing for BSMV was repeated one more time during the growing season to be sure that the retained seeds will constitute a healthy breeding stocks. This exercise will be repeated to assure that all barley breeding lines which will be advanced for yield trials are free from BSMV, a virus which is endemic in Syria. – **K. Makkouk**

Table 27. Barley stripe mosaic virus (BSMV) samples were tested from field A4 (increase barley) during the growing season 1987/1988.

BSMV	No. of groups tested*	No. of groups infected with BSMV	% Infected plants (estimated)
BKL-29	12	1	0.2
BKL-39	12	0	0.0
BKL-61	12	6	1.1
BKL-71	12	2	0.3
BKL-74	12	1	0.2
BKL-79	12	0	0.0
BKL-80	12	0	0.0
BKL-81	12	1	0.2
BKL-85	12	1	0.2
BKL-96	12	1	0.2
BKL-98	12	0	0.0
BKL-104	12	3	0.5
BKL-151	12	1	0.2
BKL-160	12	0	0.0
BKL-162	24	14	4.8
BKL-165	12	4	0.6
BKL-195	12	2	0.3
BKL-197	12	2	0.3
BKL-198	12	1	0.2
BKL-207	12	2	0.3
BKL-209	12	2	0.3
BKL-225	12	3	0.5
BKL-234	12	1	0.2
BKL-255	12	1	0.2
BKL-276	12	0	0.0
BKL-281	12	0	0.0
BKL-287	12	0	0.0
BKL-298	12	0	0.0
BKL-314	12	0	0.0
BKL-320	12	0	0.0
BKL-369	12	2	0.3
BKL-399	12	1	0.2
BKL-400	12	0	0.0

* All samples were tested in groups of 60 plants each.

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6. GRP Staff List in 1988

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Andreas Antypas	Data Assistant
Mayssa Antabi	Secretary II
Micheline Sandouk	Secretary I
Mohamed Hamran	Asst. Technician/Driver

Seed Health Laboratory

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

Virology Laboratory

Khaled Makkouk	Plant Virologist
Widad Ghoulam	Senior Technician
Walid Radwan	Senior Technician
Safaa Koumari	Technician

* Left during 1988 on sabbatical leave

** Left during 1988

*** Joined during 1988