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GENETIC RESOURCES PROGRAM

Annual Report for 1986

ICARDA

GENETIC RESOURCES PROGRAM

ANNUAL REPORT 1986

The International Center for Agricultural
Research in the Dry Areas

Aleppo, Syria

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GENETIC RESOURCES PROGRAM

The overall objective of the Genetic Resources Program (GRP) is to collect, safeguard and promote the utilization of genetic resources of crop species which are of interest to ICARDA. In pursuing this major objective, the program undertakes collecting missions and continues to strengthen and enhance its work on the characterization, evaluation, documentation and conservation of the Center's germplasm. The GRP also undertakes short training courses and conducts genetic resource research on a modest scale. Weaknesses in any of these program elements could seriously endanger the germplasm collections and impede the use of the genetic resources. Strenuous and persistent efforts are being made to remove deficiencies and strengthen the various activities in order to establish a balanced and effective work program.

The Seed Health Laboratory which forms part of the program continues to monitor the movement of germplasm and breeder's material to protect against the accidental spread of seed-borne diseases and pests. The Virology Laboratory, also a part of the program has maintained its major objectives to study the incidence of virus diseases and develop control methods and to screen for virus diseases both on plant and seed materials.

In 1985/86, the GRP continued as in the last two years, to emphasize the evaluation, documentation, rejuvenation and storage of the germplasm holdings as priority program components. But notable progress was also achieved in enlarging the germplasm collections in response to the expressed needs of the breeders. Two other program elements, genetic resource research and training, continued as low-keyed activities as personnel and other constraints inhibited further development.

Interesting program highlights in 1985/86 were:

- A total of 2369 new accessions were obtained from collection missions in Syria, Turkey and Pakistan. In addition, 2977 new entries were acquired from genebanks and other institutes abroad.

The total number of accessions in the germplasm collections is now 70,091.

- Multiplication of 200 new accessions of durum wheat, 531 of bread wheat and 4498 new samples of barley for characterization and evaluation.
- Rejuvenation of 2844 entries of durum wheat, 1691 of barley, 2869 of Vicia, 536 entries of Lathyrus, 3020 chickpea accessions, and 1911 lentil entries to meet storage requirement.
- Multiplication and evaluation of 4030 entries of durum wheat, 477 of bread wheat, and recently acquired accessions of Triticum turgidum var. dicoccoides (885), chickpea (525), lentil (258), wild species of chickpeas (24) and wild species of lentils (111).
- The production of the first volume of the Barley Catalog, the entire text of which was produced camera-ready, solely by the GRP staff.
- A total of 42,127 passport descriptors were assigned to the various crop species, 16,711 collection descriptors were documented and 206,590 items of evaluaton data were added to the genetic resources data base.
- Altogether 3000 accessions of durum wheat, 500 of bread wheat, 100 entries of barley, 2770 accessions of chickpea and 1300 seed samples of lentil were processed and placed in medium-term storage.
- Experiments using polyacrylamide gel electrophoresis (a) demonstrated the presence of additional genetic variation in new lentil accessions which were recently collected and (b) revealed a wide range of genetic diversity in wild species of lentil and chickpea.
- A detailed evaluation study on durum wheat landraces from Greece suggested that this type of germplasm should be exploited more fully to enhance the impact of durum wheat breeding programs.
- The Seed Health Laboratory performed tests in a total of 4415 samples of seedlots and germplasm. The SHL also initiated a study on the effects of seed-treatment chemicals on germination and seedling growth of barley.
- The Virology Section expanded its work on virus survey to include

Sudan and Egypt, evaluated cereal crops and faba bean for resistance to the most prevalent virus diseases and with the SHL, initiated seed health testing of faba bean for seed-borne viruses.

- Short-term training was given to 10 regional scientists and technicians although the program is severely handicapped by the lack of senior personnel and facilities.

1. New germplasm in 1985/1986

Ongoing research at ICARDA has continued to highlight the ever increasing importance of landraces and wild relatives in providing additional variability that can be exploited for increasing crop production and stabilizing yield. Germplasm of landraces from target areas in high altitude regions and from stress environments are specific requirements of the breeders at ICARDA. Also, broad-based germplasm of the wild and related crop species are required to incorporate desirable traits such as disease resistance, drought tolerance, improved grain quality and increased tillering capacity into the cultivars now being grown. In 1985/86 staff members of the GRP participated with national programs and other scientists and conducted collecting missions in Pakistan, Syria and Turkey.

Pakistan is considered an important center of diversity for winter cereals. Cereal germplasm from Baluchistan and the northern areas of Pakistan is poorly represented in ICARDA's collection. New cultivars are rapidly replacing old landraces in many areas and the wild and related species are fast disappearing because of overgrazing and changing patterns of land use. The main objective of a joint mission with the Plant Genetic Resources Laboratory of the Pakistan Agricultural Council was to obtain *Aegilops* spp. and barley landraces from Baluchistan and cultivated landraces of wheat and barley from the mountainous regions in the Northern Provinces. As many as 110 sites which were not covered in previous missions, were sampled in June and July, 1986, when a total of 5000 kilometers were travelled by car. Altogether 242 population samples and 261 single head collections were obtained for cereals; also 58 entries of forage and food legumes were collected. This new germplasm consisted of 93 samples of bread wheat, 36 of barley, 52 of *Aegilops* spp., one sample of *Hordeum spontaneum*, 3 of *Triticum compactum*, 11 accessions of *Vicia sativa*, 3 of *Lathyrus* spp., 24 entries of *Medicago sativa*, 8 of *V. faba*, 3 lentil accessions and 9 *Pisum sativum* accessions.

A tripartite mission to collect wild legume germplasm in Syria was undertaken from 19 March to 3 June, 1986. The three collaborating groups involved were the Vicieae Project Groups from the University of Southampton, England, members of the Genetic Resources Program of ICARDA and members of the Syrian National Program. In addition to active staff participation, the GRP acted as host for the mission and provided assistance throughout the course of the collecting activities. The mission focused on the areas in Syria rich in legume germplasm. Each area was visited twice, once to locate collecting sites and identify the species present and later when the plants matured, to collect seed samples. Herbarium voucher specimens and *Rhizobium* samples were also obtained during the first visit for a large proportion of the seed accessions collected.

A total of 1341 seed samples were collected (Table 1). A complete duplicate set of seed samples, herbarium specimens and the related information is held at ICARDA. Many of the *Vicia*, *Lathyrus* and *Medicago* species collected have potential as forage crops (e.g. *Vicia sativa*, *V. villosa*, *V. noeana*, *V. hyaeniscyamus*, *V. narbonensis*, *Lathyrus ochrus*, *L. marmoratus* and annual medics). Many important and closely related wild relatives of food legumes such as *Pisum fulvum*, *Lens orientalis*, *L. nigricans*, *L. ervoides*, *Cicer judaicum*, *C. pinnatifidum* and the *Vicia narbonensis* complex (including one new and some rare species closely related to faba bean) were also obtained.

Table 1. Legume germplasm collected in Syria by the Southampton/ICARDA/ARC Douma mission, 1986.

Genus	Number of species, subspecies, and botanical varieties	Number of accessions
Vicia	35	623
Lathyrus	21	384
Pisum	2	71
Lens	4	85
Cicer	2	8
Medicago	24	154
Lupinus	2	16
Total	90	1341

In addition to the germplasm collected by this mission, an additional 3 samples of wild chickpeas (C. judaicum and C. bijugum) and 8 population samples of wild lentils (L. orientalis and L. ervoides) were obtained during short collecting trips undertaken by GRP staff to other parts of Syria not covered by the mission.

In another joint collecting mission with the Department of Agriculture, Western Australia, germplasm of naturally-occuring annual forage legumes was collected from a range of habitats varying in soil type, rainfall and altitude. Regions not covered previously were sampled in North West Syria and in Gaziantep, Hatay, Sayhan and Adana provinces in Turkey. During a ten-day period, 456 samples were obtained. Annual Medicago species (145 accessions of 15 species) and Trifolium spp. (272 entries of 23 species) represented the bulk of the collection. Vicia spp. (14 entries), Lathyrus spp. (7 accessions) and Trigonella (10 accessions) were also obtained along with a few entries of Astragalus, Scorpiurus and Lupinus.

Altogether, the germplasm obtained in these collecting missions constitute an important and potentially valuable addition to the

ICARDA collection. Seeds will be multiplied during the 1986/87 season to permit comprehensive characterization and evaluation of this new genetic material.

In addition to field expeditions, seed samples of germplasm were requested and obtained from different genetic resources collections. A total of 5346 new samples from 26 countries were added to the ICARDA germplasm collections (Table 2).

2. Characterization and Evaluation

The characterization and evaluation of germplasm accessions in collections is a prerequisite to their potential exploitation and their conservation in genebanks. Utilization in breeding programs is the ultimate justification for crop genetic resources work. A broad range of genetic diversity in the germplasm collection is required by breeders and researchers. Evaluation data complement passport information to provide a better understanding of the range of diversity that exists in germplasm collections. Staff members of the GRP are actively involved in joint evaluation projects with crop scientists to characterize the Center's germplasm. In 1985/86, more emphasis was placed on the evaluation of durum wheat accessions, *Triticum dicoccoides*, and wild species of lentils and chickpeas.

2.1. Evaluation of cereal germplasm

2.1.1. Evaluation of durum wheat germplasm

Within the framework of a collaborative project which is supported by the Italian Government, 4030 entries of durum wheat were evaluated for 22 quantitative and qualitative traits. Field observations included seedling emergence and vigor, low temperature damage, growth habit and growth class, days to heading, productive tillering capacity, awnedness, flag leaf size and shape, flag leaf attitude, waxiness of plant, plant height, days to maturity, lodging resistance,

Table 2. Status of the germplasm collections at ICARDA in 1986.

	Number of accessions				
Crop	**New**	**Total**	**in medium term storage**	**to be multiplied**	**in long term storage**
Cereals					
Barley	304	15195	12624	500	
Durum wheat	784	19230	3000	8869	5475
Bread wheat	621	3219	1000	2219	
Wild relatives	1129	2885		2885	
Food legumes					
Lentil	231	6412	5581	752	4958
Chickpea	265	6185	5577	646	
Faba bean	66	3371	3305	3371	
Wild *Lens* spp.	89	190	111	190	
Wild *Cicer* spp.	10	40	22	30	
Forages					
Annual medics	334	3911	3911	175	
Pisum spp.	69	3299		3299	3221
Vicia spp.	623	3544	3204	1067	
Trifolium spp.	425	1212		1212	
Trigonella spp.	10	154		154	
Astragalus spp.	2	312		312	
Lathyrus spp.	384	932	838	469	
Total	5346	70091	39173	26150	13654

resistance to Septoria tritici (leaf blotch) Puccinia striiformis (yellow rust) and Tilletia caries (bunt). Characterization of the spikes for traits such as number of spikelets per spike, spike density, spike length, glume hairiness, awn colour, glume colour, and number of seeds per spikelet, was done in the laboratory. The results of this evaluation work are being documented and prepared for analyses, and subsequently, will be published in a catalog.

2.1.2. Evaluation of selected accessions of durum wheat

In a collaborative project with Dr.S.Jana (University of Saskatchewan, Canada), 100 accessions from the ICARDA durum wheat collection which previously were screened for drought tolerance in Canada, were evaluated for grain yield, days to heading, days to maturity and plant height at Tel Hadya, Breda and Bouider. The test entries together with Sham 1, Hourani and 10 additional Canadian check varieties, were planted in single row plots in an augmented design experiment. The mean grain yield for each check variety, the number of test entries which exceeded the yields of the checks, and the number of test entries which also significantly exceeded the yield of the checks at the three locations are presented in Table 3. At Tel Hadya, Pellissier was the highest yielding check variety followed by Sham 1 which was the highest yielding one at Breda and Bouider. The number of accessions at Tel Hadya which exceeded the check varieties ranged from 7 for Pellissier to 58 for Hercules. Only one accession significantly outyielded a check variety (Hercules) at this location. The number of germplasm entries exceeding the yields of the check varieties at Breda and at Bouider where the rainfall was less, increased significantly (Table 3). This increase, however, was not as great for the number of entries which significantly outyielded the checks at these two locations. Breda and Bouider would therefore appear to be preferable locations for evaluation of traits important in stress environments. The results of this evaluation study would indicate that the multilocation assessment of germplasm provide more

Table 3. Results of multilocation evaluation of selected accessions from the durum wheat collection, 1985/1986.

Checks	Tel-Hadya			Breda			Bouider		
	Mean yield kg/ha	Number of lines exceeding checks		Mean yield kg/ha	Number of lines exceeding checks		Mean yield kg/ha	Number of lines exceeding checks	
		Total	P< 5%		Total	P< 5%		Total	P< 5%
Sham 1	3160.794	21	0	1045.452	30	0	453.292	10	0
Hourani	3267.444	17	0	706.598	63	2	351.080	18	0
Arcola	2839.716	29	0	926.574	44	0	346.632	18	0
Coulter	2426.424	38	0	713.262	63	2	193.314	45	5
Kyle	2386.428	39	0	693.264	67	2	106.656	69	11
Medora	3519.648	11	0	1006.566	32	0	206.646	38	4
Wakooma	3059.694	23	0	913.242	44	0	206.646	38	4
Wascana	2559.744	36	0	886.582	45	0	119.988	69	9
Hercules	1966.470	58	1	846.582	48	0	246.642	30	1
Pelissier	3986.256	7	0	786.588	55	0	219.978	38	3
Overall mean	2443.0957			863.2101			216.3690		
LSD (5%)	3718.1163			1365.9538			313.9164		
CV (%)	36.9699			38.4402			35.2440		
Rainfall (mm)	316.2			218.3			204.2		

meaningful information. Multilocation evaluation should therefore be a strong option when detailed germplasm appraisal on a limited number of accessions is contemplated.

2.1.3. Evaluation of Triticum turgidum var. dicoccoides

A collection of 855 entries of dicoccoides of which 809 originated from Italy, Jordan, Palestine, Syria and Turkey and 46 from unknown sources, was evaluated for 23 characters and three diseases (yellow rust, leaf rust, and barley dwarf diseases). This was a collaborative trial with the Cereal Improvement Program. Individual plants were grown 20 cm apart with 10 different checks; each check had specific traits that served as standards for evaluating the dicoccoides entries.

Variation was observed for all the traits recorded. The results of 9 quantitative traits are presented in Table 4. The germplasm from Syria and Turkey had a wide range of variability for all the nine traits. Variation for days to heading was greatest in the Italian material which included some late heading entries. Early heading accessions were found in the germplasm from Jordan and Palestine. The Syrian and Jordanian germplasm were more diverse for days to maturity; the variability in this trait was relatively small for the Italian and Turkish materials which were also genetically diverse for heading time. Flag leaf length and width were variable throughout the collection but moreso in the germplasm from Jordan, Syria and Turkey which also had a broad diversity for tillering capacity. Variation for plant height was seen readily in the Jordanian, Syrian and Turkish germplasm. Entries from Italy were relatively tall whereas some of the shortest plants were detected in the Jordanian germplasm. Spike characteristics (number of spikes per plant, spike length, number of spikelet groups per spike and awn length) were also widely variable throughout the entire collection. This pattern of wide genetic diversity was also observed for the qualitative traits (growth class, early vigour, juvenile growth habit, waxiness of plants, leaf

Table 4. Minimum, maximum, mean and standard deviation for 9 characters in *Triticum turgidum* var. *dicoccoides*, 1985/1986.

Country	No. of days to Heading				No. of days to Maturity				Number of spikes/plant				Tillering capacity			
	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD
Italy	106	134	116.35	9.804	142	153	147.44	3.041	3.00	29.00	12.31	7.661	28.33	64.67	46.19	8.965
Jordan	98	118	106.42	4.429	130	152	140.41	4.613	2.00	37.33	15.24	6.593	9.50	85.33	38.03	12.549
Palestine	101	111	106.63	3.238	139	147	140.88	2.472	5.67	25.33	13.13	6.105	9.67	45.00	25.04	11.933
Syria	87	135	112.80	7.781	133	162	142.44	3.480	2.00	42.00	13.89	7.182	7.00	110.00	51.94	21.824
Turkey	92	134	111.22	7.792	132	145	138.24	2.453	2.33	51.33	19.96	9.093	17.67	92.00	42.94	11.809
Unknown	93	107	99.53	5.196	134	142	137.05	1.999	9.00	39.33	22.60	6.690	25.00	87.00	42.37	13.445

Table 4 (Contd.)

Country	Plant height (cm)				Flag leaf length (cm)				Flag leaf width (cm)				Spike length (cm)				Number of spiklet groups/spike			
	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD
Italy	55.0	92.5	76.09	9.960	11.0	24.3	16.74	4.638	1.0	1.8	1.61	0.183	9.75	13.00	11.60	0.952	19.00	27.00	22.94	2.220
Jordan	30.0	100.0	49.45	7.895	6.3	29.2	14.72	3.263	0.4	1.5	0.89	0.342	6.33	13.25	9.65	1.169	9.67	20.33	14.97	1.897
Palestine	37.5	62.5	49.06	8.191	9.4	21.2	15.38	4.319	0.8	1.3	1.01	0.190	7.67	10.50	8.69	1.008	11.33	15.33	13.33	1.291
Syria	35.0	110.0	72.70	12.645	5.5	29.6	13.26	4.472	0.2	1.9	0.75	0.403	6.67	20.50	12.71	2.332	13.00	35.67	27.75	5.633
Turkey	40.0	107.5	73.34	13.579	6.7	25.0	12.46	2.966	0.3	1.7	0.81	0.216	7.33	17.50	10.85	2.237	13.33	35.67	22.57	6.123
Unknown	42.5	72.5	59.13	8.169	8.8	21.0	13.57	2.777	0.6	1.4	1.06	0.223	7.00	31.67	10.30	3.662	10.33	21.00	14.70	2.303

attitude, glume hairiness and colour, lodging resistance, awn colour, spike density and seed size and colour). Preliminary screening was also carried out on the entire dicoccoides collection for susceptibility to yellow rust, leaf rust, and barley dwarf yellow rust. Reaction to these diseases was variable. Some entries had combined resistance to two and less frequently, all three diseases.

In another evaluation study, 17 populations of dicoccoides, 11 from Syria and 6 from Jordan, were characterized for 25 traits to assess the variability within and between populations. Seeds of each population sample were germinated in a plastic house and transplanted in the field 20 cm apart to permit full expression of tillering capacity and other traits. The summary statistics for 8 traits are presented in Table 5.

Genetic diversity for these characters was observed within and between populations; this diversity was much more pronounced between plants of the same population than between populations. On the whole, the Syrian populations appear to be more genetically diverse than the Jordanian material. For example, three populations from Jordan (J-18-1E, J-18 E and J-22) had the same minimum and maximum values (126 and 146) for number of days to heading. To a less extent, this similarity in the range of variation was detected for certain traits in some of the Syrian populations as in the case of 20096-SYR and 20121-SYR for tillering capacity, 20096-SYR and 20121-SYR for number of spikes per plant and 20085-SYR and 20124-SYR for number of spikelet groups per spike. It is speculated that the genetic diversity for these and other traits would be even greater in a larger number of populations collected from more diverse environments.

The genetic variation within and between populations were also significantly wide for kernel colour and size, coleoptile colour, early vigour, lodging resistance, growth habit, leaf size and shape, waxiness, growth class, awn length and glume colour.

The results of these evaluation studies indicate that these dicoccoides entries are a valuable source of genetic material which can be exploited in breeding programs. Also, the results underline

Table 5. Mean, minimum and maximum values for 8 characters in 17 populations for 8 traits *T. turgidum* var. *dicoccoides*, 1985/86.

Populations	Number of days to heading			Number of days to maturity			Flag leaf length (cm)			Flag leaf width (cm)		
	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
J-11-1	132.8	125	145	163.6	160	168	22.7	16.5	30.0	1.2	0.5	2.4
J-17	130.5	122	142	165.2	153	172	19.5	12.0	26.0	1.0	0.5	1.5
J-18-1 E	131.7	123	146	165.4	155	170	19.0	11.0	30.0	0.7	0.5	1.5
J-18 W	127.9	123	146	165.6	148	172	16.0	10.0	22.0	0.9	0.4	1.2
J-21	127.8	123	146	161.2	148	170	15.1	8.0	22.5	0.9	0.5	1.5
J-22	131.5	124	147	165.9	145	169	19.5	7.0	27.0	0.9	0.5	1.2
20013-SYR	133.2	127	147	167.5	168	172	20.9	11.0	30.0	1.0	0.5	1.5
20017-SYR	133.2	125	147	168.7	161	178	16.7	10.0	24.0	0.7	0.4	1.2
20021-SYR	129.8	127	140	164.1	161	176	23.5	10.0	30.0	1.1	0.7	2.5
20085-SYR	137.9	129	147	166.8	160	179	22.6	13.0	30.0	1.1	0.6	1.5
20089-SYR	141.4	137	148	174.4	170	179	17.5	8.5	24.0	0.7	0.6	1.2
20090-SYR	139.0	131	147	166.5	161	173	19.2	13.0	26.0	1.0	0.6	1.3
20096-SYR	137.2	131	147	167.8	161	173	19.5	12.0	30.0	1.0	0.5	1.5
20101-SYR	136.7	131	147	167.0	161	175	18.4	13.0	27.5	1.0	0.5	1.5
20121-SYR	130.3	126	140	167.1	161	175	15.1	10.0	26.0	0.6	0.3	1.0
20124-SYR	142.7	134	148	170.3	164	175	15.5	8.0	27.5	0.8	0.5	1.5
20184-SYR	138.1	131	147	165.7	170	176	20.6	12.0	30.0	1.0	0.5	1.5

(contd.)

Populations	Tillering capacity			Number of spikes/ spike			length (cm)			Number of spikelet groups/spike		
	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
J-11-1	25.5	14	46	16.8	13	28	9.0	7.5	10.5	14.5	12	20
J-17	33.8	16	60	20.0	7	53	9.4	7.0	11.0	15.5	12	20
J-18-1 E	37.8	30	51	22.2	11	36	9.2	8.0	11.0	15.8	13	19
J-18 W	36.6	18	49	22.6	10	32	7.7	6.0	10.0	14.5	12	19
J-21	25.9	17	34	17.7	14	25	8.4	7.5	9.5	16.2	14	18
J-22	30.9	19	55	18.4	10	33	9.3	7.0	10.5	14.6	10	16
20013-SYR	39.1	28	52	25.2	11	38	11.8	9.5	17.0	20.5	18	24
20017-SYR	38.3	30	47	20.7	14	27	9.9	7.0	10.5	20.1	12	25
20021-SYR	36.0	22	50	20.7	13	29	10.3	8.0	12.5	19.0	16	21
20085-SYR	33.7	22	42	20.6	12	30	11.3	9.5	13.0	21.6	17	23
20089-SYR	47.0	24	81	18.1	12	25	10.3	8.0	12.0	16.9	14	19
20090-SYR	40.7	30	59	22.1	14	39	11.6	9.0	13.0	19.2	16	21
20096-SYR	46.4	30	66	22.9	13	34	9.0	8.0	11.0	14.8	12	18
20101-SYR	38.4	25	55	23.3	13	34	10.9	10.0	12.0	18.6	17	20
20121-SYR	44.8	30	67	32.2	20	41	8.0	6.0	9.0	19.7	17	23
20124-SYR	38.1	23	49	19.8	11	26	10.6	8.0	11.5	18.5	15	21
20184-SYR	23.3	15	33	16.1	10	23	9.7	8.0	11.0	19.0	16	22

the need to initiate organized collecting mission for this wild species. The importance of collecting and evaluating single head entries as opposed to population samples only, to identify the true variation of the germplasm is also highlighted by the results of these evaluation studies.

2.2. Multiplication and characterization of food legume germplasm

2.2.1. Cultivated chickpea

Chickpea germplasm collected and introduced in 1984/85 were planted for multiplication in the quarantine area at Tel Hadya. Most of the material has been collected in Pakistan (189), Turkey (109) and Cyprus (27); some recent introductions from USSR (32) and Bulgaria (7) were also included.

Many of the accessions collected from Pakistan are heterogenous for flower colour and seed type. The plants with pink/purple flowers were marked and harvested separately to assist the separation of desi types from the kabuli accessions. Kabuli type subsamples will be used for further evaluation, while seed samples representing the original composition will be preserved as base collection. The Kabuli-type subsamples separated from the Pakistani accessions, still contains some intermediate seed types between desi and kabuli chickpeas, and most of them are variable in seed size, seed shape and seed coat surface. These populations will be separated to more uniform subpopulations before full evaluation will be carried out. About 80% of the new accessions yielded sufficient seeds for preservation. Remnant seeds not needed for conservation will be multiplied to provide adequate samples for full evaluation.

During the multiplication of the new accessions, days to 50% flowering, days to maturity, plant height, growth habit, seed type, flower colour and 100-seed weight were evaluated; seed yield (Kabuli and desi types) of the plots were also determined. A summary of the information for 3 characters is presented in Table 6.

Table 6. Mean, range and standard deviation for 3 characters in the new chickpea accessions, 1985/86.

Country	Number of acc.	Flowering time (days)			Plant Height (cm)			100-Seed Weight (g)		
		Mean	Range	SD	Mean	Range	SD	Mean	Range	SD
Pakistan	189	116.1	108-129	4.6	34.7	15-50	6.9	22.1	7.3-45.3	7.3
Turkey	109	118.2	113-129	4.1	46.3	32-60	5.1	42.2	17.6-61.5	7.1
Cyprus	27	116.0	113-123	2.4	40.3	24-50	7.5	31.5	25.0-42.0	4.1
USSR	32	122.3	113-129	5.0	47.0	35-68	7.3	26.8	15.9-36.3	5.1
Bulgaria	7	122.4	119-125	3.2	49.3	42-58	5.6	30.1	20.6-42.4	7.0
Overall	364	117.4	108-129	4.4	40.0	15-68	6.4	29.4	7.3-61.5	6.9

2.2.2. Cultivated lentil

All the 258 new accessions of cultivated lentil collected or obtained from other institutes were also planted for multiplication. Seed quantities of 171 accessions (78 from Ethiopia, 56 from Pakistan, 32 from Turkey, 3 from Argentina, 1 from Bangladesh and 1 from Bulgaria) were sufficient to plant them on larger plots (9 m^2). Since no information was available on the characteristics of these 171 accessions, preliminary evaluation was conducted to characterize these populations and assist in the selection of genotypes for further studies and utilization in breeding programs. Old accessions, already maintained in ICARDA's collection, were also planted to compare and assess the diversity of the new germplasm. Six replicates of six checks (Syrian local small, Syrian local large, Precoz, 78S 26013, 76TA 66088 and 78S 26002) were randomly distributed among the plots in order to estimate the magnitude of environmental variation.

The characters evaluated in populations were days to flowering, days to maturity, biological yield/plot, seed yield/plot, and harvest index. In addition, the following characters were evaluated in 10 single plants randomly selected from each plot: plant height, lowest pod height, seed weight/plant, number of pods/plant, number of seeds/plant, number of seeds/pod, 100-seed weight, testa colour, pattern on testa, colour of pattern, and cotyledon colour.

The evaluation data were analyzed separately for the accessions originating from Ethiopia, Pakistan and Turkey. A summary of the statistical analyses is presented in Table 7. The data for two checks Syrian local small (SLS), a landrace, and 76TA 66088, a promising pure line, were included for comparison. The coefficient of variation between plants within plots for the pure line check estimated the environmental variation for each character. The corresponding values for coefficient of variation within the germplasm from each country were generally larger than the value for the pure line. This indicates the presence of some genetic variation within the new populations.

Table 7. Summary of statistics on the new lentil germplasm accessions in comparison with old accessions from the collection.

Country of origin/type of material	Number of		Days to flowering			Plant Height						Lowest Pod Height					
						Overall	Population Means		Single Plants		CV (%)	Overall	Population Means		Single Plants		CV (%)
	Acc.	Plants	Mean	Min.	Max.	Mean	Min.	Max.	Min.	Max.		Mean	Min.	Max.	Min.	Max.	
Ethiopia																	
New accessions	78	780	94.4	85	99	28.2	22.7	32.8	13	40	11.2	12.3	7.8	16.1	5	22	22.4
Pakistan																	
Old accessions	18	180	104.1	94	117	28.5	22.8	31.3	18	46	13.4	14.1	8.8	23.3	5	30	22.8
New accessions	56	560	96.2	90	119	25.7	21.3	33.0	17	50	12.7	9.4	6.4	22.4	3	27	25.6
Turkey																	
Old accessions	15	150	113.7	110	119	34.5	28.4	41.6	16	54	16.1	22.1	17.3	26.2	8	33	22.5
New accessions	32	320	118.4	117	121	33.3	28.2	38.6	17	52	14.2	22.1	12.0	28.0	8	41	25.5
Checks																	
Syrian local small	1	60	104.7	102	106	32.5	31.1	33.5	27	36	8.6	18.1	15.6	20.0	14	24	15.2
76TA 66088	1	60	101.2	100	102	33.4	31.6	34.1	29	39	8.2	16.7	14.7	18.1	13	21	19.3

Table 7 (contd.)

Country of origin/type of material	Seed/Plant						100 Seed Weight						Seed/Pod					
	Overall	Population Means		Single Plants		CV (%)	Overall	Population Means		Single Plants		CV (%)	Overall	Population Means		Single Plants		CV (%)
	Mean	Min.	Max.	Min.	Max.		Mean	Min.	Max.	Min.	Max.		Mean	Min.	Max.	Min.	Max.	
Ethiopia																		
New accessions	71.1	36.4	109.2	9	212	41.7	2.50	1.45	3.08	1.11	3.83	12.9	1.42	1.17	1.61	0.65	1.97	12.1
Pakistan																		
Old accessions	58.1	37.4	100.0	5	177	47.0	2.30	1.66	3.24	1.13	5.11	20.8	1.32	0.93	1.66	0.50	2.00	13.8
New accessions	78.9	44.3	162.7	10	336	45.4	2.20	1.19	3.22	0.90	4.39	15.8	1.48	1.20	1.612	0.49	2.00	11.1
Turkey																		
Old accessions	32.3	15.2	62.4	1	125	66.1	4.04	2.40	6.22	1.67	7.37	19.4	1.07	0.89	1.36	0.29	2.00	23.1
New accessions	30.2	10.2	104.0	1	191	72.7	5.65	2.95	7.32	2.50	8.57	19.5	0.96	0.74	1.46	0.17	2.00	25.2
Checks																		
Syrian local small	47.7	43.2	58.7	19	84	42.7	3.07	2.98	3.18	2.50	3.75	12.2	1.15	1.03	1.36	0.89	1.35	18.8
76TA 66088	65.4	56.4	81.7	19	163	39.8	3.34	3.10	3.51	2.80	3.75	6.8	1.14	1.08	1.18	0.99	1.41	9.5

CV (%) : Mean coefficient of variation for single plants within population.

An appraisal of the variation of the new lentil germplasm revealed that the Ethiopian accessions were less variable than accessions from the other countries for all the traits. They were assigned to the botanical variety Abyssinica (Hochst.) Al. since they had red cotyledon colour and black spotted or dotted brown or grey seed coat. The within population variation for the quantitative characters in the Ethiopian material was similar to the landrace check (SLS). The new Pakistani and Turkish accessions had a larger range of variation for all the characters. In contrast to the new Ethiopian germplasm, both red and yellow cotyledons and different seed coat colours and patterns were observed in this new germplasm. Twelve Pakistani and 4 Turkish accessions had seeds with both red and yellow cotyledon colour.

The new accessions from Pakistan were on the average, earlier and shorter, and had more seeds per plant and more seeds per pod, when compared with old accessions maintained in ICARDA's collection. The new Turkish accessions were later, larger-seeded but similar in lowest pod height, number of seeds per plant and number of seeds per pod to the old Turkish material when the mean values were compared. Considering the range of variation in single plant samples, the new collections were more variable for number of seeds per plant, and number of seeds per pod than the older collections.

Selections from the evaluated single plants were made for utilization by the lentil breeding program. One hundred single plants were selected for the number of seeds per plant from the early Ethiopian and Pakistani accessions. Fifty large-seeded Turkish plants were also selected for utilization.

Characterization during the multiplication of newly collected germplasm samples could hasten the utilization of additional variation of different traits. Characters less affected by the environment are especially useful for the characterization of new accessions. Cotyledon and testa colour, seed coat pattern, 100-seed weight, number of seed per pod and plant height are recommended descriptors for this purpose (IBPGR/ICARDA Lentil Descriptor list).

2.2.3. Wild chickpea

Seed samples of 24 accessions were planted in a plastic house for multiplication. Heterogenous seed samples were separated into morphotypes and planted separately. Unselected bulk samples of 10 accessions (Cicer judaicum, C. pinnatifidum C. bijugum, C. cuneatum, C. echinospermum, and C. reticulatum) which had larger seed samples, were planted in the field as well. All the plants in the plastic house were checked for correct taxonomic identification. Days to flowering, number of leaflets on the first leaf and on the leaf at the first flowering node, flower size, stipule shape, seed size and shape were evaluated and used for the identification of species.

The bulk samples yielded sufficient seeds (200-1200 g) for preservation, further evaluation and distribution. Seed samples provided for the Food Legume Program will be screened for cold tolerance, cyst nematode and Ascochyta resistance and leaf miner tolerance. Genotypes of C. reticulatum can be easily utilized in breeding since this species is compatible with cultivated chickpea. The transfer of useful traits present in the other species would require embryo culture or possibly, cell hybridization techniques.

2.2.4. Wild lentil

All the wild lentil accessions in ICARDA's collection were planted in a plastic house where the temperature was controlled (18-22 ^{o}C) and 16 hours daylength was provided by additional lighting. The plants were checked for correct taxonomic identification and some heterogenous accessions were separated into different species, subspecies and genotypes. Eight characters were evaluated to characterize the different genotypes (Fig. 1).

A total of 47 accessions were identified as Lens orientalis, 27 as Lens nigricans, 7 as Lens nigricans ssp. odemensis, 31 as Lens ervoides, and 2 as Lens (Vicia) montbretii. One of the accessions (ILWL 8) had none-shattering pods, relatively large seeds and was late

Fig. 1. Wild relatives of lentil and chickpea planted for multipliction and characterization in a plastic house.

Table 8. Mean, minimum and maximum values for 6 characters in the wild lentil collection, 1985/86.

Species (Taxa)	Number of acc.	Days to flowering Mean	Days to flowering Min.	Days to flowering Max.	Days to maturity Mean	Days to maturity Min.	Days to maturity Max.	Plant height (cm) Mean	Plant height (cm) Min.	Plant height (cm) Max.
Lens orientalis	47	62.2	45	77	108.5	90	131	23.6	12	34
Lens nigricans	27	75.8	54	83	118.9	105	125	24.7	20	32
Lens nigricans ssp. odemensis	7	63.4	47	75	110.6	96	126	25.0	18	31
Lens ervoides	31	64.5	48	70	108.5	100	115	20.8	11	27
Lens (Vicia) montbretii	2	104.5	104	105	135.5	131	140	45.0	42	48
Lens culinaris (ILWL 8)	1	95	-	-	151	-	-	36.0	-	-

Table 8 (contd.)

Species (Taxa)	Seeds/plant Mean	Seeds/plant Min.	Seeds/plant Max.	100 seed weight (g) Mean	100 seed weight (g) Min.	100 seed weight (g) Max.	Seed yield/plant (g) Mean	Seed yield/plant (g) Min.	Seed yield/plant (g) Max.
Lens orientalis	51.96	5	217	0.95	0.61	1.51	0.49	0.03	1.89
Lens nigricans	151.37	44	342	0.81	0.58	1.15	1.16	0.35	2.30
Lens nigricans ssp. odemensis	58.43	17	166	1.06	0.29	1.78	0.90	0.05	1.60
Lens ervoides	85.87	8	325	0.42	0.17	0.69	0.37	0.01	1.35
Lens (Vicia) montbretii	72.50	43	102	4.55	4.30	4.80	3.38	1.87	4.90
Lens culinaris (ILWL 8)	200	-	-	3.30	-	-	6.60	-	-

in flowering and maturity and was consequently classified as Lens culinaris. Germplasm accessions of the different wild species showed considerable variation for the characters evaluated (Table 8). Lens orientalis accessions were on the average the earliest and L. nigricans the latest flowering; L. nigricans var. odemensis was more similar to L. orientalis in this character. Genotypes of L. nigricans ssp. odemensis had elongated narrow leaflets on the first leaf, similar to L. orientalis. Their growth habit was also closer to L. orientalis than to L. nigricans. Stipule shape and orientation were variable. Some of the odemensis-type accessions had relatively large seeds and yellow cotyledon colour. Plant height and 100-seed weight were the smallest in the L. ervoides accessions. On the basis of earliness, large seed size and number of seeds/plant, 9 L. orientalis, 6 L. nigricans var. odemensis, 5 L. nigricans and 4 L. ervoides genotypes were selected for further studies and interspecific crossing.

3. Documentation and Data Management

A comprehensive data base utilizing electronic data processing facilities is essential for the management of data on existing collections and for the retrieval of information important in carrying out conservation strategies and expediting the flow of germplasm to researchers. Documented information on the origin and genetic characteristics of the accessions in a collection, are required to plan collecting missions, rationalize the size of collections in the genebank and promote extensive utilization of the variability that exists in the germplasm collections.

The first barley catalog was published in 1986. The entire text (413 pages) contains available passport information and extensive evaluation data for 8000 accessions together with summary of statistics for 21 traits.

Additional data were added to the genetic resources data base which include evaluation data for:

(a) 15 descriptors for 4000 entries of durum wheat,

(b) 26 descriptors per accession for 858 single head accessions of Triticum turgidum var. dicoccoides,

(c) 25 traits per population for 17 population samples of dicoccoides,

(d) 25 characters for each of 1000 winter-planted chickpeas entries,

(e) 6 traits for each of 364 new chickpea accessions,

(f) 16 descriptors for 204 new lentil accessions,

(g) 8 characters for 111 wild lentil genotypes.

Passport information for 1705 faba bean populations, and collection data for 2101 forage legume samples were also documented (Tables 9, 10).

A faba bean catalog containing passport information for 3,305 populations is in its final stages of preparation.

4. Rejuvenation, Conservation, and Distribution of Germplasm

In 1985/86, considerable effort was made to continue the rejuvenation and further multiplication of the Center's germplasm to obtain sufficient quantities of high-quality seeds for medium-term conservation in controlled conditions ($4^{o}C$ + $2^{o}C$ and 15% relative humidity). All the new material, collected, or obtained from other institutes in 1984/85 were also planted for multiplication in the quarantine area. Some of these accessions yielded sufficient seeds for conservation and evaluation but those with small initial sample sizes require further multiplication. This material is being handled with special care to reduce the number of cycles of multiplications, in order to minimize changes in the genetic composition of these populations.

Two hundred durum wheat, 531 bread wheat, and 4498 barley populations and, single line entries were multiplied from the new material. Seeds of new accessions of chickpea (525) and lentil (258)

Table 9. Documentation status of the germplasm passport and collection data at ICARDA.

Crop	Collections		Documented in 1986		Documented to date	
	Number of accessions	Descriptors to be documented	Number of accessions	Descriptors/ crop	Number of accessions	Descriptors/ crop
Barley	15195	15	4138	4	4138	4
Barley					8000	15
Durum wheat	19230	15			10207	3
Bread wheat	3219	15			637	10
Chickpea	6185	15			5726	15
Lentil	6412	15			5525	15
Faba bean	3371	15	1705	15	3305	15
Medics	3911	15			3536	15
Pisum spp.	3299	15			3230	7
Vicia spp.	3544	15			2869	5
Collection data	8748	24	253	24	253	24
		24	1394	4	1394	4
		24	454	15	454	15
		24			6647	15-25

Table 10. Documentation status of the germplasm evaluation information at ICARDA.

Crop	Collections		Documented in 1986		Documented to date	
	Number of accessions	Descriptors to be documented	Number of accessions	Descriptors/ crop	Number of accessions	Descriptors/ crop
Barley	15195	24			14158	24
H. spontaneum	1644	25	1386	4	1386	4
Durum wheat	19230	28	4030	28	4030	28
Durum wheat		28			5000	15
Bread wheat	3219	28	1540	28	1540	28
Wild wheat relatives	1241	25	877	22	877	22
Chickpea (W)	6185	29	1000	25	4344	25-29
Chickpea(N)			364	6	364	6
Chickpea(S)		18			3341	18
Lentil	6412	26			5032	12-26
Lentil (N)			204	16	204	16
Wild lentil	190	26	111	8	111	8
Medics	3911	19			627	19
Medics					562	17

(W) Winter planted (N) New accessions (S) Spring planted and forage legumes (111) were also increased in the isolation area. The new material was carefully inspected by the Seed Health Laboratory to avoid the accidental introduction of new pests and diseases, and to obtain healthy seeds for further multiplication or storage. For the cereal collections, 3000 durum wheat, 500 bread wheat, and 100 barley accessions were rejuvenated and processed for storage. For the food legume collections, 3020 chickpea and 1911 lentil accessions were planted for rejuvenation and multiplication of seed stocks. Seed samples of 2770 chickpea accessions were also processed for storage. A total of 1300 lentil accessions which yielded sufficient amount of seeds for storage will be processed for conservation in 1987.

Bulk samples of 10 wild chickpea accessions from 6 different annual species were also processed for storage. The wild lentil accessions and some selected Cicer genotypes need further multiplication to obtain sufficient amount of seeds for preservation and evaluation. Seed samples of all the faba bean accessions (3305) have been transferred to the cold store for temporary storage to prevent further deterioration of this material. Rejuvenation of seed stock starts in 1986/87 growing season, and will continue in subsequent years as isolation facilities become available. The present status of germplasm conservation is summarized in Table 2.

In 1985/86, the entire collection of Vicia (2869) and Lathyrus species (536) was planted for multiplication, and for species identification. A total number of 2331 Vicia and 197 Lathyrus accessions was classified into subspecific taxa with the assistance of scientists from the Southampton University, England. Reference herbarium specimens were also prepared from the classified material.

The GRP plays an important role in distributing germplasm to meet requests worldwide. The movement of seeds is monitored by the Seed Health Laboratory to prevent accidental spread of pests and diseases with the seed samples dispatched. In 1985/86, 14,845 germplasm samples were distributed to 18 countries from the genetic resources collections (Table 11).

Table 11. Number of germplasm samples distributed to different countries, 1985/86.

Country	Cereals		Food legumes			Forages		
	Barley	Durum wheat	Chickpea	Lentil	Faba bean	Medicago spp.	Vicia spp.	Other spp.
Argentina							21	83
Australia								13
Bangladesh			390	500				
Burundi								50
Egypt							33	
England			47	50			119	
France			50			30		18
FRG			6					
Hungary								33
India	35			338	10	60		12
Iran						112	8	
Italy		6045				6		1
Morocco							25	
Pakistan			113			1	65	6
Saudi Arabia			5					
Syria						150	40	40
Tunisia		5567						
USA	660		6					97
Total	695	11612	617	888	10	359	311	353

NB. Figures do not include breeding materials sent for international nurseries.

5. Genetic Resources-Related Research

Genetic resource research was carried out on a modest scale by the GRP. The main objective of this work was to generate pertinent information to complement evaluation and passport data and thereby increase the knowledge of the genetic diversity of the materials present in the germplasm collections. An understanding of the genetic diversity of the germplasm is an essential prerequisite for its effective preservation and utilization in breeding programs.

Esterase banding patterns were studied by electrophoresis in lentil landraces and wild lentil and chickpea accessions using 7% polyacrylamide gel slabs and following the procedures reported in the ICARDA Annual Report (1985). Field studies were also conducted to evaluate the adaptability and performance of durum wheat landraces from Greece.

5.1. Electrophoresis Studies

5.1.1. Comparative study of some old and new lentil accessions from Pakistan and Turkey

Population samples collected in Pakistan and Turkey, in 1985, were planted for multiplication together with 18 Pakistani and 15 Turkish samples previously accessioned to the collection. Ten accessions from each group (Old Pakistani, New Pakistani, Old Turkish, and New Turkish) were selected for electrophoresis to compare their esterase banding patterns. Seed samples of 8 single plants from each population were tested. Band frequency data were calculated and stepwise discriminant analyses were applied to study the variation between single plant samples and groups of accessions.

All the esterase bands detected showed polymorphism in each group of accessions. The total number of bands was the largest in the new Pakistani germplasm (Table 12). Two additional bands (Rf 0.06 and 0.46), which were not present in the old accessions, were detected in that material. An equal number of bands (16) were found in the old and new accessions from Turkey; 15 bands were present in both groups, one band (Rf 0.40) was detected only in the old and another (Rf 0.38), only in the new material. One new Turkish accession (ILL 6163) was monomorphic for esterase isozymes (all the plants tested had the same banding pattern) but all the others including the Pakistani accessions, showed variation for 1 to 12 esterase bands. No correlation was found between the polymorphism in esterases and in seed characters. This suggests that the genetic variation in these populations is complex, and they are not simply the mixtures of a few distinct genotypes.

Table 12. Polymorphism of esterase bands in lentil populations originated in Pakistan and Turkey.

Group of Accessions	Total Number of bands	Number of bands/acc.			Polymorphic bands/acc.			Mean percentage of polymorphic bands/acc.
		Mean	Min.	Max.	Mean	Min.	Max.	
Pakistan								
Old	19	9.0	6	11	4.2	1	10	46.7
New	21	8.8	5	13	6.0	1	12	68.2
Turkey								
Old	16	7.9	6	10	2.2	1	4	27.8
New	16	8.2	7	10	2.4	0	5	29.3

When the frequencies of esterase bands were analysed by stepwise discriminant analysis, the new and old Pakistani accessions separated from each other almost completely. On the other hand, the new and old accessions from Turkey did not form distinct groups (Figs. 2,3). The between accessions variation was generally greater than the variation among single plants from the same accessions. All the Pakistani, and

Fig 2. Scatter diagram of two canonical variables for old and new accessions from Pakistan based on observed esterase banding patterns.

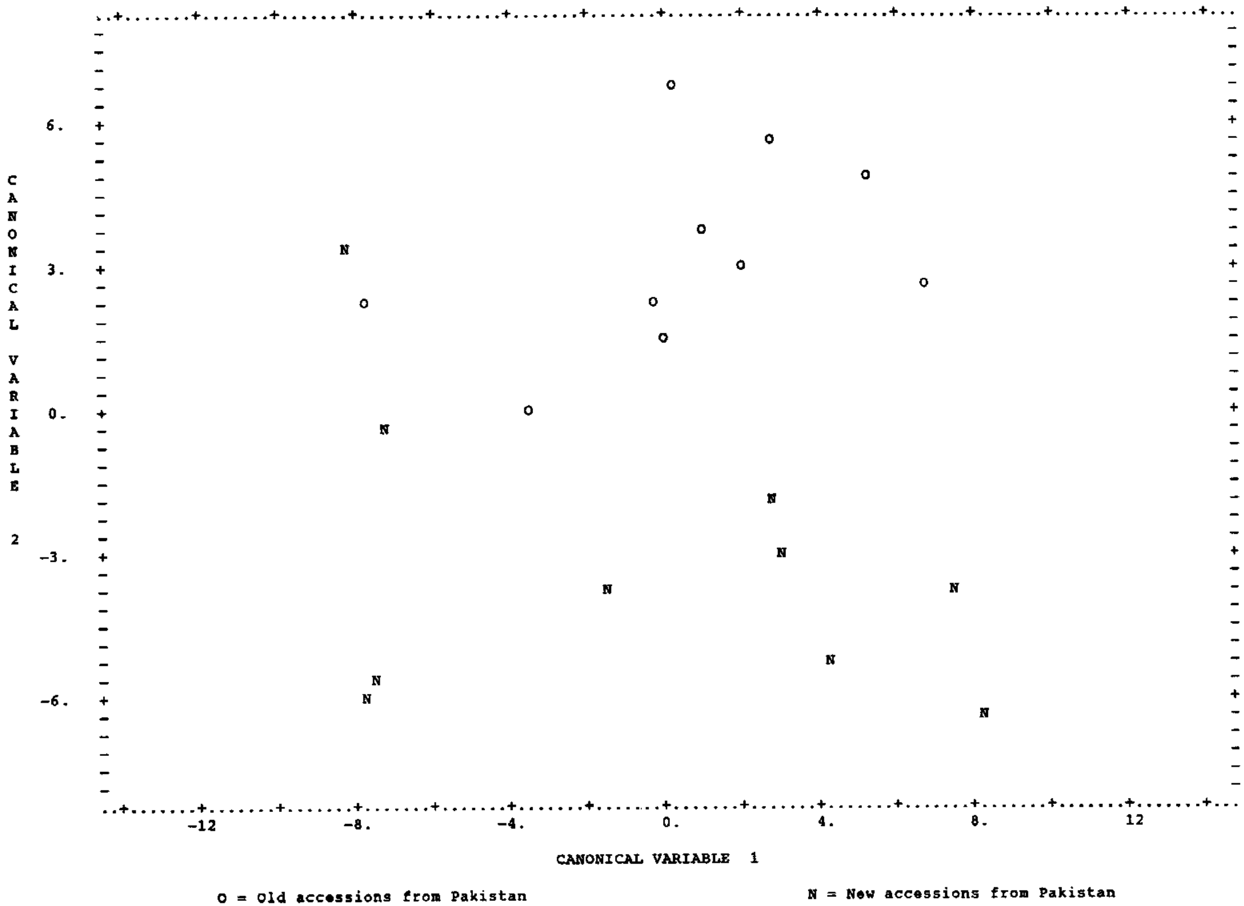
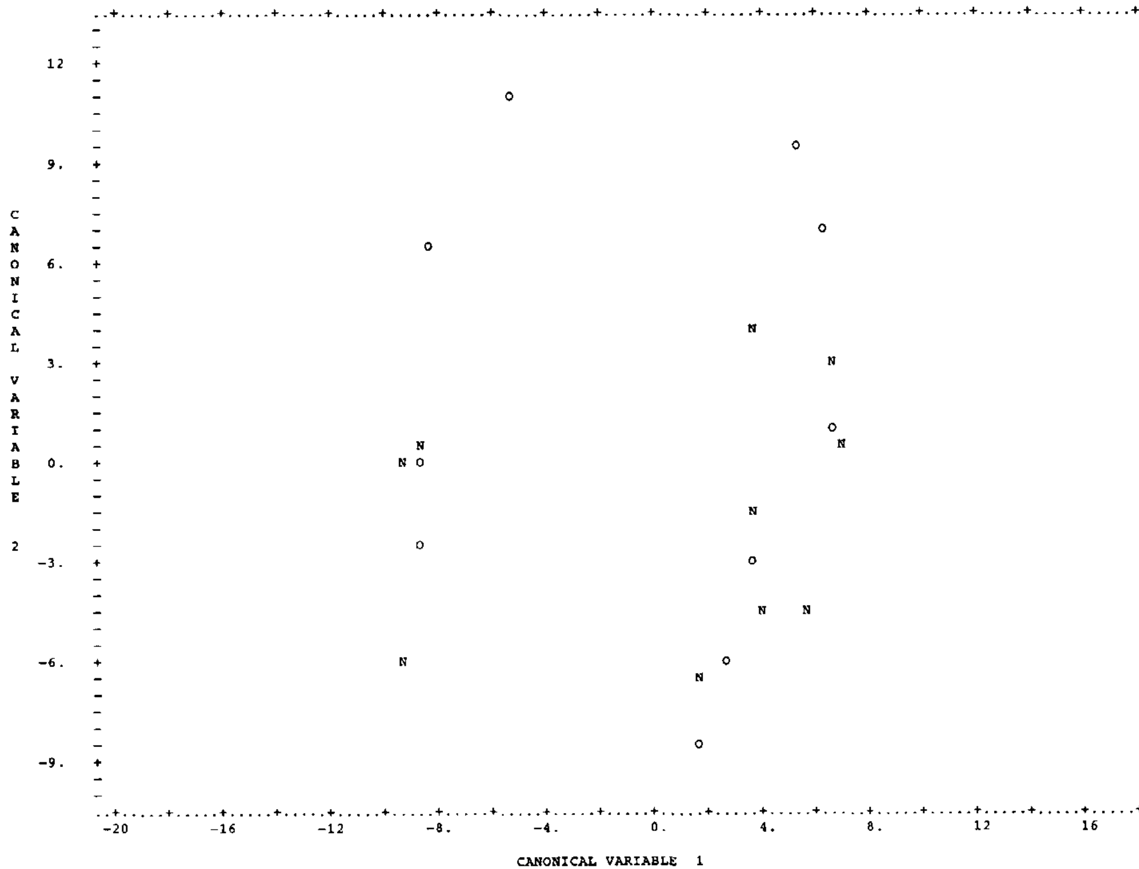


Fig 3. Scatter diagram of two canonical variables for old and new accessions from Turkey based on observed esterase banding patterns.



O = Old accessions from Turkey N = New accessions from Turkey

17 of the 20 Turkish accessions substantially differed from each other in overall esterase band frequencies.

The results would indicate that the germplasm recently collected, differs from the old germplasm previously accessioned in the ICARDA collection. The presence of additional esterase bands in the newly collected accessions also indicates that this material has additional genetic variation which is not present in the old collections.

5.1.2. Variation of esterase isozymes in wild lentil and chickpea germplasm

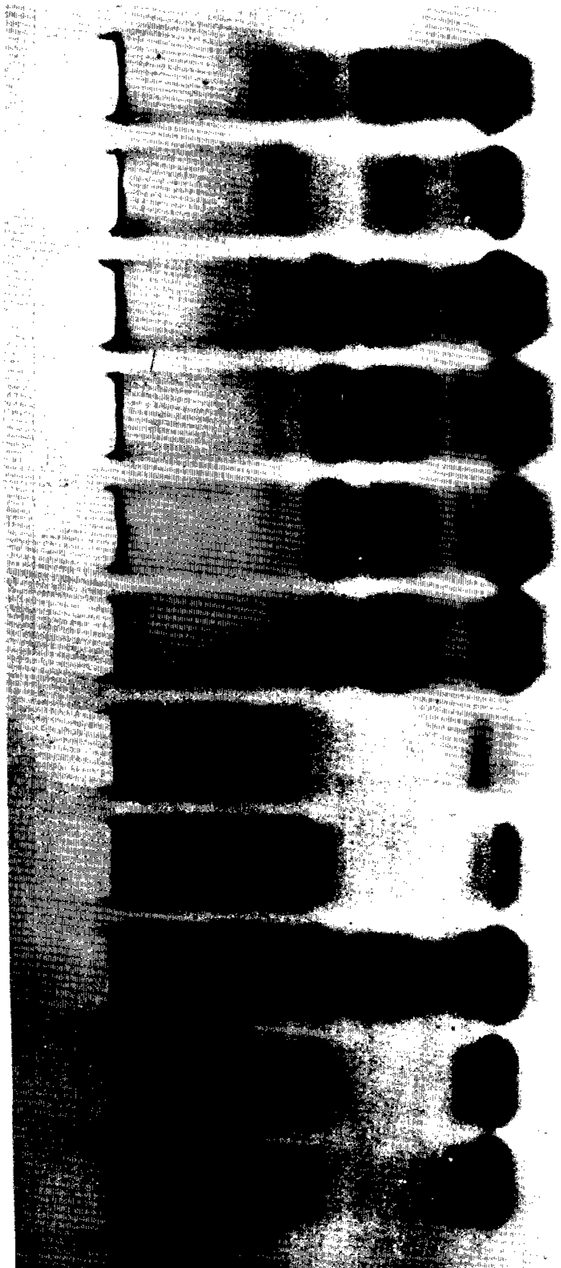
Electrophoresis on seed samples of single plants of 25 Lens orientalis, 14 Lens nigricans and 4 Lens ervoides revealed 13 clearly distinguishable esterase bands. Twelve of them were present in Lens orientalis, eleven in Lens nigricans and eight in Lens ervoides.

Some of the accessions were homogenous, but plants with different esterase banding patterns were identified in accessions ILWL 36, 48, 70, 73 and 104. Stepwise discriminant analysis on band frequency data showed that not all the genotypes of a certain species can be separated from the genotypes of another species.

This result suggests that variation in esterase isozymes overlap among these closely related species and therefore this enzyme system would appear to have a limited use to discriminate between them. It can however assist in the separation and characterization of genotypes, the detection of intergradation between species and the selection of genotypes for interspecific crosses.

Esterase banding patterns of seeds of 28 single plant samples of 8 annual Cicer species were also studied by electrophoresis. Eight different banding patterns were detected in C. pinnatifidum (Fig. 4) and three patterns in C. judaicum (Fig. 5). Cicer bijugum and C. reticulatum samples showed no intraspecific variation.

Accessions ILWC 9 and ILWC 22 of C. pinnatifidum were considered duplicates on the basis of collector's numbers. The present study revealed that they are not completely identical, and ILWC 22 contain



ILWC 9

ILWC 30-1

ILWC 30-3

ILWC 29-2

ILWC 22-2

ILWC 8-2

ILWC 29-1

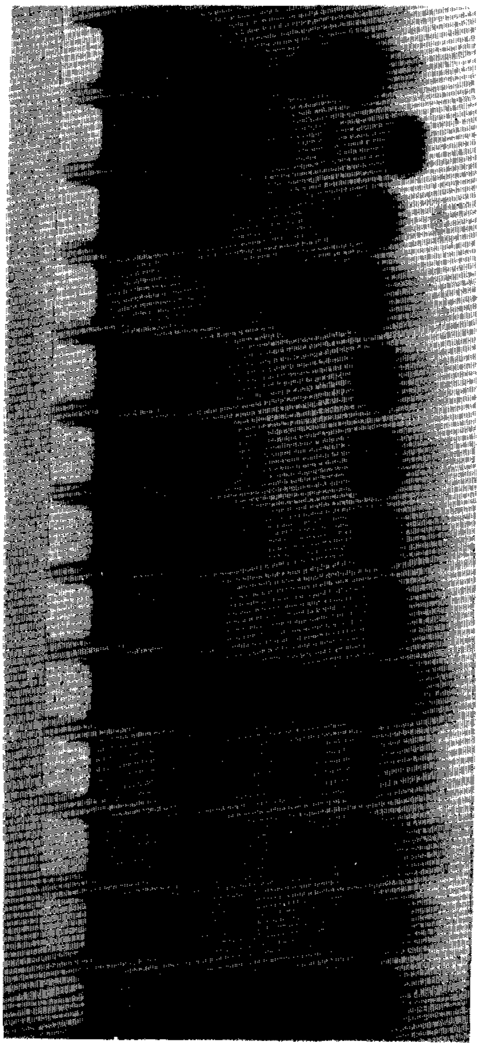
ILWC 7-5

ILWC 22-1

ILWC 19-1

ILWC 4-1

Fig. 4. Esterase banding patterns of C. pinnatifidum genotypes



Species	ILWC
C. cuneatum	37
C. echinospermum	35
C. reticulatum	21-1
C. chorassanicum	15
C. bijugum	32
C. bijugum	8-3
C. bijugum	7-1
C. yamashitae	3
C. judaicum	31-4
C. judaicum	30-2
C. judaicum	19-2
C. judaicum	4-2
C. pinnatifidum	9

Fig. 5 . Esterase banding patterns of wild chickpea genotypes

an additional genotype differing both in esterase pattern and seed coat colour. The C. pinnatifidum genotype ILWC 4-1 which was separated from a C. judaicum accession (ILWC 4) had a unique banding pattern not present in any of the other C. pinnatifidum accessions. This accession was collected in Lebanon where the distribution areas of the two species overlap, and therefore the sample originally collected might have been a mixture of the two species. The same banding pattern was found in another C. pinnatifidum genotype (ILWC 19-1) which was separated from a C. cuneatum accession that was collected in Ethiopia. The presence of this genotype in the C. cuneatum accession is most probably the result of mechanical mixing.

The esterase banding patterns identified for each Cicer genotypes were documented and added to the morphological descriptors of the wild chickpea accessions. Considering the small number of accessions of Cicer species in the collection, and the narrow variation detected by electrophoresis, there is a need to broaden the genetic base by the addition of collections from the original habitats of the different species.

The results of this study clearly demonstrate that electrophoresis is a valuable supplement to the morphological classification of wild germplasm. Studies on different enzyme systems and proteins would increase the effectiveness of this technique, and would provide additional data to characterize the genetic variation which exists both within and among populations.

5.2. Evaluation of durum wheat landraces

During the second year (1985/86) of a collaborative project between Professor P.Limberg (University of Berlin, W.Germany) and Mr. N.Kyzeridis (Cereal Institute, Saloniki, Greece), 15 landraces and 10 varieties were planted in a simple lattice design experiment to evaluate and compare the yield performance of the landraces. Tel Hadya and two other locations in Greece (Serres and Salonoki) were chosen to conduct this evaluation study of selected landraces from Greece.

The 25 entries, which included Sham 1 and Hourani, were planted in plots of 6 rows (6.4 m long and 25 cm apart) at a seeding rate of 22.8 kg/ha. Data were recorded for germination density, growth habit, vigour, number of days to heading, grain filling and maturity, and number of tillers and spikes per square meter, number of days to awn appearance, plant height, 1000-kernel weight and both biological and grain yield. The harvest index was also calculated.

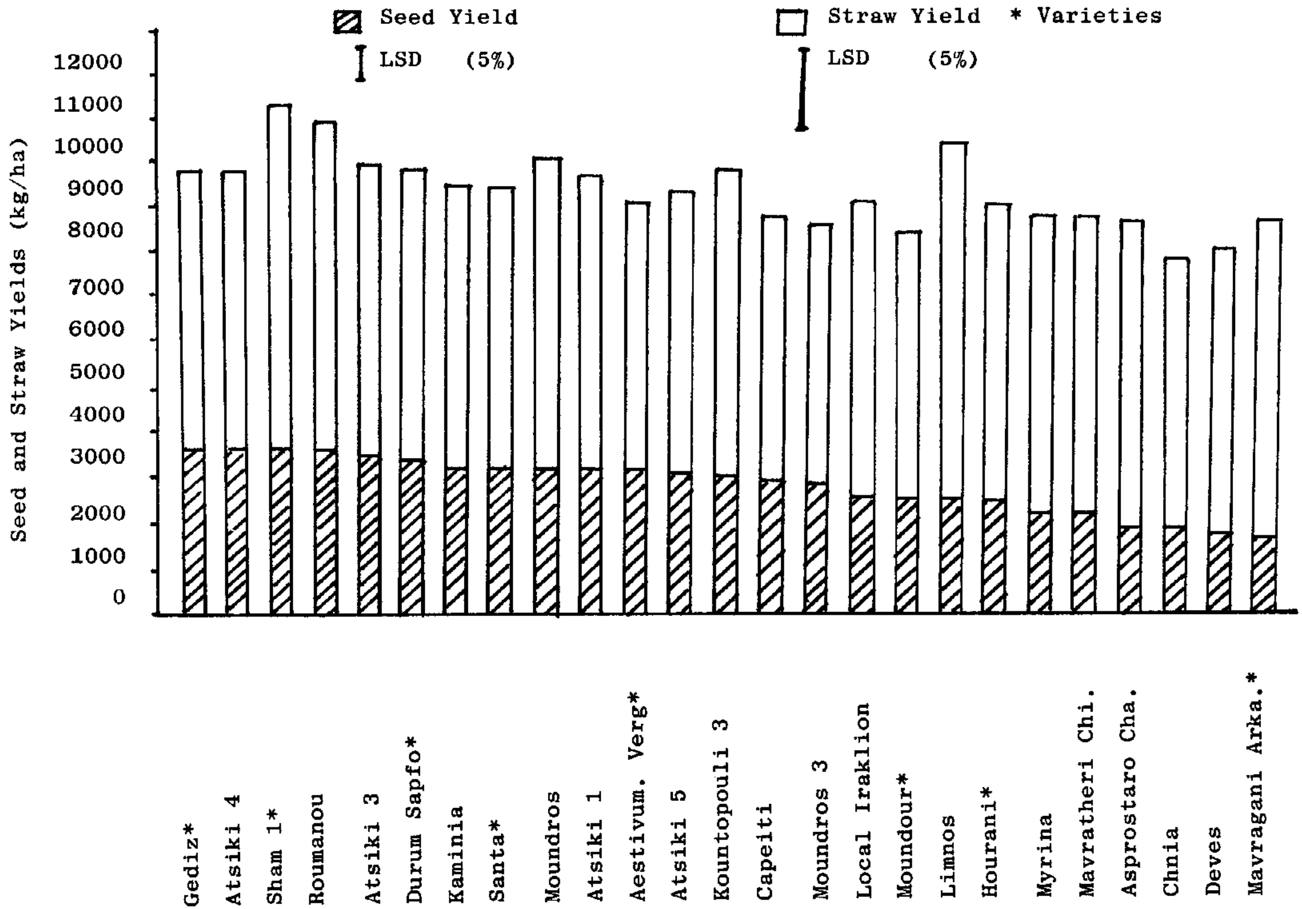
The mean values of 8 quantitative traits and the harvest index are given in Table 13. The average grain yield and the total biological yield (kg/ha) are shown in Fig. 6. The Turkish variety Gediz and one landrace (Atsiki-4) outyielded Sham 1 (Table 13) but the grain yield of these two entries were not significantly greater ($P > 0.05$) than that of Sham 1. Similarly, the yields of 3 varieties (Durum Sapfo, Santa and Aestivum Vergina) and 7 landraces (Roumanou, Atsiki-3, Kaminia, Moundros, Atsiki-1, Atsiki-5 and Kontopouli) which were below that of Sham 1 were not significantly different ($P > 0.05$) from the yield of this cultivar check. There was no relationship between the straw yield and the grain yield (Fig. 6). For example, the straw yield of both Sham 1 and the landrace Limos were relatively high but the grain yield of this landrace was low (2588 kg/ha c.f., 3751.5 kg/ha for Sham 1). Generally, entries with shorter plant height which were early with shorter grain filling period, were the best yielding ones.

The results of this trial would suggest that some landraces from Greece are adapted to the growing conditions in Syria. The collection, evaluation and exploitation of landraces from countries in the ICARDA region could therefore undoubtedly complement hybridization work in a durum wheat improvement program, to achieve a greater impact.

Table 13. Mean values of 9 traits for 9 varieties and 16 landraces grown at ICARDA Aleppo, 1985/1986.

Variety	Number of tillers/m^2	Number of spikes/m^2	Biological yield kg/ha	Grain yield kg/ha	Harvest index	1000 kernel weight (gr)	number of days to heading	number of days to filling	Plant height (cm)
Sham 1*	610.25	292.00	11300.00	3751.50	33.47	38.18	136.00	176.75	93.75
Moundouc	591.25	310.25	8437.50	2611.50	30.96	37.37	145.75	183.00	114.25
Capeiti*	525.50	328.75	8825.00	3011.50	33.87	41.53	135.50	174.00	117.50
Asprostaro chanion	685.75	363.00	8637.50	2008.50	23.30	37.01	140.00	180.75	115.00
Atsiki-4	711.75	357.00	9812.50	3754.25	38.21	40.41	133.50	171.75	97.50
Myrina*	646.75	309.00	8825.00	2231.50	25.28	35.44	135.00	171.00	121.25
Mavragani Arkadias	933.25	327.25	8750.00	1768.75	20.04	36.82	145.25	182.75	126.00
Kontopouli-3	699.00	309.00	9887.50	3071.50	30.69	41.67	134.75	174.00	115.50
Durum sapfo*	691.00	332.25	9862.50	3385.50	34.32	38.71	135.00	179.00	85.50
Chania	594.25	310.75	7862.50	1940.00	25.07	40.79	138.50	175.50	121.25
Moundros-3	535.75	257.00	8625.00	2917.00	33.75	43.54	134.75	174.00	116.00
Local Iraklion	752.25	348.50	9137.50	2677.00	29.20	37.47	136.00	177.00	123.75
Atsiki-3	558.75	283.75	9987.50	3511.50	35.16	43.50	134.25	175.00	113.50
Kaminia	597.50	292.25	9475.00	3265.50	34.25	43.38	134.75	177.00	116.00
Mavratheri chiow	648.00	266.25	8850.00	2219.75	25.13	38.76	135.75	180.00	117.00
Santa*	714.00	262.00	9412.50	3262.75	34.54	43.23	138.50	183.00	82.25
Romanou	714.25	317.75	10925.00	3697.25	33.92	42.70	134.75	174.00	114.75
Atsiki-5	563.00	290.00	9362.50	3194.00	34.13	43.74	134.75	174.00	116.75
Aestivum vergina*	767.50	285.75	9137.50	3237.25	35.43	36.38	135.00	172.50	105.00
Moundros	648.50	304.75	10112.50	3257.00	32.13	42.24	134.75	175.50	117.25
Deves*	699.75	323.75	8100.00	1886.50	22.67	39.13	137.75	176.00	124.50
Gediz*	611.00	273.25	9862.50	3768.75	37.02	35.66	136.00	177.25	95.00
Limnos	689.75	289.00	10450.00	2588.50	24.87	37.54	140.50	176.25	131.25
Atsiki-1	755.00	270.25	9750.00	3256.75	33.45	41.00	134.25	174.00	111.50
Hourani*	665.75	303.25	9087.50	2546.00	28.00	37.83	137.25	177.25	121.25
LSD P< 0.05	159.61	70.00	1788.75	714.76	4.18	3.84	1.34	3.38	7.98
Overall mean	664.38	304.27	9379.00	2912.80	30.75	39.76	136.73	176.45	112.53

*Varieties.


Seed Yield
LSD (5%)
Straw Yield
* Varieties
LSD (5%)
Seed and Straw Yields (kg/ha)
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Gediz*
Atsiki 4
Sham 1*
Roumanou
Atsiki 3
Durum Sapfo*
Kaminia
Santa*
Moundros
Atsiki 1
Aestivum. Verg*
Atsiki 5
Kountopouli 3
Capeiti
Moundros 3
Local Iraklion
Moundour*
Limnos
Hourani*
Myrina
Mavratheri Chi.
Asprostaro Cha.
Chnia
Deves
Mavragani Arka.*

6. Seed Health Laboratory

6.1. Seed health tests

As in previous years, the Seed Health Laboratory (SHL) assisted the Crop Improvement Programs and the Genetic Resources Program in their seed exchange activities. During the period October 1985, to September 1986, a total of 446 seed consignments were dispatched to 68 countries. The quantities varied from a few grams of germplasm to several tons of basic seed of released varieties. All the seeds were inspected visually, in order to avoid contamination with soil, weed seeds and other impurities. In addition, health tests on random samples of seeds were carried out for different pathogens. The total number of tests conducted exceeded that of the previous year by almost three fold (Table 14).

Table 14. Seed health tests conducted on seeds dispatched from ICARDA, 1985/86.

Crop	Centrifuge wash test	Freezing blotter test	Agar media test	Ditylenchus
Durum wheat	124	-	-	-
Bread wheat	136	-	-	-
Barley	-	306	82	-
Lentil	-	255	744	-
Faba bean	-	-	1244	327
Chickpea	-	119	261	-
Total	260	680	2331	327

Care was taken to ensure that all material was free from quarantine pathogens, and that the Phytosanitary Certificates complied with the regulations of the importing countries.

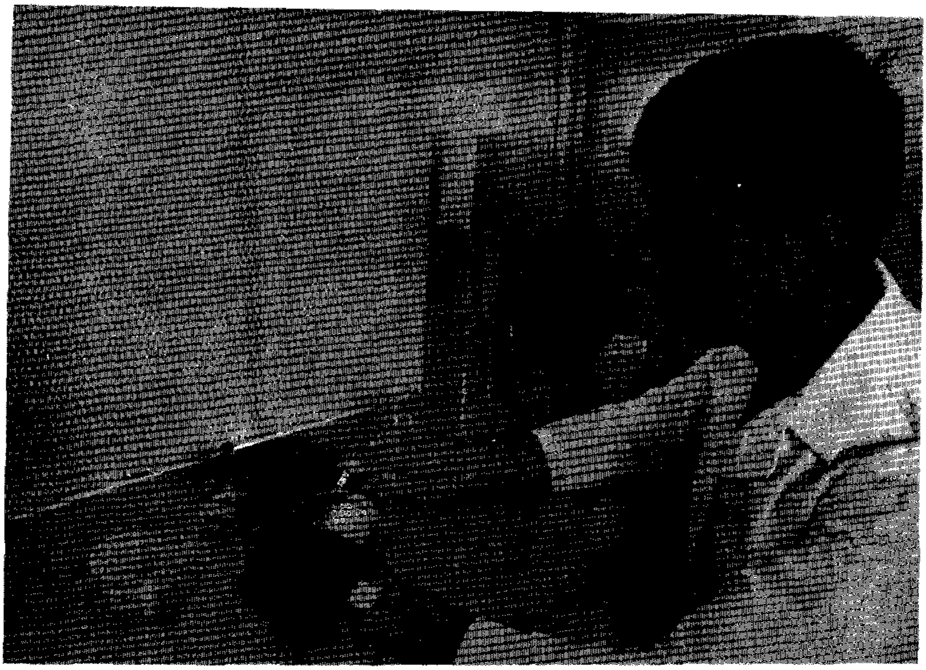


Fig. 7. Laboratory seed health testing of faba beans: surface-sterilized seeds are planted on agar media.

Table 15: Seed health tests conducted on seed received at ICARDA 1985/86.

	Number of samples			
Crop	**tested**	**"clean"**	**infected**	**Pathogens observed**
Durum wheat	201	17	140	Tilletia caries, T.foetida
			55	Tilletia indica
			3	Urocystis tritici
Bread wheat	142	69	46	Tilletia caries, T.foetida
			16	Tilletia indica
			14	Urocystis tritici
Barley	75	46	20	Helminthosporium sp.
			10	Fusarium sp.
Lentil	26	22	4	Ascochyta lentis
Faba bean	112	95	7	Ascochyta fabae
			10	Fusarium sp.
Chickpea	108	106	2	Fusarium sp.
Forages	153	134	19	Fusarium sp.
Total	817	489	346	

During the same period a total of 96 shipments from 31 countries were received by the Seed Health Laboratory. Most of the consignments were not treated with fungicides, and several had live insects. Therefore, as a rule all incoming material is now subjected to cold temperature treatment (-18 ^{o}C for 4 days), or to fumigation, before the consignment is opened. After completion of health tests (Fig. 7) and seed dressing, all materials with satisfactory health status were planted in the isolation area. Table 15 shows the number of tests carried out and some of the pathogens identified in the seed shipments received by the SHL.

6.2. Field inspection

During frequent field inspections (Fig. 8) no exotic diseases were detected. However, a high incidence of barley stripe disease in barley germplasm from Morocco (15% of accessions diseased) and loose smut in Tunisian breadwheat (63% of entries diseased), was observed in the isolation area. These observations provide ample justification to continue the practice of planting all foreign incoming material in the isolation area, in order to protect ICARDA germplasm from infection and to prevent the introduction of exotic pathogens or new races of endemic pathogens in Syria.

6.3. Effects of seed treatment fungicides on barley

In addition to routine testing of incoming and outgoing material, an experiment on seed treatment was conducted to monitor the effects of overdosage of seed treatment fungicides on germination and seedling growth of five barley varieties. Overdosage is a problem particularly when small quantities of seeds are being treated. The fungicides used were Ferrax LS (2.5% flutriafol + 2.5% thiabendazole, ICI), Vitaflo 280 (15% carboxin + 13% thiram, Uniroyal), Baytan WS (7.5% triadimenol + 3% imazalil, Bayer) and Baytan Universal WS (22%

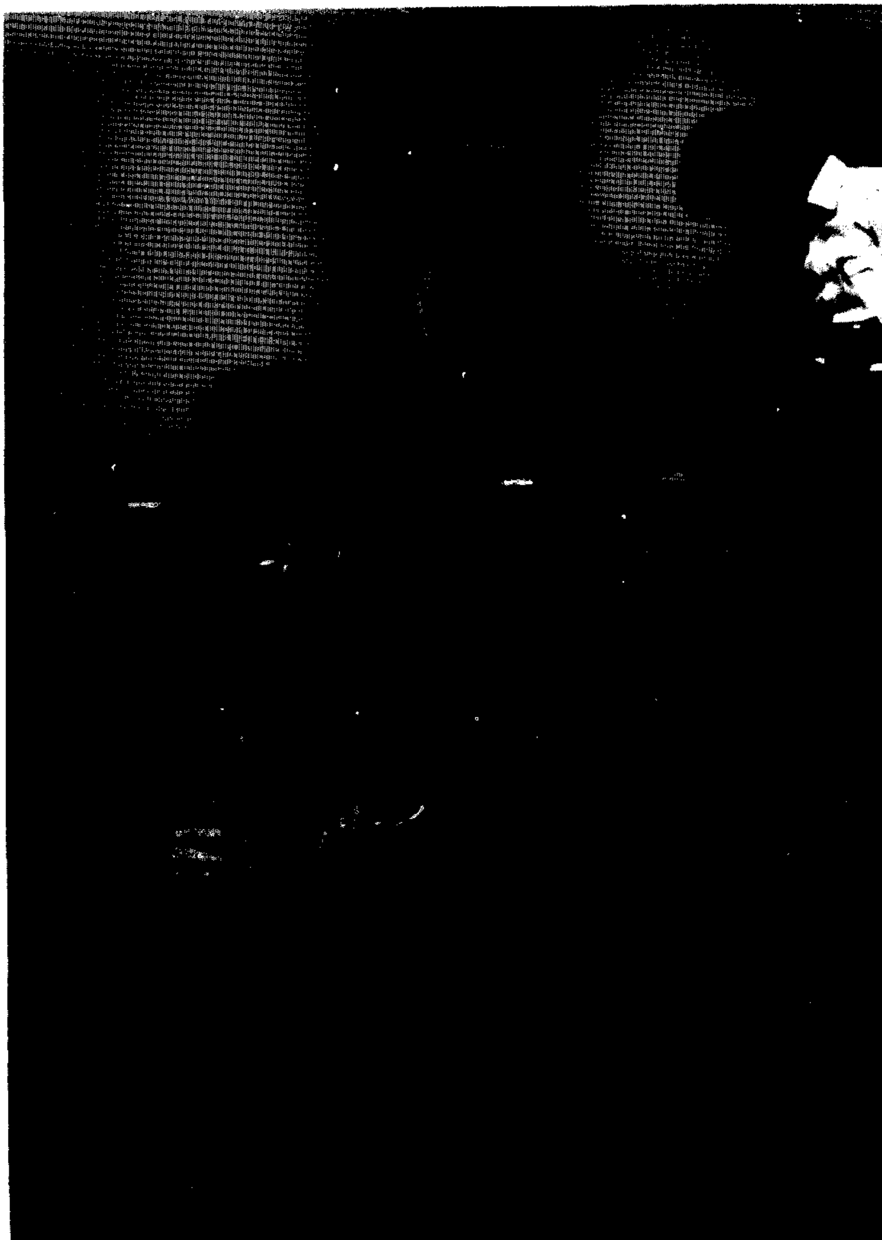


Fig. 8. Field inspection of newly introduced wheat in the isolation area.

triadimenol + 3% fuberidazole + 3.3% imazalil, Bayer), Baytan 170 FS (15% triadimenol + 2% fuberidazole, Bayer). The two formulations with imazalil were included because of their reportedly excellent effectivity against barley stripe disease (*Pyrenophora graminea*). The fungicides were applied at a standard rate of 2.5g or ml/kg and at 10 g or ml/kg, to 100 g of barley seeds.

The results of a laboratory test on the effect of different chemicals on germination and seedling size of barley are given in Tables 16 and 17.

Table 16. Effect of seed treatment on germination (percentage) of barley.

Chemical	Dosage (g/kg or ml/kg)	Variety				
		C 63	ER/ Apam	Beecher	Arabi Abiad	Tadmor
Ferrax	2.5	90	85	88	86	91
Ferrax	10.0	85	79	85	82	79
Vitaflo	2.5	92	81	85	77	75
Vitaflo	10.0	89	86	90	73	82
Baytan WS dust	2.5	89	80	84	81	83
Baytan WS dust	10.0	65	61	58	56	49
Baytan Univ.WS slurry	2.5	85	80	75	65	81
Baytan Univ.WS slurry	10.0	42	62	42	38	10
Baytan FS liquid	2.5	86	78	78	80	85
Baytan FS liquid	10.0	85	79	75	68	82
Check (untreated)	-	97	91	95	90	93

Overall LSD (1%)=7.92
CV = 5.7%

The varieties tested showed marked differences in their germination to the treatments. Arabi Abiad and Tadmor were the most susceptible ones. Ferrax at 2.5 ml/kg did not affect germination significantly.

The other chemicals reduced the germination percentage. The difference between normal dosage and overdosage was greatest in the Baytan WS and Baytan Universal WS applications, both of which contain Imazalil.

Table 17. Effect of seed treatment on seedling growth (cm) of barley

Chemical	Dosage (g/kg or ml/kg)	Variety				
		C 63	ER/ Apam	Beecher	Arabi Abiad	Tadmor
Ferrax	2.5	8.5	8.3	11.0	11.3	8.0
Ferrax	10.0	7.3	5.8	8.5	9.0	5.5
Vitaflo	2.5	11.3	12.3	14.3	15.8	11.8
Vitaflo	10.0	11.8	12.5	13.8	14.8	11.3
Baytan WS dust	2.5	5.0	8.0	5.8	7.3	6.5
Baytan WS dust	10.0	1.4	3.3	2.5	1.9	2.0
Baytan Univ.WS slurry	2.5	2.3	5.3	4.8	2.8	3.5
Baytan Univ.WS slurry	10.0	0.6	3.5	2.0	0.8	0.5
Baytan FS liquid	2.5	5.3	6.8	6.8	7.5	8.8
Baytan FS liquid	10.0	5.0	6.0	5.0	4.3	6.5
Check(untreated)	-	10.0	12.5	12.5	15.5	10.5

Overall LSD (1%) = 1.22
CV = 9.7%

The growth (height) of the seedlings was also affected by the treatments. Only Vitaflo-treated seeds produced seedlings with growth comparable to the check or even significantly better than the cneck as in the case of C63 and Beecher.

These and other new chemicals will be tested in a yield trial at two locations in the 1986/87 season.

7. Virology

Research activities in virology during 1986 were conducted in close cooperation with the Institute of Plant Protection (IPO) at Wageningen, The Netherlands. In addition, part of the work which is being supported by the Lebanese National Council for Scientific Research was done at the Faculty of Agriculture, American University of Beirut. Research on virus diseases of cereal and food legume crops in 1985/86 included (i) surveys for viruses conducted in six countries in the region (ii) evaluation of cereals germplasm for barley yellow dwarf virus resistance and faba bean germplasm for bean leaf roll virus and bean yellow mosaic virus resistance (iii) testing faba bean seeds to be sent to international nurseries for seed-borne virus (iv) antisera production for three legume viruses (v) identifying wild legume species which could be virus reservoirs for broad bean stain virus.

7.1. Virus surveys

7.1.1. Faba bean

A total of 589 faba bean samples with virus-like symptoms were collected from different regions of Egypt, Lebanon, Morocco, Sudan, Syria and Tunisia. Among the sap-transmissible viruses, bean yellow mosaic virus (BYMV) was the most prevalent in all the countries surveyed except Tunisia where broad bean mottle virus (BBMV) was the dominant virus. The incidence of eight viruses in the countries surveyed is shown in Table 18. Based on visual observations in the field, bean leaf roll virus (BLRV) was the most prevalent in the countries surveyed.

Table 18. Viruses identified in faba bean samples collected from six countries, 1985/1986.

Country	Number of samples tested	Number of field samples which contained							
		BBMV	BBSV	BYMV	PSbMV	CMV	PEMV	BBWV	BBTMV
Egypt	70	5	4	49	10	11	7	4	0
Lebanon	44	0	6	4	1	0	*	*	*
Morocco	7	1	0	1	0	0	*	*	*
Sudan	254	45	19	145	3	6	5	1	1
Syria	145	6	36	67	30	*	2	0	0
Tunisia	69	41	8	8	9	13	2	1	0
TOTAL	589	98	73	274	53	30	16	6	0

BBMV = broad bean mottle virus
BBSV = broad bean stain virus
PSbMV= pea seed-borne mosaic virus
BYMV = bean yellow mosaic virus
CMV = cucumber mosaic virus
BBWV = broad bean wilt virus
PEMV = pea enation mosaic virus
BBTMV= broad bean true mosaic virus
* = not tested

7.1.2. Cereals

Randomly selected leaf samples (7125) of barley, wheat and oat from a large number of fields from different areas in Morocco, Syria and Tunisia were collected in April 1986. These samples were tested for the presence of barley yellow dwarf virus (BYDV). The results obtained indicated that BYDV incidence in Syria was low as compared to Morocco and Tunisia (Table 19).

Table 19. Incidence of the PAV type of barley yellow dwarf virus (BYDV) on leaf samples of barley, wheat and oat from three countries, 1986.

Country	Number of fields surveyed	Number of leaves tested	BYDV incidence
Morocco	14	1590	22
Syria	10	4160	7
Tunisia	11	1375	24

7.2. Germplasm evaluation for virus resistance

7.2.1. Faba bean

Faba bean screening for bean yellow mosaic virus (BYMV) and bean leaf roll virus (BLRV) resistance was carried out in cooperation with the Food Legumes Improvement Program. Screening for resistance to these two viruses was initiated because both are present at a relatively high incidence in the region and the potential losses induced by them could be considerable.

7.2.1.1. Screening for BYMV resistance

At Tel Hadya, Syria 672 faba bean lines were evaluated for their resistance to BYMV using mechanical inoculation. Plants were inoculated twice with the virus, 2 and 5 weeks after sowing the seeds, and were evaluated 3 weeks after the second inoculation. Nineteen lines showed good level of BYMV resistance; these lines will be re-evaluated during the next growing season (1986-1987).

7.2.1.2. Screening for BLRV resistance

Altogether 386 faba beans lines were evaluated for their resistance to BLRV at Lattakia, Syria. All plants were artificially inoculated with BLRV using a mixture of the aphid vectors Aphis fabae and Aphis craccivora. Over 100 single plant selections resistant to BLRV were identified for seed increase during the summer of 1986. These lines will be re-evaluated during the next growing season (1986-1987).

7.2.2. Cereals

Screening for barley yellow dwarf virus (BYDV) resistance was carried out in cooperation with the Cereals Improvement Program at Tel Hadya on 515 entries of bread wheat, 429 of durum wheat and 457 of barley. All the entries were artificially inoculated with a PAV type of BYDV using a mixture of three species of aphids Rhopalosiphum padi, Sitiobion avenae, and Schizaphis graminum. Around 20 entries of each of bread wheat, durum wheat and barley were found to be tolerant to BYDV infection. These lines will be subjected to re-evaluation.

7.3. Detection of seed-borne viruses of faba beans

Since some of the viruses which infect faba beans are seed-borne, procedures were developed to detect broad bean stain virus (BBSV) and broad bean true mosaic virus (BBTMV). Seed increases of faba beans for international nurseries were subjected to very strict roguing (twice) during the growing season in addition to weekly insecticidal spray for beetle control. Seed lots obtained, were tested in the laboratory for the presence of BBSV and BBTMV to ensure that virus-free germplasm were forwarded to collaborators. This work was carried out in cooperation with the Food Legumes Improvement Program and the Seed Health Laboratory.

7.4. Antisera production

To meet the requirements for virus testing, antisera for broad bean stain virus, broad bean mottle virus and pea enation mosaic virus were produced. Some of these antisera were requested and sent to cooperating scientists in national programs for use in their laboratories for virus testing.

7.5. Virus reservoirs

Forty four wild legumes species collected from Syria were tested for their possible role as a virus reservoir for BBSV. Fourteen species were found to be susceptible to BBSV infection with only two species showing visible symptoms. Further investigations will be carried out to determine whether BBSV is seed-borne in these species.

7.6. Workshop

A two-day virology workshop was organized (March 31 and April 1, 1986) at ICARDA, Aleppo, Syria. Nine participants from Syria, Lebanon, Tunisia, Morocco and Egypt, and Dr.L.Bos from IPO, Wageningen, The Netherlands, attended the meeting. The workshop provided a forum to evaluate the progress made in virology work at ICARDA. It also provided an opportunity to initiate cooperation between ICARDA and different countries of the region in the area of plant virus research on food legume and cereal crops. Cooperation has already started on work related to barley yellow dwarf virus on cereals with the virology laboratory of the National Agricultural Research Institute of Tunisia (INRAT).

8. Training

Personnel and financial constraints did not permit the Genetic Resources Program to initiate an independent residential training course, but program staff participated in the residential training courses undertaken by the Crop Improvement Programs. In addition, short duration (1-4 weeks) individual training in specific areas related to genetic resources work and seed health testing was also provided to ten participants.

In 1986, two participants from Jordan were trained in electrophoresis methodology for 2 weeks. Two trainees from the Syrian national program and one from Egypt spent 5 weeks at the GRP for on-the-job training in germplasm work. Two Ethiopian participants from the residential courses were also provided with specific training in the evaluation and documentation of cereal and food legume genetic resources. Genetic resources scientists from the Syrian national program who participated in a joint forage legume collecting mission, gained additional experience in collecting germplasm and identifying various wild legume species.

Two participants one from Ethiopia and the other from Turkey, and two trainees from Syria were provided with short training in seed health testing methodologies and field inspection techniques at the Seed Health Laboratory. Two students, one from the University of Damascus and the other from the University of Tishreen are conducting research for their MSc. theses on the "Transmission of BYMV, BLRV and BYDV viruses by aphids" and the "Relationship between populaton dynamics of cereal aphids and BYDV incidence in cereals grown in the northwestern region of Syria", respectively.

Organized training in germplasm conservation is a serious gap in ICARDA's overall training program that needs to be considered. The interests and demand for this training is increasing and a regular residential course needs to be implemented to build a network of collaborators in the regional programs.

المركز الدولي للبحوث الزراعية في المناطق الجافة
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