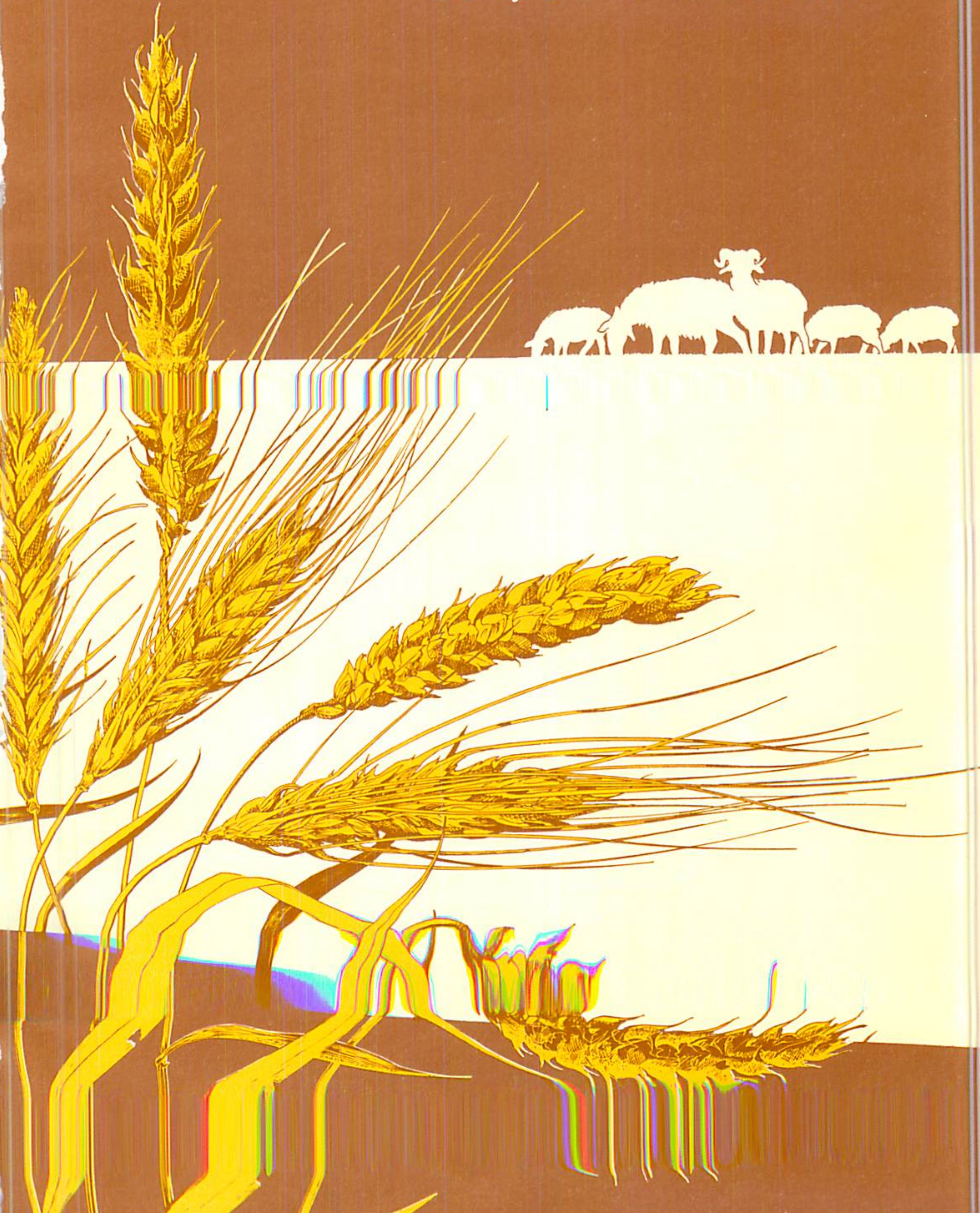
RACHIS

Barley and Wheat Newsletter



Vol. 8, No. 1, Jan 1989

ISSN 0255-6421

The Center and its Mission

The International Center for Agricultural Research in the Dry Areas (ICARDA) was established in 1977 to undertake research relevant to the needs of developing countries and specifically for the agricultural systems in West Asia and North Africa. The overall objective of the Center is to contribute towards increased agricultural productivity, thereby increasing the availability of food in both rural and urban areas, and thus improving the economic and social well-being of people.

The Center focuses on areas with 200 to 600 mm annual winter rainfall. Where appropriate, research also covers environments with summer rainfall.

ICARDA is a world center for the improvement of barley, lentil, and faba bean; and a regional center for the improvement of wheat, chickpea, farming systems, pasture and forage crops, and livestock. Training agricultural researchers from developing countries is an important component of ICARDA's activities.

ICARDA is one of 13 international research centers receiving support from donors through the Consultative Group on International Agricultural Research (CGIAR). The CGIAR, an association of governments, organizations, and private foundations, supports agricultural research worldwide to improve food production in developing countries.

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RACHIS - the Barley and Wheat Newsletter - is published by the International Center for Agricultural Research in the Dry Areas (ICARDA). It contains mainly short scientific articles but also includes book reviews and news about training, conferences, and scientists in barley and wheat.

Published half-yearly in January and July, RACHIS can be obtained free by writing to the Distribution Unit, Scientific and Technical Information Program (STIP), ICARDA, P.O. Box 5466, Aleppo, Syria. Contributions to RACHIS should be sent to Mr Tarek Abdel Malak.

CONTENTS

EDITORIAL

Breeders, in their unrelenting quest for superior genes, affirm that landraces and wild relatives of food crops are indispensable for developing adapted, resistant varieties that would provide a sound base for sustainable agriculture. However, these precious sources of useful genes are gradually loosing ground to newly-released varieties in farmers' fields, and are being banished from their natural habitat by man through his increased agricultural and industrial activity. ICARDA feels concerned that this genetic erosion is jeopardizing the centers of origin of barley and wheat in West Asia and North Africa (WANA), the region that it seeks to serve.

The International Symposium on Evaluation and Utilization of Genetic Resources in Wheat Improvement, held at ICARDA, 18-22 May 1989 was devoted to the importance of landraces and wild relatives in contributing useful genes to improve the productivity of new cultivars, especially in stressed environments. The Symposium was timely and its location very appropriate. It brought together genetic resources scientists, gene-bank managers, and plant breeders from both within and outside the WANA region to discuss how to handle the germplasm, how to optimize its use in current crop improvement programs, and how to enhance cooperation among the different research institutes.

In its persistent efforts to develop high-yielding stable varieties of cereals, ICARDA has also recognized that cooperation between physiologists and plant breeders can accelerate the pace of research. This, in fact, was the driving force for organizing the International Symposium on Physiology/Breeding of Winter Cereals for Stresses of the Mediterranean Environments held at Montpellier, France, 3-6 July 1989. At this Symposium, participating researchers discussed the physiological traits to be used by breeders in screening cereals under abiotic stresses. Small working groups of specialized scientists were formed to strengthen cooperation in research on the root system, growth at low temperatures, desiccation techniques, C_{13} screening, rate of grain filling, and excised-leaf water loss as potential characters for screening large segregating populations. We hope that useful and practical screening techniques will become available to plant breeders in the near future.

Research and Production

Variability of Agronomic Characters of Moroccan Durum and Bread Wheat Landraces

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The variability of *Triticum* spp, maintained by the peasants for about 10 000 years, is now decreasing due to the development of new "high yielding" varieties which have supplanted original landraces in many countries (Cauderon 1980). These landraces are not adapted to intensive types of agriculture and usually have a low yield potential. Some of them, however, possess interesting agronomic characters such as disease and insect resistance, and good adaptation to environmental stresses (water deficit, low or high temperatures). Therefore, it is important to preserve this "variability stock" and to collect, identify, and evaluate landraces in order to use them in breeding programs.

North Africa presents a particularly interesting genepool with highly variable wheat forms (Orlov 1923). This variability is due to the great diversity of the environment, the high frequency of natural hybridizations (caused by warm and dry weather at *flowering*), and the introduction of wheats from other regions (Middle East, Western Asia).

Since the beginning of the century, many wheat landraces have been collected in North Africa, particularly in Morocco (Miege 1922, 1923, 1927). A great part of them is now conserved in genebanks. Germplasm collection and evaluation, however, must be continued to improve our knowledge of the agronomic characters of plant genetic resources in this region.

This paper summarizes the preliminary evaluation data on Moroccan wheat landraces. The work was conducted by ENA (Ecole Nationale d'Agriculture), Meknes, Morocco, in collaboration with ENSA-INRA (Ecole Nationale Superieure Agronomique-Institut National de la Recherche Agronomique), Montpellier, France.

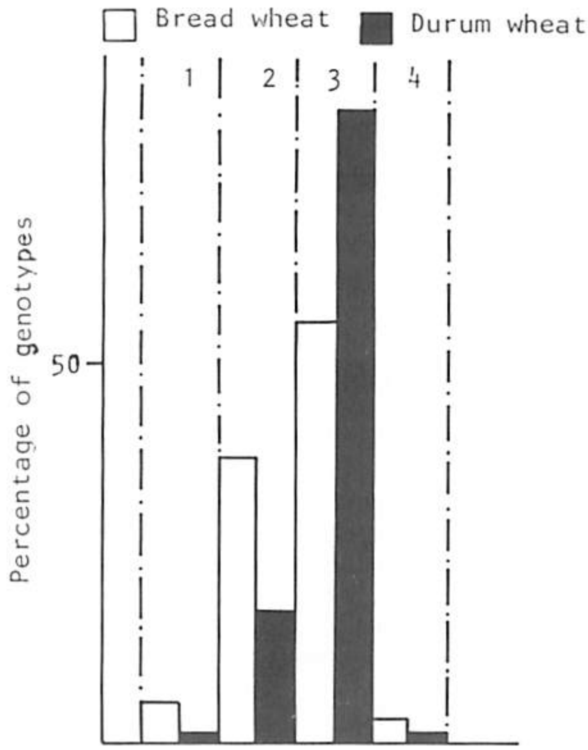
Materials and Methods

A total of 549 durum and 167 bread wheat landraces were collected in 1986 in 6 zones in Morocco receiving very different amounts of annual rainfall, namely, Rif, Pre-Rif, Middle Atlas, Oriental, High Atlas, and Pre-Saharan zone. Seeds of these landraces were sown in Nov 1986 at ENA's Experimental Station, Meknes (560 mm rainfall/annum). In the first year of evaluation, days to flowering, stem height, yield components (number of spikes/plant, number of spikelets/spike, number of fertile spikelets/spike, number of grains/spike, 1000-kernel weight), and reaction to rusts were recorded. Rusts caused by *Puccinia graminis* Pers., *Puccinia striiformis* Westend, and *Puccinia triticina* Erikss constitute the most drastic wheat diseases in North Africa. As a first step, the three rusts were studied together, and a global level of attack was considered. Four organs of the adult plant were observed (stem, leaf sheath, leaf blade, and spike). The check varieties were NESMA 149, 5-70-9, and 5-70-32 for bread wheat, and Cocorit for durum. These varieties, which have been recommended by INRA-Morocco for the "bour" (non-irrigated) zones, are widely cultivated in Morocco.

Results and Discussion

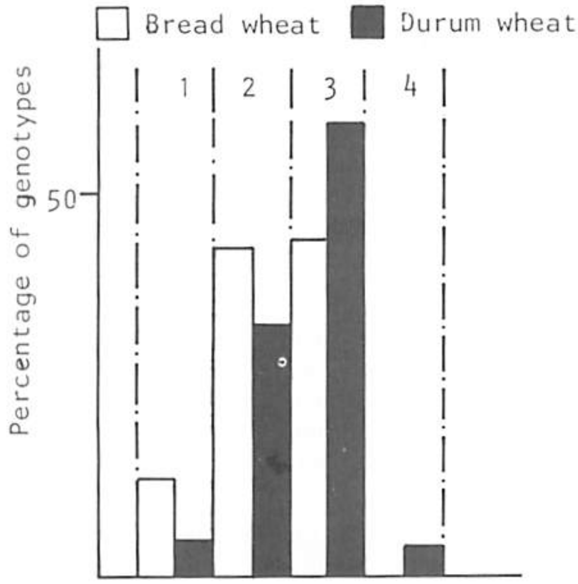
Results in Fig. 1 indicate a high variability in days to flowering, as a difference of 30 days separated the earliest landrace from the latest. Bread wheats were earlier than durums, with 41.9% having a sowing-to-flowering period of less than 120 days, as compared to 17.1% for durums. However, only few landraces were earlier than the checks, which flowered 110 days after sowing.

Results on plant height indicate the presence of dwarf-type landraces, particularly in bread wheat (Fig. 2). None of the bread wheats was tall (125-150 cm), whereas a relatively high percentage (13.1%) was of a dwarf type (50-75 cm). In durum landraces, 3.6% was tall and 5.5% was dwarf (50-75 cm). The percentage of short and dwarf types was higher in bread wheat (56.3%) than in durum (38.1%).



Class 1=100-110 days Class 3=120-130 days
Class 2=110-120 days Class 4=130-140 days

Fig 1. Moroccan durum and bread wheat landraces distribution according to number of days to flowering.



Class 1=50-75 cm (dwarf) Class 3=100-125 cm (medium)
Class 2=75-100 cm (short) Class 4=125-150 cm (tall)

Fig 2. Moroccan durum and bread wheat landraces distribution according to stem height.

A great variability in the number of spikes/plant was observed in both durum and bread wheat landraces (Fig. 3). The highest percentage of bread wheat landraces (35%) had 4-5 spikes/plant, whereas 59.6% of the durums had 3-4 spikes/plant, which indicates a lower tillering ability of the durums. These results should not however be compared with data obtained during normal cultivation because the greater inter-row distance used in our experiment favored *tillering*.

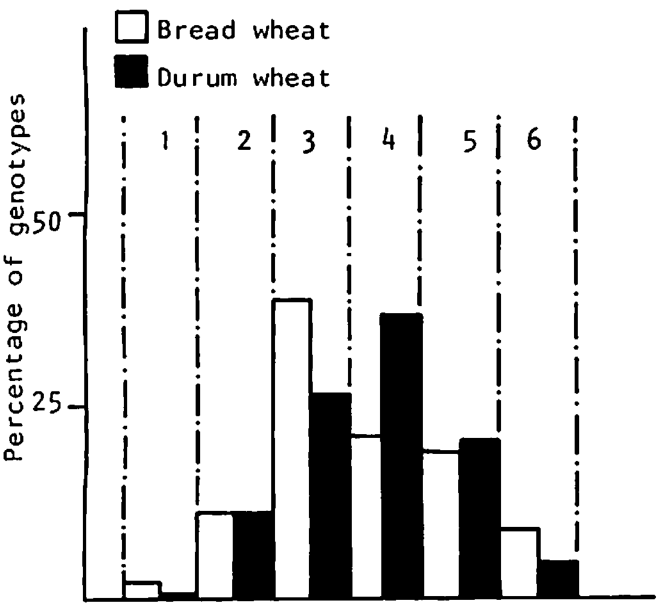
Most of the landraces had a similar number of spikelets/spike (Fig. 4) as the check varieties NESMA and 5-70-32 (20-22 spikelets/spike). This yield component is generally higher for durum than for bread wheat.

The number of fertile spikelets/spike, when compared with the total number of spikelets/spike, permits one to estimate the susceptibility of fertilization and flowering to environmental stresses. In general, the bread wheat landraces had a lower number of fertile spikelets/spike than the durums (Fig. 5). By comparing Fig. 5 with Fig. 4, it can be seen that the increase in percentage of landraces having a lower number of spikelets/spike, and the decrease in the percentage having a higher number of spikelets/spike were more marked in bread wheat than in durum. This indicates that the tetraploid species has a better fertility rate of the spikelets.

Class 1=1-2 spikes/plant Class 4=4-5 spikes/plant
Class 2=2-3 spikes/plant Class 5=5-6 spikes/plant
Class 3=3-4 spikes/plant Class 6=≥6 spikes/plant

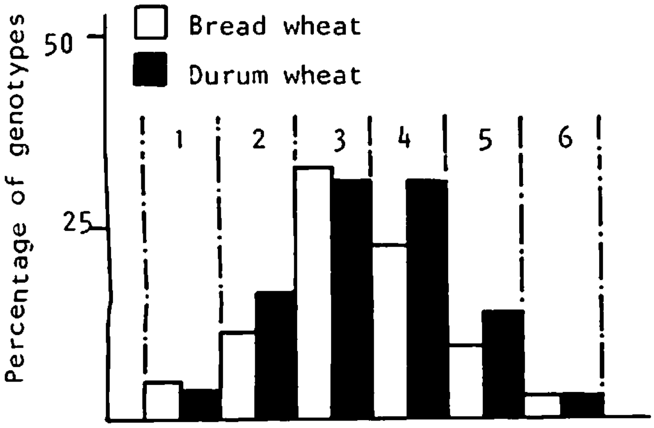
Fig 3. Moroccan durum and bread wheat landraces distribution according to number of spikes/plant.

Fifty-eight percent of the bread wheat landraces and 61% of the durums had 30-50 grains/spike (Fig. 6). The durum landraces as a whole had a higher number of grains/spike than the bread wheat landraces.



Class 1 = 13-15 spikelets/spike Class 4 = 20-22 spikelets/spike
Class 2 = 15-18 spikelets/spike Class 5 = 22-24 spikelets/spike
Class 3 = 18-20 spikelets/spike Class 6 = 24-26 spikelets/spike

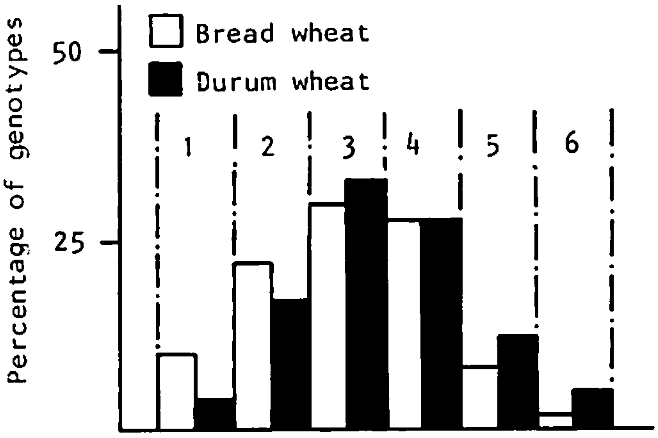
Fig 4. Moroccan durum and bread wheat landraces distribution according to number of spikelets/spike.



Class 1 = 13-15 fertile spikelets/spike
Class 2 = 15-18 fertile spikelets/spike
Class 3 = 18-20 fertile spikelets/spike
Class 4 = 20-22 fertile spikelets/spike
Class 5 = 22-24 fertile spikelets/spike
Class 6 = 24-26 fertile spikelets/spike

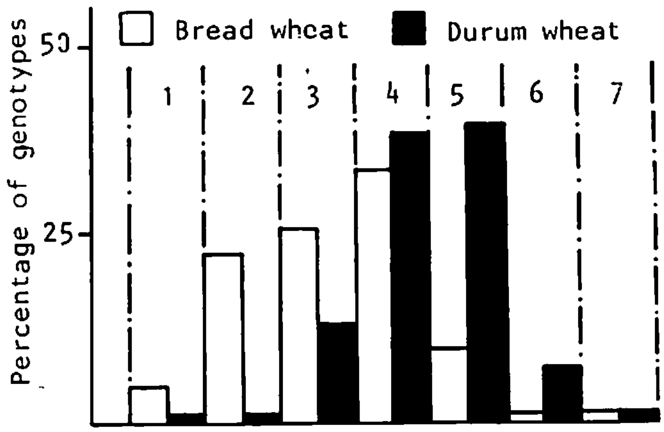
Fig 5. Moroccan durum and bread wheat landraces distribution according to number of fertile spikelets/spikes.

The 1000-kernel weight varied highly among the landraces (the ratio of extreme values being 1:6). In general, the durums had a higher 1000-kernel weight than the bread wheats, as 47% had it in excess of 50 g, compared to 12% only for the bread wheats (Fig. 7). Only three bread wheat landraces had a 1000-kernel weight in excess of 60 g (NESMA and 5-70-32 had an average 1000-kernel weight of 58 g). Forty-seven durums had a 1000-kernel weight superior to 60 g, with a maximum of 88 g (Cocorit had an average 1000-kernel weight of 55 g). It should be noted that the low values



Class 1 = 10-20 grains/spike Class 4 = 40-50 grains/spike
Class 2 = 20-30 grains/spike Class 5 = 50-60 grains/spike
Class 3 = 30-40 grains/spike Class 6 = 60-70 grains/spike

Fig 6. Moroccan durum and bread wheat landraces distribution according to number of grains/spike.



Class 1 = 10-20 g
Class 2 = 20-30 g
Class 3 = 30-40 g
Class 4 = 40-50 g
Class 5 = 50-60 g
Class 6 = 60-70 g
Class 7 = >70 g

Fig 7. Moroccan durum and bread wheat landraces distribution according to 1000-kernel weight.

recorded for some landraces was associated with rust susceptibility and shrivelness.

Table 1 shows that durum wheats are more resistant to rusts, the percentage of durum landraces with less than 40% attack being always larger than that of bread wheats. Bread wheat landraces from the Pre-Saharan zone were highly susceptible to rusts. Results, show the existence of sources of resistance that can be exploited in breeding programmes, both in durum and bread wheat.

Table 1. Susceptilbility of Moroccan bread and durum wheat landraces to rust expressed as percent attack on spike, leaf blade, leaf sheath, and stem.

	Percent attack				
	0	<10	10-40	40-70	>70
Bread wheat					
Spike	11.6	25.2	34.7	28.7	0.0
Leaf blade	0.6	0.6	9.6	56.9	32.3
Leaf sheath	1.8	3.6	18.6	50.3	25.7
Stem	7.8	11.4	25.8	29.8	25.2
Durum wheat					
Spike	20.0	21.9	48.8	9.3	0.0
Leaf blade	4.2	6.0	39.2	49.0	1.6
Leaf sheath	14.9	8.6	32.1	40.6	3.8
Stem	29.8	12.4	50.1	7.1	0.6

Conclusion

Among the lanraces there is a wide variability of all characters studied, particularly in 1000-kernel weight where high values were especially noted for durum wheat. Results indicate that genes conferring rust resistance, earliness, and dwarfness are present in durum as well as in bread wheat landraces.

Acknowledgment

Thanks are due to Roy Hammond and Dr. H. Ketata for revising the English manuscript.

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Genetic Resources of Wild Relatives in Cereal Crops: I. Germplasm Sampling Strategy

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Wheat, barley, and rice sustain a substantial part of the world's population that is concentrated in poor countries in arid zones of the globe. As cultivars developed in favourable environments are not successful in stressed areas, breeders had to turn to wild progenitors and primitive forms in their search for resistance genes to biotic and abiotic stresses. It would therefore be prudent to preserve the genetic diversity of the wild and weedy gene pool and of landraces and primitive forms which normally retain genomic homology and inter-fertility with their cultivated cousins.

With the establishment in 1974 of the International Board for Plant Genetic Resources (IBPGR), collection and conservation of landraces was accelerated, but priority was not given to primitive forms and wild progenitors of major cereal crops. The exploitation of wild genetic resources for stress tolerance has been insufficient due to three reasons: (i) collections of wild progenitors in the past have been fragmentary and scanty, thus material available in collections is not representative: (ii) work on wild forms has primarily concentrated on evolutionary and taxonomic studies; (iii) variability within populations of wild species has not been adequately addressed (Srivastava *et al.* 1988).

Human pressures on the natural ecosystems in many areas of the world is intensifying as a result of population growth and the subsequent increase in food demand. For example, much of the savannas in Africa are being cleared for cultivation, which is destroying the habitats of endemic wild species. Some species and their variable genotypes will be irretrievably lost within the coming decade, unless representative samples are collected and conserved. Two approaches to planning a collection strategy for the wild relatives and weedy forms of crops can be adopted.

The first is the gene pool approach which is designed to maximise the number of wild species (and their weedy derivatives) to be collected in a particular target area. This area would normally belong to an unexplored region situated in a first-priority zone. For example, recently, it has been strongly recommended to collect wheat and barley germplasm from certain parts of South West Asia and the Middle East (Anon 1987).

The second is an ecological approach wherein sampling is carried out in a much smaller pre-planned area where a special effort is made to recover specific characters with diverse agronomic background. The collector may also record detailed information on physical characteristics of the terrain, nature of the habitat, and the chemical properties of the soil. Collections could be made within a small area of the swarm and then repeated over a larger area of the same population*.

Whichever approach is chosen by a collecting team, the following factors should be considered when planning an expedition for wild relatives of cultivated cereal crops.

Identification

Since the wild relatives and their weedy derivatives of most cereals resemble grasses, at least in the early stages of growth, a taxonomist should be included in the team, as identification of the correct material to be collected would be of paramount importance. When habitats of the wild species are unknown it would be prudent to consult the local herbarium records and primarily go where the plants have been previously reported. Where local records are non-existant, as is often the case for wild forms, a large world repository of herbarium material can be very useful to acquaint oneself with the germplasm to be collected.

Areas containing the wild species are not as easily defined as those for the cultivated types. Sometimes the car is driven at such a speed that no identification, even to a trained eye is possible. Thus expeditions for wild types should include considerable amount of work on foot or slow off-road means of transport. It is quite possible in such a case that nothing of worth may be found on certain days whereas on other occasions valuable germplasm may be discovered within a small area.

Therefore, locating the exact population to be collected may be the first problem one encounters. Occasionally, luck also plays a role. To illustrate this point, a sample of wild rice, *Oryza officinalis*, which the team was exploring in Sri Lanka for days, was located purely by chance when one of the collectors abandoned the planned route and went into the bushes. It would have been impossible to locate the small clump of plants by any systematic means of collection, as the site was not larger than 10 meter quadrat and invisible from a distance of more than a few meters (I.R. Denton, personal communication).

If a local name exists for the wild species the collector should be aware of it so the farmers can help the team locate the required material.

Sampling Site

The size of the sampling site in case of the wild species depends on the range of variability of the population, the size of the colony, and the environmental factors involved (Hawkes 1980). Areas to be sampled may vary from 5x5 to 50x50 m according to the density of the individuals and the size of the population. If the population is continous, samples may be taken at random over large distances, followed by intense sampling in a small area from which all forms or morphotypes are collected. The frequency of collections may be increased if altitude, climate, soil type, and farming practices vary within the target area.

Weedy types are mostly found in the vicinity or within cultivated fields. Samples should therefore be collected from the borders as well as from within the cultivated area. Due to introgressive hybridization, the weedy species resemble closely the cultivated varieties until maturity and, hence, cannot be weeded out at an earlier stage. In adition, owing to their annual nature and grain-shedding characteristic they are regenerated year after year at the same site without human interference. The percentage of weedy types in cultivated fields is about 3% on average, but can reach 30% in badly infested ones. It would be prudent to sample the two extremes in a weedy population (i.e. forms resembling the cultivated species and those entirely wild) and include a few which are intermediate.

There are no satisfactory models as to the number of spikes (or heads) to be sampled in order to capture the greatest allelic diversity in the wild forms. Therefore, material from at least 25-50 plants should

* A copy of the collecting form suggested for wild forms is available from the author.

be sampled in a field (Marshall and Brown 1975). However, where the species are rare or plants very few in number, even this may not be possible.

A photograph should accompany each sample so that the species and the site of its occurrence could be identified if further collections are needed in the same area as a result of electrophorectic or morphological evaluation (Damania *et al.* 1983).

Timing of Collections

The lack of phenological information on the species to be collected and the heterogeneity of the seed maturing time are the most common constraints to timing a collecting expedition. For example, though a wild progenitor was reported in Nigeria (Brunken *et al.* 1977) it could not be found in the same area when revisited in Aug 1983 (Appa Rao, personal communication). This may be due to two reasons: (i) The habitat has been disturbed by natural or human causes such as cultivation, burning, or development of land, or (ii) the wild species might have escaped attention if they were not in the flowering stage.

Since heterogeneous seed maturing time is a frequent attribute of wild populations, a single, short expedition may gather a relatively small portion of the existing variability even if sampling and collecting procedures are applied rigorously. Because of the shattering habit of the wild and weedy types it is imperative that collections be made directly from standing plants as once the heads shatter and the seeds are dispersed on the ground, collecting becomes very difficult if not impossible. When sampling over a very large area or country it may be advisable to field two or more teams so that the largest amount of genetic diversity can be collected at the optimum time.

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Historical Background of Wheat Improvement in Baluchistan, Pakistan (1909-1980)

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The province of Baluchistan lies between 28°-32° N and 61°-70° E, occupying about 347 000 km², which represents approximately 42% of the total area of Pakistan. Baluchistan is the heart of an ancient Asian wheat producing belt. It is bordered from the west by Iran where wheat production dates back to prehistoric times, and from the east, by the province of Sind where archeological investigations at Mohanjo-Daro have shown that wheat was being cultivated in this area 5000 years ago. In the north, it is bounded by southeastern Afghanistan. Along with the northwestern wheat belt of the Indo-Paki subcontinent, Baluchistan has been proved to be the center of origin of soft and club wheat.

Wheat has long been the staple food of the majority of the population in Baluchistan. However, because of the poor communication network between the vast stretches of the province and the extreme variability in the climatic conditions and the soil types of the different regions, no single variety has been widely grown. Although the names of some local varieties have been mentioned in local gazetteers, they are of little interest, as in some cases a same variety is referred to by different names, whereas in others a same name is given to different varieties.

Phases of Wheat Improvement

Four phases characterize wheat improvement in Baluchistan:

First phase (1909-1916). During this period, interesting indigenous *Triticum turgidum* types were first reported. Surveys and research were conducted from a purely botanical viewpoint.

Second phase (1933-1944). After the construction of Sukker Barrage, a large area in Nasirabad Sub Division was brought under canal irrigation. This was accompanied by the designation of 122 ha at Usta Mohammad (Sibi District) for testing local and introduced wheats, and for multiplying the seeds of promising varieties, with an aim of releasing the most adapted ones.

Concurrently, the Department of Agriculture of Baluchistan conducted trials on wheat varieties from the Punjab, Sind, and Pusa such as CPH 47, AT.33, C518, C591, C228, and IP 80-5. Some of these varieties performed well, with C591 giving the best results. About 22.4 tonnes of seed of these varieties were distributed in Nasirabad Sub Division during this period. These varieties, however, performed poorly in the uplands because of winter frost. Most of them were also susceptible to black and yellow rust.

Third phase (1945-1949). In 1944-45, the Government integrated the multiplication and distribution of improved wheat seed in its "grow-more-food" campaign. The province was divided into three zones, and four farms at Usta Mohammad, Sibi Jadid, Loralai, and Quetta covering a total of about 240 ha were set up for seed multiplication.

As C591 was found to be only suitable for early sowing in the lowlands, an early maturing variety, C228, was introduced for late sowing. In the uplands, introduced varieties did not perform well, thus local varieties were tested. Pending the selection of an adapted variety, 'Local White' was being multiplied and distributed at the Departmental Farm at a rate of 3400 t/year, which was sufficient to plant 40 000 ha.

In 1950-51 the previous scheme was reorganized. The Extension Section became responsible for seed production while the Economic Botany Section was alloted to the research. In that year wheat improvement in Baluchistan entered its fourth phase.

Fourth phase. One may say that systematic wheat improvement research in Baluchistan really started in 1950 with the appointment of the first economic botanist. In an attempt to develop a wheat improvement strategy, a survey of the province was started and five zones were delimited.

Zone 1 comprises the plains with an altitude of less than 300 m, and has a mainly alkaline soil. Seeds are sown in Nov-Dec and harvested in Apr, and the crop is canal irrigated. Summers are extremely hot (50°C maximum temperature). This zone is very important for wheat production.

Zone 2 (300-900 m) has a soil type varying between sandy and sandy loam. The climate is warm but cooler than in Zone 1, with sandstorms common to some areas. Wheat is planted in Nov-Dec and harvested in May. Of the small area planted with wheat, a larger portion is under irrigation or *sailaba* condition and a smaller one is rainfed.

Zone 3 (900-1500 m) is quite important for wheat production. Its climate is mild, with the rain mainly falling in spring and summer. Wheat is sown between Oct and Dec and harvested in May and June.

Zone 4 (1500-1800 m) has a loamy soil rich in plant nutrients. The temperature is mild in summer but very cold in winter. Wheat is sown between Oct and Feb and harvested by the end of June or July. No single variety can be considered as popular in this zone. A large part of this area is rainfed and in great need for a spring wheat that can be sown after winter rains in Dec and Jan.

Zone 5 (1800-2400 m) has a very rich soil. Precipitations occur in winter in the form of snow. In this zone, winter wheat is grown, but spring types are needed. Wheat is sown between Sept and Mar and harvested between July and Aug.

The total area under wheat in the five zones added up to a about 168 000 ha, with an average yield of 670 kg/ha according to a report in 1973/74. Of this area, 87 000 ha were irrigated whereas the remaining 81 000 ha were under *khushkaba* and *sailaba.*

During this period, the few attempts made to introduce improved varieties to the uplands met with little success. The first ecònomic botanist, Dr Obedur Rehman Khan, made an extensive collection of indigenous wheat practically from all over Baluchistan, and isolated them into hundreds of lines. Unfortunately he died in 1955 and the work remained unfinished. Dr S.A. Quereshi, appointed in 1960, concentrated his work on foreign segregating material. A few lines, such as 297-299, were subsequently developed. They performed as well as local varieties in terms of yield, and were more resistant to rust. Thus in the event of rust epidemics, which occur every 5-8 years in the uplands, they significantly outyielded the locals. Another line (398) with a high tillering capacity gave a good yield as compared with local varieties, but was found susceptible to leaf and stem rust.

From Dec 1966 until Dec 1968, research conducted by Mr Suleiman Khan on local material resulted in the selection of 'Local White' for its good grain quality (it is worth mentioning that leavened bread as well as chapities are popular in Baluchistan, hence high gluten content is desirable) and its cold and drought resistance. 'Local White', however, was found to be susceptible to all the three rusts and could not resist high fertilizer doses.

From 1969 to 1975 Mr Mohammad Saeed, as the economic botanist, could not intensify research on wheat due to commitment on several other crops like potato, oil seed, maize, sorghum, melon, and cantaloups.

In 1975 the Government of Baluchistan appointed a wheat botanist. The Improvement of Wheat, Barley, and Triticale Scheme, financed by the Pakistan Agricultural Research Council (PARC), was launched in the same year. The research conducted in the following years resulted in the release of two new wheat varieties, namely, Zarghoon 79 and Zamindar 80, which were particularly recommended for the uplands. These varieties were subsequently tested throughout the country and, according to the National Uniform Wheat Yield Trial carried out by PARC in 1979, were found to perform well all over the country.

Zarghoon 79 is a late maturing variety with a medium height, good response to heavy doses of fertilizer, frost resistance, and good tillering ability. Grains are white amber, with a protein content, flour yield, and Pelshenke value of 13.61%, 64.5%, and 120, respectively.

Zamindar 80 is an early maturing variety. It has a medium height and white amber grains. It is recommended for the uplands for its resistance to frost and stripe rust, which are the main constraints to wheat production in these areas. Protein content, flour yield, and Pelshenke value are 12.92%, 72.5%, and 114, respectively.

Inheritance of Dwarfism in Wheat

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The development of semi-dwarf wheat varieties has changed the pattern of agriculture in India and several other countries. Although plant height in wheat (*Triticum aestivum* L em Thell) is mainly controlled by major genes commonly known as Norin genes, this trait is also influenced by minor genes. This paper reports the results of an experiment designed to investigate this aspect of plant height inheritance in wheat.

Materials and Methods

Six dwarfing sources of wheat, namely, Tanori 71 (Gai/Rht 1), Tobari 66 (Gai/Rht 2), Tordo 'S' (Gai/Rht 3), Norin (Gai/Rht 1 and 2), Olson (Gai/Rht 1 and 2), and S 948 A1 (Gai/Rht 1 and 2) were crossed with two Indian tall varieties NP 876 and Hybrid 65. A randomized complete block design replicated three times was used to evaluate the parents, F_1s, and F_2s. The parents and F_1 replicates consisted of a single row, whereas F_2 replicates had nine rows. The rows were 1.5 m long and spaced 25 cm apart, with a plant-to-plant distance of 25 cm. Plant height of all plants was measured at maturity.

Results and Discussion

Tanori 71 and Tobari 66, which contained Gai/Rht 1 and Gai/Rht 2, respectively, had similar heights, while Norin, Olson, and S 948 A1 which had Gai/Rht 1 and 2 were shorter (Table 1). Tordo 'S', which had Gai/Rht 3, had the same height as the Norin group.

The F_1 plant height of the crosses between Tanori 71 and the two tall varieties was equal to the mid-parental value (Table 1), indicating that Gai/Rht 1 present in Tanori 71 was not dominant, and that plant height was mainly controlled by additive gene effect. This finding is different from that of Gale and Marshall (1976), who reported that Gai/Rht 1 is partially recessive. Gai/Rht 2 present in Tobari 66 (Gale and Marshall 1976) showed no dominance in the F_1 population of Tobari 66 x NP 876, however, partial dominance was observed when Tobari 66 was crossed with Hybrid 65 (Table 1). This varied behavior of a major gene in two different crosses is probably due to minor genes that may modify its expression. This observation thus confirms the earlier reports of Gale and Marshall (1977) and Nelson *et al.* (1980) regarding the varied behavior of Gai/Rht genes.

In the crosses of Tordo 'S' (a Tom Thumb derivative) with tall varieties, the F_1 plant height was equal to the mid-parental value, indicating no dominance (Table 1). CIMMYT workers on the other hand found that Tom Thumb wheat had a dwarfing effect when

Table 1. The means, ranges, and CV of plant height (cm) for the parents, F_1s, and F_2s of tall x dwarf crosses in wheat.

Parent/cross	Mean		Range		CV	
	P/F_1	F_2	P/F_1	F_2	P/F_1	F_2
Tanori 71 (Rht 1)	92		81-102		6.5	
Tobari 66 (Rht 2)	90		82-100		4.6	
Tordo 'S' (Rht 3)	51		42-55		5.8	
Norin (Rht 1 & 2)	63		53-69		6.2	
Olson (Rht 1 & 2)	43		37-49		7.2	
S 948 A1 (Rht 1 & 2)	36		25-44		11.8	
NP 876	112		99-138		5.0	
Hybrid 65	115		100-127		6.0	
NP 876 x Tanori 71	104	104	91-120	43-134	2.5	12.8
NP 876 x Tobari 66	103	102	82-116	73-135	3.0	11.7
NP 876 x Tordo 'S'	80	81	68-92	38-132	3.4	27.0
NP 876 x Norin	102	93	75-108	54-130	2.9	14.9
NP 876 x Olson	86	81	75-94	41-127	2.8	19.9
NP 876 x S 948 A1	78	73	70-86	38-118	2.8	20.6
Hybrid 65 x Tanori 71	101	102	85-117	65-133	4.3	10.4
Hybrid 65 x Tobari 66	97	103	90-106	64-134	2.3	11.1
Hybrid 65 x Tordo'S'	79	78	70-92	32-139	5.9	30.6
Hybrid 65 x Norin	94	94	76-110	28-141	3.0	29.0
Hybrid 65 x Olson	89	81	80-96	40-135	2.9	21.4
Hybrid 65 x S 948 A1	77	74	69-83	50-113	2.7	21.1

crossed with tall wheats, and suggested that it may possess one or more dwarfing genes (CIMMYT Review 1966/67). The F_2s of the Tordo 'S' crosses had a very high coefficient of variation and displayed a tri-modal distribution (Table 1).

Dwarfism was found partially recessive when Norin and Olson were crossed with both the tall varieties, as mean F_1 plant height of each cross exceeded its mid-parental value. No dominant or recessive effects were detected in the crosses between S 948 A1 and the two tall varieties.

In the Tanori 71, Tobari 66, and Tordo 'S' crosses with tall varieties, there was a high transgressive segregation towards dwarfness. This suggests the presence of minor genes in the tall varieties which may reduce plant height.

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Interrelationship between Yield and Some Quantitative Characters in Hull-less Barley Grown in Saline-Alkaline Conditions

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Crop plants possess considerable genetic plasticity (Shannon 1978), and the importance of germplasm collection and utilization has been generally recognized (Frankel 1970; Konzak and Dietz 1969; Krull and Borlaug 1970). Substantial progress in the conservation of barley genetic resources has been made by the Germplasm Collection, Conservation and Evaluation Unit (GCEU) at the All India Coordinated Barley Improvement Project, IARI-Regional Station, Karnal. One of the most important and basic responsibilities of the GCEU is to generate information on barley germplasm performance under moisture stress and problem-soil conditions. The present investigation was aimed at studying the genetic variability of hull-less barley and the interrelationship among grain yield, yield components, and other important agronomic traits under saline-alkaline soil conditions.

Materials and Methods

A total of 113 accessions from the world barley collection were planted in a saline-alkaline soil (pH = 8.5-10.0, ESP = 32) in a randomized complete block design with three replications. Five competitive plants per replication were selected, and data on the number of productive tillers/plant, plant height, days to 75% flowering, days to 75% maturity, spike length, number of grains/spike, 200-grain weight, grain yield/plant, and number of plants/m were recorded. Coefficient of variability, heritability, and correlation coefficients were computed following Hanson *et al.* (1956) and Deway and Lu (1959).

Results and Discussion

Differences among barley accessions were significant for all characters, indicating a considerable genetic variability under saline-alkaline soil conditions. The phenotypic and genotypic coefficients of variability ranged from 3 to 36% and from 3 to 28%, respectively (Table 1). They differed, in decreasing order of magnitude, in the number of tillers/plant, grain yield/plant, number of plants/m, spike length, number of grains/spike, and height. Days to flowering and maturity, and grain weight were found to have high heritability estimates, and are therefore expected to be responsive to selection. The other characters had low to moderate heritabilities and, hence, may not respond to selection under saline-alkaline soil conditions.

The number of productive tillers/plant and grain weight were significantly and positively correlated with grain yield both at the genotypic and phenotypic levels (Table 2). On the other hand, the number of plants/m, plant height, and days to flowering and maturity had a slight, negative correlation with grain yield at the genotypic level. A positive and significant correlation between grain yield and number of productive tillers/plant has also been reported by Singh and Sethi (1985). Singh *et al.* (1986) observed positive correlation between grain yield/plant and

Table 1. Mean, range, coefficient of variation, and heritability estimate for yield, yield components, and other agronomic characters of hull-less barley germplasm under saline-alkaline soil conditions.

Character	Mean	Range	SE (±)	Genotypic CV (%)	Phenotypic CV (%)	Heritability (%)
Number of plants/m	37	30-52	6.30	8	22	14
Productive tillers/plant	4.0	1.9-9.0	1.00	20	36	29
Plant height (cm)	65	45-84	6.40	6	14	20
Days to flowering	81	72-87	0.20	5	5	99
Days to maturity	108	101-113	0.30	3	3	98
Spike length (cm)	6.1	4.3-8.3	0.76	9	18	27
Number of grains/spike	50	20-67	7.11	3	22	37
200-grain weight (g)	4.6	1.3-8.8	0.14	28	28	98
Grain yield/plant (g)	4.1	1.3-8.9	0.96	21	36	34

Table 2. Genotypic and phenotypic correlations of yield and yield components of hull-less barley germplasm grown on saline-alkaline soil.

Character	Productive tillers/ plant	Plant height	Days to flowering	Days to maturity	Spike length	Grain number/ spike	200-grain weight	Grain yield/ plant
Number of	0.096	0.271**	-0.009	-0.120	-0.164	-0.121	-0.264**	-0.232*
plants/m	-0.104	0.007	0.005	-0.041	-0.113	-0.033	-0.095	-0.062
Productive		0.068	0.008	0.198*	0.041	-0.047	0.098	0.405**
tillers/plant		0.227*	0.001	0.102	0.121	0.132	0.061	0.247**
Plant height			-0.062	-0.001	0.266**	0.108	-0.024	-0.250**
			-0.029	0.000	0.370**	0.222*	-0.011	0.085
Days to				0.823**	0.046	-0.134	-0.250**	-0.196*
flowering				0.814**	0.024	-0.082	-0.247**	-0.114
Days to					0.080	-0.176	-0.283**	-0.303**
maturity					0.040	-0.113	-0.278**	-0.173
Spike length						-0.321**	0.002	-0.113
						0.219*	0.002	0.049
Grain number/spike							0.262**	0.081
							0.138	0.178
200-grain weight								0.641**
								0.380**

*, ** significant at the 1% and 5% levels, respectively.

1000-kernel weight, days to flowering, and shoot length at both the genotypic and phenotypic levels.

Results on heritability estimates and correlations among traits indicated that the number of productive tillers/plant, days to flowering, days to maturity, and grain weight may be the most valuable selection traits of hull-less barley under saline-alkaline soil conditions.

Acknowledgement

The author wishes to thank Dr Ganesh Prashad, Principal Investigator, S.D.J. Post Graduate College, Chandeshwar, Azamgarh (U.P.) for raising germplasm material at the experimental farm.

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Stomatal Frequency in Cultivars of *Triticum* and Related Species

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The three important plant processes, respiration, transpiration, and photosyntesis, are influenced by the nature and frequency of the stomata. At least 90% of water loss from leaf surface occurs by diffusion through the stomata (Ketellarpar 1963). Varieties with low stomatal frequency are associated with greater drought resistance in *Panicum antidotale* (Dobrenz *et al.* 1969), and with high photosynthetic rate in beans (Izhar and Wallace 1967). Khurshid and Muhammad (1967) stated that the varieties with many small stomata were more resistant to drought than those with large stomata. Hopman (1971) reported that the behaviour of the stomata is more important than its dimension. Frequency and size, as well as the ratio of the number of stomata in the upper leaf surface to that in the lower surface are highly heritable, and thus, may be relatively easy to manipulate (Miskin and Rasmusson 1970; Miskin *et al.* 1972). The objectives of this study were to study the variability of stomatal frequency in wheat and other related species.

Materials and Methods

The study was carried out at the Indian Agricultural Research Institute, New Delhi, India. A total of 52 genotypes: 9 strains of *Triticum durum*, 33 of *T. aestivum*, 4 of exotic types, 1 of *T. dicoccum*, 1 of *T. carthlicum*, 2 of barley (*Hordeum vulgare*), and 2 of triticale were included. They consisted of 29 tall genotypes (95 cm or more), 15 single-gene (D1) dwarfs (86 to 95 cm), 5 double-gene (D2) dwarfs (75 to 85 cm), and three triple-gene (D3) dwarfs (up to 75 cm). These varieties were seeded in dry land conditions in a randomized block design with three replications. Each variety was seeded in four rows spaced 20 cm apart, with a 10-cm spacing between plants. One seedling per hill was maintained. The two middle rows were used for taking stomatal observations.

The leaves used for stomatal impressions were collected at a similar stage of development from the second fully developed leaf below the primary panicle. A strip of the leaf (about 12 cm) in the middle portion was removed by scissors and half a drop of transparent "Ranson's synthetic gum" was applied uniformly as a thin, 3-4 cm long layer on the lower surface of the leaf. After one hour of drying, the gum layer was carefully peeled off from the strip with a forceps. The peeling containing stomatal impressions was mounted on a glass slide and the stomatal frequencies were recorded. Five counts were made per leaf and five plants sampled per replication. The area observed for stomatal frequency per microscopic field was 2.98 mm^2.

Results and Discussion

Differences in stomatal frequency were significant among entries, among height groups, and within groups (Table 1). In *T. durum*, the stomatal density varied from 36.3 (Macs 11) to 46.7 (HI 4783) per microscopic field, with a mean of 40.8; while in *T. aestivum* it ranged from 28.1 (HP 795) to 50.4 (HD 1962), with a mean of 37.12 (Table 2). In *T. dicoccum*, *T. carthlicum*, barley, and triticale, the mean stomatal frequency was 41.5, 36.4, 46.85, and 38.05, respectively. The mean stomatal density in talls, D1, D2, and D3 groups was 39.3, 35.5, 34.8, and 33.3, respectively, in bread wheat. In general, the number of stomata increased with increased plant height. These results agree with those obtained by Sherman and Bread (1972) on *Agrostis* spp.

Table 1. Analysis of variance for stomatal frequency.

Source of variation	df	F ratio
Replications	2	0.07
Entries	51	5.73**
Among height groups	3	7.34**
Tall vs dwarfs	1	15.02**
Among dwarfs	2	3.50*
Within talls	28	5.09**
Within dwarfs (D1)	14	7.03**
Within dwarfs (D2)	4	3.97**
Within dwarfs (D3)	2	4.45**
Error	102	

* Significant at 5% level.
** Significant at 1% level.
EMS = 15.9.

The varieties HP 795, Sonalika, Monti, and Timgalin in *T. aestivum*; Macs 11, Macs 5, NI 5749, and Macs 9 in *T. durum*; and P 2923 in triticale had significantly fewer stomata per microscopic field. Presumably, these varieties with low stomatal density could have had an advantage when soil moisture was in short supply. They could be useful as parents when breeding for low stomatal number under rainfed conditions.

Table 2. Stomatal frequency per microscopic field (2.98 mm^2) in wheat and related species in rainfed condition

Variety	Stomatal frequency	Variety	Stomatal frequency
T. durum		Kalyansona	32.4
Talls		Sonalika	28.3
HI 7483	46.7	WL 303	33.5
NI 5749	38.6		
Macs 9	38.7	D2 Dwarfs	
Macs 88	43.5	S. Sonora	31.4
Macs 11	36.3	HD 2009	36.8
Macs 293	39.5	Raj 857	36.1
Macs 5	37.3	D3 Dwarfs	
D2 Dwarfs		Hira	40.4
HD 4502	44.9	Moti	28.8
HD 4530	42.1	Raj 723	30.7
T. aestivum		**Exotic**	
Talls		Talls	
HD 1917	36.3	Ridley	44.7
HD 1962	50.4	EC 57191	34.5
HD 1739	40.9	D1 Dwarfs	
HP 741	44.3	Green Valley	40.1
HS 1140-8-1	40.5	Timgalin	29.8
MP 157	33.8		
MP 152	31.0	**Other spp.**	
NI 5439	36.7	Talls	
Wa 377	34.3	*Triticum*	
C 306	40.6	*diococcum*	41.5
K 65	49.3	*Triticum*	
Narbada 4	37.8	*Carthlicum*	36.4
Hy 65	41.6	**Barley**	
NP 884	42.2		
HP 795	28.1	D1 Dwarfs	
WL 489	40.8	PB 226	46.5
D1 Dwarfs		K 572/10	47.2
Shera	41.5	**Triticale**	
HD 1982	41.2	Talls	
HD 1981	41.0	P 2923	32.6
HP 916	31.7	P 2936	43.5
HD 2021	31.8		
WL 399	32.8	SE (m)	3.2
Raj 821	38.5	CD at 5%	6.3
K 802	38.8		

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Susceptibility of Wheat Cultivars to Bacterial Blight

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Bacterial blight of wheat caused by *Xanthomonas campestris* pv. *translucens* (J.J. and R.) Dows (=*X. translucens*) was identified on barley by Jones *et al.* (1916), on wheat by Smith (1917), on rye by Reddy *et al.* (1924), and on triticale by Zillinsky and Borlaug (1971). In trials conducted in 1985 at the National Agricultural Research Centre, Islamabad, Pakistan, the bacterium was observed to cause severe blight on wheat (Akhtar and Aslam 1985). Bacterial blight represents a potential threat to wheat production in Pakistan, but so far, no detailed studies on this disease have been conducted in this country. The purpose of this study was to evaluate the resistance of some commercial wheat cultivars to bacterial blight.

Materials and Methods

Thirty commercial wheats comprising twenty early, six medium, and four late varieties were evaluated for resistance to *X. campestris* pv. *translucens* in the 1985/86 season at the National Agricultural Research Center, Islamabad. The seeds were planted during the third week of Nov in 1m-long rows spaced 30 cm apart, with a plant-to-plant distance of 7 cm. The bacterium was grown on yeast extract dextrose calcium carbonate (YDC) (Schaad 1980; Schaad and Forster 1985) in an incubator at 27^{o}C for 72 hrs. Ten plants from each entry were inoculated with a bacterial suspension adjusted to 1.2×10^7 colony forming units (cfu)/ml in a 0.01 M phosphate buffer. The concentration was verified with a spectrophotometer at 590 nm. The inoculation was made in Dec, Feb, and Mar, which approximately coincided with growth stages 6, 8, and 9, respectively (Wiese 1977). The plants were inoculated by hypodermic injection of a few micro-liters of inoculum into the leaves. Bacterial blight symptoms were evaluated on disease intensity percentage 10 days after each inoculation. Disease samples were collected, and the bacteria were isolated on YDC media and compared with an original stock culture.

Results and Discussion

None of the 30 commercial varieties was resistant to *X. campestris* pv. *translucens*. The mean disease rating ranged from 36.6% in ZA-77 to 83.3% in Pak-81 (Table 1). In terms of pathogenicity, the results of this study were similar to those obtained by Bamberg (1936), Boosalis (1952), Fang *et al.* (1950), and Cunfer and Scolari (1982), though different cultivars and bacterial strains have been used.

Bacterial blight ratings were highest in Mar and lowest in Apr, which indicates that wheat may be less vulnerable to this bacterium at late growth stages. There was not much variation among groups, though the late group tended to have a lower average disease rating. However, variation was observed among varieties within groups and, as expected, was lowest in Mar. Some varieties showed higher disease intensity as compared to others in different times. This variability in reactions needs further investigations. It would be desirable to test more cultivars with wider genetic basis for resistance to *X. campestris* pv. *tranlucens*.

Table 1. Disease rating (%) of wheat cultivars artificially inoculated with *Xanthomonas campestris* pv. *translucens*

Cultivar	Jan	Mar	Apr	Average
Early group				
Barani-83	70	90	60	73.3
Khyber-97	40	60	40	46.6
Indus-79	70	80	50	66.6
ARZ	70	80	30	60.0
Pavan	80	90	70	80.0
Pak-81	80	90	80	83.3
Lyallpur-73	80	80	50	70.0
ZA-77	30	50	30	36.6
Barani-70	60	70	30	53.3
Barani-79	50	60	30	46.6
C-271	30	60	40	43.3
C-273	50	60	40	50.0
C-518	50	60	30	46.6
C-591	40	60	50	50.0
Chenab-70	30	50	40	40.0
Local white	30	60	30	40.0
Mexipak	40	70	40	50.0
Pak-70	40	70	40	50.0
Sarhad-82	60	70	40	56.6
Punjab-76	70	80	50	66.6
Mean	53.5	69.5	43.5	55.5
Medium group				
LU-26	80	90	50	73.3
Sandal	80	80	30	63.3
Punjab-81	50	60	40	50.0
PARI-73	70	80	50	66.6
Yecora	70	80	50	66.6
WL-711	30	70	30	43.3
Mean	63.3	76.6	41.6	60.5
Late group				
Bahawalpur-79	60	70	60	63.3
Blue Silver	30	60	30	40.0
Sonalika	40	60	30	43.3
T.J.83	50	70	30	50.0
Mean	45.0	65.0	37.5	49.2

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The Interaction of Vesicular-Arbuscular Mycorrhizae and Common Root Rot (*Cochliobolus sativus*) in Barley

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Vesicular-arbuscular mycorrhizae (VAM) are soil-borne fungi that form a symbiotic relationship with the roots of a wide range of plants. Growth responses in mycorrhizal plants, which can be shown to be similar to those obtained by application of phosporus fertilizers, vary with the level of soil phosphorus available to both the plant root and the mycorrhizal fungus. In natural soil environments, mycorrhizae are not a substitute for phosphorus fertilizer, but rather improve its utilization efficiency. In addition, a mycorrhizal association is thought to benefit nutrient uptake and water use during periods of moisture stress (Hayman 1983). This symbiosis may be enhanced by localized placement of effective inoculum near the plant roots, and by selecting superior VAM strains and hosts (Abbott and Robson 1982).

The role of indigenous soil pathogens in dryland barley cultivation needs to be investigated. In particular, the effect of common root rot (a term used to designate a group of diseases of wheat and barley characterized by necrosis of lower leaf sheaths, culms, crowns, subcrown internodes, and roots) on VAM should be studied. *Cochliobolus sativus* (Ito and Kurib.) Drechsl. ex Dastur. and *Fusarium* spp. are primary pathogens isolated from necrotic root tissue of barley collected from countries of North Africa and the Middle East as well as from the Northern Great Plains of North America. Seed-borne and soil-borne inocula of these fungi are largely responsible for reduced yields under low moisture conditions during the growing season (Grey and Mathre 1984).

The purpose of this work was to determine the effects of VAM and *Cochliobolus sativus* separately and interacting together on two locally adapted barley cultivars grown under simulated low moisture conditions with high and low phosphorus-fertilizer regimes.

Materials and Methods

Chickpea (*Cicer arietinum* L.) plants were inoculated with spores of *Glomus* spp. collected from field soils at Tel Hadya, Syria. The resultant pot cultures were harvested at plant maturity and used as a source of mycorrhizal inoculum (courtesy of E. Weber, Food Legumes Improvement Program, ICARDA). To inoculate the plants, a mixture of soil-root VAM inoculum was layered on the soil surface (100 ml/container), sown with seed, and covered with a 6-8 cm layer of soil.

Common root rot inoculum was originally isolated from discolored subcrown internode tissue of barley plants collected from the ICARDA nursery at Bouider, Syria. Actively growing *C. sativus* cultures on corn meal agar were rinsed with sterile distilled water to collect detached conidia. The suspension was adjusted to a concentration of 10^3 conidia/ml, and 25 ml/container were poured on the soil surface both at planting and at plant emergence to insure infection. Four treatments were initiated: (i) VAM and *C. sativus* together, (ii) VAM alone, (iii) *C. sativus* alone, and (iv) no addition of either fungal inocula.

Plants were grown in columnar containers (1.0 x 0.15 m) cut from a polyvinyl chloride (PVC) irrigation pipe (Ellis *et al.* 1985). Each container was placed vertically with the lower end resting in a 6-liter pail. A greenhouse soil mix (soil:sand, 2:1) was steam pasteurized and 22 kg added to each container. Half of the containers contained soil mix fertilized with triple superphosphate (46% a.i.) at a rate of 4g/10 kg soil mix, and the rest contained a soil mix without supplemental fertilizer. The soil was brought to field capacity by filling the pails with water and allowing capillary action to saturate the soil. The containers were placed under a plastic cover with evaporative cooler ventilation. Average night/day temperature was 18/25°C until boot stage (Zadoks 38-42), and 25/33°C thereafter until harvest.

Seeds of two spring, 2-row barley (*Hordeum vulgare* L.) cultivars, namely, 'WI 2291' (Waite Institute, Australia) and 'Harmal' (Union x CI 03576 x Coho), free of chemical treatments, were provided by ICARDA's Cereal Improvement Program. These two varieties have shown good performance under dry conditions in West Asia (WI 2291) and North Africa (Harmal). Five seeds/container were planted on 1 Apr and thinned to 3 plants on 15 Apr. One month after emergence, 50 ml of potassium nitrate solution (70 ppm) were added to each container. Water was maintained in the pails until initiation of early boot stage (Zadoks 40-42), then the plants were stressed by discontinuing water addition to the pails. Watering from the top of the containers was to be discontinued after plant boot stage, but there was uneven water usage between treatments due to differences in plant biomass. A marginal amount of water was applied to the pails to even the water usage between treatments until plant maturity. The experimental design was a randomized complete block with three replications. Data were collected at maturity on plant dry weight and grain weight.

The subcrown internode tissue from each plant was surface sterilized in 10% commercial bleach and plated on acidified potato dextrose agar (2% w/v). The number of plants with subcrown internode tissue yielding *C. sativus* was determined.

Results and Discussion

The 1-m-long columnar container was adequate to grown spring barley to maturity in spite of high temperatures (> 30°C) during grain development. However, a low percentage of sterility among Harmal florets (< 10%) was noted in the VAM-phosphorus fertilizer treatment.

The consistent isolation of *C. sativus* from subcrown internode plant tissue taken from the non-inoculated treatments (Table 1) suggests that there was a residual level of background soil inoculum in spite of treating the soil with heat. Inoculation with *C. sativus* increased the percentage recovery by 1-2

Table 1. The frequency (%) of *Cochliobolus sativus* recovered from subcrown internode tissue of WI 2291 and Harmal under the four treatments (averaged over phosphorus and no-phosphorus treatments).

Cultivar	- VAM		+ VAM		Mean
	C. sativus		*C. sativus*		
	−	+	−	+	
WI 2291	22	62	28	50	42
Harmal	24	39	28	29	30
Mean	23	50	28	40	

folds in WI 2291 as compared to the non-inoculated treatments, but had no effect or only minor increase in Harmal. Phosphorus fertilization had no effect on the recovery of *C. sativus*. The frequency of *C. sativus* recovered from the subcrown internode tissue in Harmal was lower than in WI 2291 (30% and 42%, respectively).

Without adding *C. sativus*, the grain yield of WI 2291 was increased by VAM from 31.9 g to 46.6 g with supplemental phosphorus, but there was no increase without phosphorus (Table 2). This would confirm that a VAM symbiosis with a barley plant requires a minimum level of available phosphorus for beneficial growth responses to result (Hayman 1983). However, when both VAM inoculum and phosphorus fertilizer were applied, *C. sativus* inoculation significantly reduced the yield of WI 2291 to a level similar to that of a non-fertilized treatment, and negated any benefits provided by VAM inoculation. A similar effect of *C. sativus* inoculation was observed on plant dry weight.

In contrast to WI 2291, Harmal showed no response in grain yield to the addition of phosphorus fertilizer, VAM, or *C. sativus* (Table 2). With VAM inoculation only, Harmal's plant dry weight significantly decreased in response to phosphorus application, but increased when both VAM and *C. sativus* inoculation accompanied phosphorus addition (Table 2). This increase in plant dry weight and the lower frequency of *C. sativus* recovered from Harmal plant tissue suggest that Harmal may exhibit a higher level of tolerance to *C. Sativus* infection than WI 2291.

It appears that the beneficial effects of a VAM symbiosis may be negated by infection with soil pathogens such as *C. sativus*. Results from this study should be confirmed by field experiments. Detailed experiments with varying levels of both VAM and *C. sativus* inoculum and sampling during growth stage would aid in elucidating the complex interactions among soil-borne organisms.

Table 2. The effect of *Cochliobolus sativus* and vesicular-arbuscular mycorrhiza (VAM) fungi on grain yield and plant dry weight (g/3 plants) of two barleys, WI 2291 and Harmal, grown with and without phosphorus fertilizer.

	- VAM		+ VAM		LSD (P<0.05)
	C. sativus		*C. sativus*		
	−	+	−	+	
WI 2291					
Grain yield					
No Phosphorus	26.0	25.0	23.2	31.7	19.4
phosphorus	31.9	28.7	46.6	24.8	
Dry weight					
No Phosphorus	34.6	48.9	33.8	43.6	23.3
phosphorus	66.7	42.0	63.7	39.3	
Harmal					
Grain yield					
No Phosphorus	30.4	21.3	31.1	35.0	NS
phosphorus	27.1	37.1	31.1	34.3	
Dry weight					
No phosphorus	40.8	40.7	61.1	50.4	21.1
phosphorus	46.8	61.9	33.4	65.4	

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Yield and NPK Uptake by Wheat as Influenced by Fertilizer and Manure Application

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The beneficial effect from the addition of organic matter to the soil in Pakistan has been shown by Azad and Yousaf (1982). The application of N and P to Pakistani soils has also been shown to enhance crop production (Chaudry 1983). Little is known however, about the long term effects of fertilizer, manure, and frequency of application under different cropping systems (AARI 1983; Anonymous 1983). The National Agricultural Research Center (NARC), Islamabad, initiated during *rabi* 1983 a long-term field trial to study the effect of manure and commercial NP-fertilizer under different cropping patterns on crop productivity and soil properties. The present report discusses the effect of some of the fertilizer and manure treatments on wheat yield and NPK uptake by wheat.

Materials and Methods

Soil characteristics of the experimental site at NARC experimental farms, Islamabad, are presented in Table 1. Soil texture was analysed following Day (1965). Chemical analyses were carried out according to the standard procedures described by Richards (1954). The original plan involved three variables, namely, cropping system, frequency of fertilization, and individual and combined application of organic manure and chemical fertilizers. A split-split plot design with four replications was used. During the first year of the study, the three cropping patterns started with wheat. The four fertilizer and manure treatments were each repeated 36 times and consisted of (i) a control, (ii) 120 kg N + 60 kg P/ha, (iii) 20 t manure/ha, and (iv) 120 kg N + 60 kg P + 20 t manure/ha. The sources of N, P, and manure were urea, single super phosphate, and farmyard manure, respectively.

Grain yield was measured from an area of 105 m^2. Straw yield and grain/straw ratio was measured and calculated from three 1-m^2 grids. Composite grain and straw samples prepared from ground material from 36 plots under each of the four treatments were analysed in triplicate for NPK. NPK uptake by wheat plants was calculated based on NPK concentration in grain and straw and on grain and straw yield. No estimate was made of the nutrients present in the roots.

Table 1. Soil characteristics of the experimental site.

Mechanical composition (%)		
Sand		41.24
Silt		28.90
Clay		29.86
Class		Clay loam
pH (paste)		7.84
ECe (mmho/cm)		0.66
Soluble ions in saturation (me/l)		
Na^+		0.50
K^+		0.68
Ca^{++}		6.25
Mg^{++}		9.45
Cl^-		1.30
CO_3^{--}		1.80
HCO_3^-		1.62
SO_4^{--}		1.66
Exchangeable cations (me/100 g soil)		
Na^+		1.13
K^+		0.20
$Ca^{++} + Mg^{++}$		19.37
CEC		20.50
ESP	(%)	5.51
Organic matter	(%)	0.62
$CaCO_3$	(%)	0.95
Total-N	(%)	0.07
$NaHCO_3$-P	(ppm)	6.00

Results and Discussion

While manure alone did not increase either grain or straw yield, the application of NP-fertilizer with and without manure resulted in significant yield increases over the control. Grain and straw yields were significantly higher than in the other three treatments when both NP-fertilizer and manure were added. No significant effect on grain/straw ratio was noted (Table 2).

Table 2. Effect of manure and NP-fertilizer on mean wheat grain and straw yield.

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Grain/straw ratio
Control	3.37	6.97	0.49
NP	3.83	8.74	0.44
Manure	3.44	7.44	0.47
NP+Manure	4.41	9.40	0.48
Significance	**	**	NS
LSD (P<0.05)	0.23	0.51	

** = significant at the 1% level, NS = nonsignificant.

The application of NP-fertilizer and NP+manure increased grain-N from 2.03% (control) to 2.38% and 2.31%, respectively (Table 3), but had no effect on straw-N. The highest grain-N uptake of 102 kg/ha (149% of the control) was recorded in the NP+manure treatment (Table 4). No appreciable effect on P concentration in wheat grain and straw was observed.

Individual and combined application of NP-fertilizer and manure produced a more pronounced effect on K concentration and uptake in straw than in grain (Tables 3 and 4). The application of manure and NP+manure increased K from 0.82% (control) to 1.05% and 1.24%, respectively. The uptake of K by straw under the NP+manure treatment was the highest (117 kg/ha), about 106% higher than under the control.

Results showed that although soil was originally low in organic matter, mere application of manure did not significantly increase wheat grain or straw yield. However, there was a positive interaction of manure with applied NP-fertilizer on both grain and straw yield, which suggested that the favorable effect of manure might have been due to soil tilth rather than fertility *per se*.

No appreciable change in P uptake by wheat was observed; an increased K uptake by wheat straw was rather noted. This phenomenon suggests that K, besides N and P, should be included in future trials.

Table 3. Effect of manure and NP-fertilizer on NPK concentrations (%) in wheat straw and grain.

Treatment	Grain			Straw		
	N	P	K	N	P	K
Control	2.03	0.18	0.51	0.025	0.02	0.81
NP	2.38	0.18	0.48	0.025	0.02	0.89
Manure	1.93	0.15	0.43	0.025	0.01	1.05
NP + Manure	2.31	0.19	0.48	0.025	0.01	1.24

(%)

Table 4. Effect of manure and NP-fertilizer on NPK uptake (kg/ha) by wheat grain and straw.

Treatment	Grain			Straw			Total		
	N	P	K	N	P	K	N	P	K
Control	68.4	6.07	17.1	1.74	1.39	56.4	70.1	7.46	73.6
NP	91.1	6.89	18.3	2.19	1.75	77.7	93.3	8.64	96.1
Manure	66.3	5.16	14.7	1.86	0.74	78.1	68.2	5.90	92.9
NP+Manure	101.8	8.38	21.1	2.35	0.94	116.5	104.2	9.32	137.7

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Short Communications

Genetic Resources of Wild Relatives in Cereal Crops II. Prospects for *in situ* Conservation

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In recent years, *in situ* conservation of wild and weedy germplasm has been advocated (Altieri and Merrick 1987). A major arguement in favor of this method is that when seeds are collected and stored in a genebank, their dynamic evolution stops. In contrast, evolution in the wilds is continuous, which is desirable for the retention of genes for disease and pest resistance (Hoyt 1988).

Several aspects, however, have to be studied before adopting this method:

- The taxonomy of most wild crop relatives needs clarification, and genetic diversity within areas must be ascertained. Valuable time and funds can be lost if incorrect areas or types are conserved.
- Eco-geographical surveys of occurrences and the determination of the biological requirements of individual types are vital and need to be studied. All too often these components are lacking in *in situ* conservation programs, resulting in the loss of many populations as well as individuals. Criteria such as minimal viable population size and area must be scientifically determined. Access to germplasm must be maintained and regulated to preserve genetic integrity.
- Conservation objectives for specific species and their populations are as yet unclear and must be ascertained on a site-specific basis. This will require considerable amount of basic research and technical progress before *in situ* conservation can be considered as a practical option.
- There is a lack of monitoring devices for the populations which are already conserved on an *in situ* basis and data on these are, on the whole, unavailable. Standardization of data is not adequate for wild relatives and hence information is not freely exchangeable at present.
- As wild species of some crops such as wheat and barley hybridize freely with the cultivated types, considerable care should be taken to see that *in situ* conservation areas in the proximity of cultivated fields do not cause mass scale hybridization, hence, considerable loss to the farmer.

Existing protected areas such as wild life reserves constitute good *in situ* conservation sites where the germplasm of wild species is preserved in its natural ecosystem. However, such a 'genetic reserve' should encompass adequately large and diverse populations in different types of habitats to sustain the desired level of diversity for future crop improvement.

In conclusion, *in situ* conservation has some advantages but is not feasible with the present infrastructure. Although one may like to develop the necessary infrastructure for such an activity with the cooperation of international agencies, much more work is needed to understand the population dynamics, ecology, and genetics of the wild species. In addition, a clear concept of the exact commitments in terms of science, logistics, economics, and politics is a dire need for successful *in situ* conservation.

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Barley Research at the Institute of Agricultural Science in the Coastal Area, Jiangsu, China

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The Institute of Agricultural Science in the Coastal Area, Jiangsu (IASCAJ) was founded in 1959 with the objective of conducting research tackling the agricultural problems of this region. The IASCAJ is located in Yancheng district which lies along the western shore of the Pacific Ocean between 32°35'-34°25' N and 119°25'-120°56' E, covering 10 000 km^2 of which 650 000 ha are cultivated. Yancheng is one of the most important Chinese barley-growing districts, with a barley-planted area and yield representing 5% and 10% of those of China, respectively. The area under 2-row malting barley represents 12% of that of the country and meets one third of China's total demand for this commodity.

The IASCAJ has five programs engaged in research on barley, food crops, cotton, saline soil amelioration, and plant protection, respectively. The Barley Program consists of three sections, two laboratories, and an editorial department.

The New Cultivars Breeding Section is responsible for developing feed and malt high-yielding cultivars with good quality and resistance to common diseases in Jiangsu Province. Three cultivars (YC1, YC5, and YC9), which had been bred by the New Cultivar Breeding Section, were widely grown before 1980. Two malting cultivars, namely, YFA3 and SP1, have been subsequently developed. YFA3 was registered in 1982 and is now the most widely grown malting barley in China, occupying a total area of 350 000 ha in 21 provinces, which won the Barley Program the third, second, and first awards for scientific and technological achievement given by the Ministry of Agriculture, Animal Husbandry, and Fishery; Jiangsu Province Government; and Yancheng District Government, respectively. SP1 was registered in 1986, and became widely grown in many provinces including Shandong, Hebei, Xingjiang, Zhejiang, Yunnan, and Anhui over an area of about 160 000 ha. Four malting cultivars, namely, 80-192, 84-117, J-75, and J-63 are expected to be released soon. The first two are resistant to barley yellow mosaic virus (BYMV) while the other two are high yielding cultivars.

The Cultivation Section evaluates new barley cultivars bred at the IASCAJ or introduced from other provinces, countries, and international organizations, and develops cropping systems to improve yield and quality. This section was awarded the second and first prizes for scientific and technological achievement in studies on barley cropping systems by Jiangsu and Yancheng Governments, respectively. In addition, a classification of wheat and barley growing areas in the coastal regions of Jiangsu has been completed.

The Germplasm Section collects and identifies local and foreign barley varieties, and works in coordination with foreign and international organizations such as the International Center for Agricultural Research in the Dry Areas (ICARDA), Syria, and Kirin and Sappora Beer corporations, Japan. Many malt barley varieties adapted to Yancheng have been identified. It has also been verified that Japan's and Yancheng's barley-growing areas have similar agro-ecological conditions, which allows them to make use of each other's barley germplasm. In addition, the Germplasm Section has finished cataloguing the local barley varieties in Jiangsu.

The Barley Program also has a grain and malt quality laboratory and a biology laboratory. In the latter, research is conducted on *in vitro* techniques with special emphasis on production of haploid plants and introduction of interesting traits from wild germplasm.

The Editorial Department publishes Barley Newsletter, the journal of the Barley Council of Chinese Crop Association. Barley Newsletter was started in 1984, and eleven issues have been published so far.

The Barley Program comprises 11 research workers (three senior, three intermediate, and five junior research workers), seven technicians, and nine field workers. The facilities available consist of experimental fields (4.66 ha), offices and computer room (200 m^2), quality laboratory (100 m^2), biology laboratory (100 m^2), greenhouse (260 m^2), disease nursery (700 m^2), plant characters observation room (120 m^2), threshing room (60 m^2), and seed storehouse (20 m^2) as well as a set of micromalt producing facilities, and instruments for analysing barley grain and malt quality.

Screening for High-yielding Triticales to Replace Wheat in the Cukurova Region of Turkey

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In Turkey, triticale is being introduced to environments that are unsuitable for wheat production. Triticales that can outyield wheat under unfavorable environmental conditions are needed also in the rainfed wheat-producing areas of Cukurova.

In the Cukurova region, wheat is mostly grown as monoculture. The growing period, which is characterized by large seasonal fluctuations in rainfall and temperature, is between 15 Nov and 15 June. In 1985, the total area under wheat, mostly bread wheat, was 504 000 ha (Anonymous 1985). Triticale is not yet cultivated on a commercial scale.

The purpose of this study was to determine the grain yield and physical grain quality characteristics of some promising triticale from ICARDA and CIMMYT, and to compare them with those of commercial wheat cultivars grown in Cukurova.

Forty-six selected triticale lines and two wheat cultivars were tested for grain yield, 1000-kernel weight, and test weight under rainfed conditions in Cukurova in 1985, 1986, and 1987. The local bread wheat cultivar Cumhuriyet-75 and the local durum wheat cultivar Gediz-75 were used as checks. The experiment consisted of two trials each comprising 23 triticale lines and the two checks (Table 1). The experimental design was a randomized complete block with four replications. The plot area was 6.0 m^2 (1.2x5.0 m), with 8 rows/plot spaced 0.15 m apart. The seeds were drilled at a rate of 450 grains/m^2. At maturity, grain yield was determined by combine-harvesting the six central rows of each plot.

Differences were significant among the genotypes in all three studied characters. When averaged over the three seasons, 22 and 4 triticale lines gave significantly higher yields than the wheat checks in trial I and II, respectively (Table 1). Entry 20010 (Drira OutCross x 21295-OAP6) from ICARDA was the highest yielding line in trial I. With an average yield of 6670 kg/ha, it exceeded that of the highest yielding check by 23%. It yielded more than the checks in all three seasons; the difference was significant in two of them. In trial II the highest yielding line was 20045 (Merino's'-JLO) with an average yield of 6730 kg/ha, which was 14% higher than the checks. It also yielded more than the checks in all three seasons, but the yield difference was significant in only one.

Table 1. Mean of grain yield, 1000-kernel weight, and test weight of 46 triticale lines and two wheat cultivars in Cukurova, 1985-87.

Field trial I				Field trial II			
Entry	Grain yield (kg/ha)	1000-kernel weight (g)	Test weight (kg/hl)	Entry	Grain yield (kg/ha)	1000-kernel weight (g)	Test weight (kg/hl)
10002*	5410 e[&]	44.3 bcd	80.3 b	10002	5880 d-g	48.5 a	79.9 b
00001**	5330 e	41.4 d-h	81.4 a	00001	5860 efg	43.0 c-f	81.0 a
20001	5960 bcd	44.7 bcd	71.3 hi	20024	6430 a-e	42.1 c-g	76.0 cd
20002	5550 de	43.1 b-f	73.0 efg	20025	6570 ab	39.7 e-h	72.4 k
20003	6150 abc	43.8 b-e	72.8 efg	20026	5760 fg	47.2 ab	73.1 jk
20004	5400 e	39.0 h-k	74.5 d	20027	6250 a-g	36.6 h	76.5 c
20005	6400 ab	43.1 b-f	72.1 gh	20028	6500 abc	41.0 d-g	73.9 hij
20006	6100 bcd	44.9 bc	72.3 gh	20029	6230 a-g	38.4 gh	73.3 ijk
20007	5630 cde	49.4 a	73.5 def	20030	5770 fg	40.9 d-g	72.4 k
20008	6180 abc	43.9 b-e	72.6 fg	20031	5680 g	46.2 abc	75.2 def
20009	6040 bcd	37.5 ijk	73.7 de	20032	5760 fg	47.4 ab	74.5 e-h
20010	6670 a	41.3 d-h	72.1 gh	20033	5800 fg	42.9 c-f	74.1 ghi
20011	6140 abc	45.4 bc	70.7 ij	20034	5960 c-g	43.1 c-f	74.2 f-i
20012	6000 bcd	42.0 c-h	70.9 i	20035	6120 b-g	38.9 fgh	75.5 cde
20013	6410 ab	42.6 b-g	72.4 gh	20036	6050 b-g	41.9 d-g	74.3 f-i
20014	5950 bcd	45.7 b	75.9 c	20037	5860 efg	48.1 a	76.0 cd
20015	6080 bcd	39.1 h-k	71.5 hi	20038	6520 abc	41.2 d-g	72.8 k
20016	6300 ab	43.0 b-f	72.3 gh	20039	6070 b-g	44.1 bcd	75.2 def
20017	5940 bcd	35.9 k	71.4 hi	20040	5930 d-g	42.8 c-f	75.3 def
20018	6150 abc	39.6 g-j	69.2 k	20041	6280 a-f	44.1 bcd	75.7 cd
20019	5990 bcd	40.2 f-i	69.9 jk	20042	6450 a-d	42.5 c-g	76.0 cd
20020	6140 abc	45.4 bc	72.6 fg	20043	6430 a-e	43.7 b-e	76.5 c
20021	6420 ab	46.0 b	72.8 efg	20044	6390 a-e	45.1 a-d	74.5 e-h
20022	6370 ab	40.7 e-i	76.0 c	20045	6730 a	48.2 a	75.1 d-g
20023	6130 abc	36.4 jk	75.6 c	20046	6280 a-f	41.1 d-g	75.3 def
Mean	6030	42.3	73.2	Mean	6140	43.1	75.2

& Means in each column followed by the same letters are not significantly different at the 5% level determined by the Duncan's new multiple range test.

* bread wheat check.

** durum wheat check.

In general, the triticale lines had a lower 1000-kernel weight than the bread wheat checks (Table 1). However, entry 20007 had a significantly higher kernel weight. Entries 20010 and 20045 had a kernel weight comparable with that of the bread wheat check. All triticale lines had a significantly lower test weight than the two wheat checks (Table 1).

In conclusion, some high yielding lines with lodging resistance, earliness, acceptable kernel weight and test weight, and plump smooth kernels have been identified. Entries 20010 and 20045 have the potential of being released as cultivars.

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The Response of Wheat Cultivars to Different Dates of Nitrogen Application in Eastern Sudan

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In the Sudan, wheat (*T. aestivium*) is traditionally grown in the north, but has been recently introduced in new regions, mainly the Gezira and New Halfa Schemes (Ali 1987), to cope with the increasing demand for this crop. Wheat yields in the New Halfa Scheme are low, perhaps because of bad timing of nitrogen fertilizer application. This study attempted to find the optimal N-application date for the scheme.

The trial was conducted at New Halfa Research Farm (15° 19' N; 38° 41' E) in 1982/83, 1983/84, and 1984/85. Three wheat cultivars, namely, Mexicani, Debeira, and Giza 155 were compared. There were 4 nitrogen application dates: at sowing, and at 2, 3, and 6 weeks after sowing. Eighty-six kg N/ha was hand-broadcasted as urea. The crop was grown on 90 cm beds with a 20-cm row spacing. The plot size was 4.5x7.0 m and the harvested area was 2.7x5.0 m.

There was no significant nitrogen x cultivar interaction for grain yield in all three seasons. Grain yield differences due to N-application at different dates were not significant in the first two seasons. In 1984/85, applying nitrogen 6 weeks after sowing produced a significantly higher yield than N-application at sowing (Table 1). Averaged over the three seasons, N-application 6 weeks after sowing gave the highest yield.

Timing of application did not appear as important as expected. N-application 4-6 weeks from sowing could produce higher grain yields if weeding has already been completed. This confirms the results of Ayoub (1972). However, other workers recommend that N be applied at sowing for practical reasons (Ali 1987; Akasha 1974).

Yield differences among cultivars were not consistent, as each cultivar outyielded the other two in one of the three seasons (Table 2). In general, Debeira performed better than the other two cultivars under good growing conditions, but was more susceptible to termite attacks. Daffala (1972, 1973) found Mexicani to outyield Giza 155.

Table 1. Grain yield (t/ha) averaged over the three cultivars at various N-application dates in the three seasons.

Timing of N application (weeks after sowing)	Season			
	82/83	83/84	84/85	Mean
0	3.09	1.97	2.09	2.38
2	3.07	2.00	1.95	2.34
4	2.88	2.07	2.24	2.40
6	3.16	1.95	2.31*	2.47
SE (±)	0.14	0.09	0.09	

* Significantly greater than N-application at sowing at the 0.05 level.

Table 2. Average grain yield (t/ha) of the three cultivars in the three seasons.

Cultivar	Season			
	82/83	83/84	84/85	Mean
Giza 155	3.09	1.28	2.64	2.34
Mexicani	3.19	2.33	1.52	2.35
Debeira	2.88	2.36	2.31	2.52
SE (±)	0.12	0.07	0.07	

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Survey of Hessian Fly in Northern Tunisia*

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Hessian fly (HF), *Mayetiola destructor* Say, has long been known to infest wheat in North Africa (Jourdan 1937, 1938; Durand 1967). Yearly surveys are currently performed for HF in Morocco where 100% crop losses have been observed in severely infested wheat fields south of Settat (Kieth *et al.* 1986). Recent yield losses due to HF have been estimated at about 200 million dirhams ($27 million US). In addition, the Great Plains Uniform Hessian Fly Nursery (UHFN) composed of wheats containing known HF resistance genes, is planted annually at several sites in Morocco. Results of screening the UHFN suggest that the H5, H11, and H13 genes confer resistance to Moroccan HF (El Bouhssini and Hatchett 1986). Morocco barley fields have also been observed with high HF infestations, although yield losses due to comparable HF infestations appear much lower than in wheat.

In Tunisia wheat and barley are annually planted on 1.2 to 1.5 million ha, half of which is located in the relatively favorable northern areas receiving 350 mm to over 1000 mm rainfall each year. The central and southern production zones, receiving 150 mm to 350 mm rainfall and less than 150 mm rainfall, respectively, are more heavily planted to barley (69% of total barley production) as compared to bread wheat (28% of total bread wheat production) and durum wheat (40% of total durum wheat production). Durum wheat comprises about 55% of the total hectarage planted to cereals, with bread wheat and barley covering 19% and 26%, respectively (Kamel *et al.* 1988).

Hessian fly was observed in wheat in Tunisia in 1986 (J. Hatchett, personal communication, USDA-ARS, Manhattan, KS). However, no attempts have been made to quantify HF infestations in Tunisia in recent years. It was found necessary to assess the extent of Tunisian wheat and barley HF infestations prior to initiating HF control programs there.

Methods

The survey was conducted in early May 1988, a period which coincided with the heading of most wheat in northern Tunisia. The survey was conducted by visually inspecting wheat and barley fields along a transect formed by paved roads traveled by the survey team. Fields were inspected at about 20-km intervals. Five individuals inspected about 100 stems at each sampling site, and an overall infestation estimate was then calculated for the field.

Results and Discussion

A total of 53 wheat fields and 16 barley fields were inspected over a two-day period (Table 1). A greater proportion of barley fields were infested than wheat fields, with infestation levels also generally higher

Table 1. Results of 1988 Hessian fly survey in northern Tunisia. The survey was conducted over two days along the itineraries shown.

May 2: Tunis-Tabarka-Bizerte-Tunis

Wheat		**Barley**	
% Infection	*Frequency*	*% Infection*	*Frequency*
0	11	0	1
1-10	4	1-10	1
11-20	2	11-20	1
21-30	0	21-30	0
31-40	0	31-40	0
41-50	1	41-50	0
> 50	2	> 50	2

May 3: Tunis-Beja-Kef-Tunis

Wheat		**Barley**	
% Infection	*Frequency*	*% Infection*	*Frequency*
1	12	0	0
1-10	19	1-10	2
11-20	0	11-20	1
21-30	0	21-30	1
31-40	0	31-30	2
41-50	0	41-50	2
> 50	2	> 50	3
Total fields infected 57%		**Total fields infected 94%**	

* Cooperative activity between the International Center for Agriculture Research in the Dry Areas (ICARDA), the National Institute of Agronomy Research (INRA) in Morocco, the National Institute of Agronomy Research in Tunisia (INRAT), and the Mid-America International Agricultural Consortium (MIAC). Financing was provided by ICARDA and through USAID/MIAC.

in barley than in wheat. Some wheat plants were infested above the first node, indicating that a second generation of flies had emerged prior to the survey. Flaxseed pupae found on barley frequently were surrounded by oblong galls, a symptom also observed in HF infested barley in Morocco.

Hessian fly infestations were limited to areas not affected by the severe drought Tunisia was experiencing at the time of the survey. Younger wheat and barley were more frequently and more heavily infested than more mature fields. All HF observed were in the flaxseed pupa stage, or had emerged from the pupae prior to the survey.

While it is impossible to estimate yield losses in such a cursory survey, it is apparent that HF is present in significant numbers in the most productive cereal producing areas of Tunisia. Had the severe drought of 1987/88 not destroyed wheat and barley crops in central and southern Tunisia, HF would have been observed there, perhaps in greater number than in the wetter northern region. Further survey work in Tunisia is justified and should be coupled with estimates of yield loss. The presence of HF in Tunisià and in a wide range of rainfall zones and elevations in Morocco suggests that it will also be found in Algeria. Annual surveys in each of these three countries coupled with the screening of nurseries possessing lines with known resistance genes to HF would provide valuable information on the biology of HF and would allow entomologists and breeders to begin to identify resistant wheats and barleys for use by farmers across the Maghreb region.

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Kamel, A.H., Harrabi, M., Deghaies, M., Halila, H. and Ben Salah, M. 1988. Wheat and barley diseases in Tunisia. Rachis 6(2):24-28.

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Recent Publications

Joshi, L.M., Singh, D.V. and Srivastava, K.D. 1988. Manual of wheat diseases. Malhotra Publishing House, A-38/3, Mayapuri Industrial Area, New Delhi-110 064, India. 75 pp. ISBN 81-85048-07-X.

This manual deals with wheat diseases common to the various regions in India. It contains a presentation of new techniques recently adopted in field and glasshouse investigations on wheat diseases including symptomatology, isolation of the pathogen, multiplication and preservation of inoculum, and *creation* of epiphytotics in the field for screening germplasm and recording field data. This book will help scientists and technicians conducting research on wheat diseases in India in maintaining uniform data collection as well as in properly interpreting results.

CIMMYT (Centro Internacional de Mejoramento de Maiz y Trigo). 1989. Wheat research and development in Pakistan. CIMMYT, Mexico, D.F. 129 pp. ISBN 968-6127-31-3.

This book consist of a survey of wheat research and development in Pakistan covering the last 25 years. In its seven chapters, the volume provides an overview of agriculture in Pakistan and the main factors that led to the wheat revolution and the growth and development of the wheat economy in the country. Latest research data as well as the best recommendations for improving productivity of wheat have been included. The book also acquaints the readers with the infrastructure of the national wheat research system in Pakistan, and the various technologies currently used and constraints faced in production.

Fabriani, G. and Lintas, C. (eds.). 1988. Durum, chemistry and technology. American Association of Cereal Chemists, 3340 Pilot Knob Road, St Paul, Minnesota 55121, USA. 332 pp. ISBN 0-913250-50-3.

This multiauthored book comprises reviews on the chemistry and technology of durum wheat and its derived products in addition to an updated bibliography. The nineteen chapters that constitute the book have been written by experts and touch on origin, distribution, and production of durum wheat in the world; genetics and breeding; pathology; biochemistry; technological and nutritional characteristics; and other topics related to durum wheat and its derived products.

Anderson, J.R., Herdt, R.W. and Scobie, G.M. 1988. Science and food, the CGIAR and its partners. The International Bank for Reconstruction and Development/The World Bank, 1818 H Street, N.W., Washington, D.C. 20433, USA. 134 pp. ISBN 0-8213-0947-1.

This book gives a general view of the various activities of the CGIAR and its related International Agricultural Research Centers, and their effect on agriculture in the developing countries. The authors, more specifically, have tried to determine what the Centers have done to help the developing countries improve their own agricultural research capabilities and what contributions they have made, directly or collaboratively with national programs, towards increasing food production. In the study, however, no clear-cut boundary has been drawn between the centers' contribution and that of their national collaborators, but it was rather concluded that advances in agriculture are continuing and progress is being made in many crops and technical areas where the CGIAR centers are involved.

Agrios, N.G. 1988. Plant pathology (3rd ed.). Academic Press, 1205 Sixth Avenue, San Diego, California 92101. 803 pp. ISBN 0-12-044563-8.

This book incorporates the new important developments in plant pathology that occured after the publication of the second edition. Two new chapters, "Plant Disease Epidemiology," and "Application of Biotechnology in Plant Pathology," have been added, whereas already existing chapters have been expanded and revised to include more information on the history of plant pathology, development stages of the diseases, mode of attack of the pathogen, the genetics of plant diseases, as well as integrated pest management and new chemical and biological agents for plant disease control.

Miller, T.E. and Koebner, R.M.D. 1988. Proceedings of the Seventh International Wheat Genetics Symposium, 13-19 July 1988, Cambridge, England. Institute of Plant Science Research, Cambridge Laboratory, Trumpington, Cambridge CB2 2JB. 1423 pp. ISBN 0-7084-0483-9.

Cereal News

Dr Guillermo Ortiz-Ferrara, CIMMYT/ICARDA Bread Wheat Breeder, visited the Egyptian National Program from 12 to 17 Mar 1989. He had discussions with Drs R.A. Fischer (Wheat Program Director, CIMMYT), B.C. Curtis (CIMMYT/Ankara), W.L. McCuiston (NARP's Inter-disciplinary Research Advisor), and Abdel Maboud Abdel Shafi Ali (National Wheat Research Coordinator) on the ARC/ICARDA Cereal Nile Valley Regional Program, as well as on a new cooperation agreement between ARC (Egypt) and ICARDA. During his stay he also evaluated and selected durum and bread wheats in upper Egypt. The wheat season in Egypt has been usually cool this year and extensive aphid infestations were observed in the Shandaweel, Quena, and Sohag.

Drs Astrid Gland, P. Zwergert, H. Soller, and Mr M. Mayer from Hohenheim University, Federal Republic of Germany, visited ICARDA 16-21 Mar 1989 and discussed scientific research of mutual interest with biotechnologists and scientists of the Cereal Improvement Program. They also visited Breda and Bouider experimental stations. Plans for future collaborative research have also been discussed.

Dr Ahmed Zahour, Cereal Scientist, ICARDA, travelled to Egypt on 26 Mar 1989 for a five-day visit. The main purpose of the visit was to get acquainted with the barley breeding program in Egypt and to meet with the Egyptian barley workers, with an aim of strengthening cooperation between ICARDA and ARC, Egypt. He called at several locations and trials as well as farmers fields, and had discussions with Dr Abdel Fattah El Sayed, Leader, Barley Program, Dr Maher Noaman, Barley Breeder, and other Egyptian cereal scientists.

Dr Edmundo Acevedo, Cereal Physiologist, ICARDA, travels to Montpellier (France), Morocco, and Algeria. In his visit to Montpellier (3-7 Mar 1989), Dr Acevedo had meetings with Drs A.P. Conesa and P. Monneveux to discuss (i) the technical aspects and logistics of a joint INRA/ICARDA training workshop on "Strategies for Developing Stress Tolerance in Cereal Crops" for the Maghreb countries in Apr 1990; (ii) the progress of laboratory experiments and field assessments of nurseries jointly grown by INRA, ENSA, and ICARDA within the frame work of collaborative project on "Physiology/Breeding for Improved Performance of Durum Wheat in Dryland Areas;" and (iii) details of the International Symposium on Physiology/Breeding of Winter Cereals for Stressed Mediterranean Environment to be held at Montpellier 3-6 July.

Dr Acevedo then flew to Morocco and discussed with Moroccan scientists and Dr M.S. Mekni wheat and barley adaptation trials at Djemaa Shaim, Sidi El Ayali, and Annaceur. In Algeria, he visited the cereal physiology nurseries at El-Khroub Station, and discussed program activities with Dr Benbelkacem, director of the station, and Dr Meziani Larbi, Cereal Physiologist. Dr Acevedo's trip also included a visit to the ITGC headquarters, Algiers, where he discussed with Dr Ait Amer, Director General, ITGC, the stress physiology project.

Prof Ronald W. Stubbs from the Research Institute for Plant Protection (IPO), Wageningen, The Netherlands, visited ICARDA's Cereal Improvement Program in March 1989. His discussions with the cereal scientists of the Program mainly centered on the problems of yellow and stripe rust. Prof Stubbs is one of the leading scientists working on *Puccinia striiformis* on wheat and barley. He has been analyzing this pathogen's incidence on a global basis for the last 25 years.

Elite lines of durum wheat landraces identified at ICARDA. The project on "Evaluation and Documentation of Durum Wheat Germplasm" is nearing completion. During the last four seasons the project has identified 1693 lines of durum landraces with the following desirable traits: tolerance to cold in the early vegetative phase; early heading; long grain-filling period; early heading and long grain-filling period combined; tolerance to yellow rust, common bunt and septoria; combination of tolerance to two diseases; tolerance to saline soils; combination of early heading, long grain-filling period, high tillering, and tall plants; combination of high 1000-kernel weight, tillering capacity, number of seeds/spike, and grain yield. A report listing theses accessions, other evaluation data, and information on environmental conditions under which this study was conducted is in press and will soon become available. Breeders and germplasm scientists from the national programs are encouraged to request this material which is available in limited quantities of seed. Please contact Dr A.B. Damania or Mr L. Pecetti in the Cereals Improvement Program at ICARDA.

Training course in cereal pathology. The Cereal Improvement Program conducted at ICARDA headquarters, Aleppo, Syria, a short training course on "Cereal Disease Methodology with an Emphasis on Cereal Rust" form 21 Mar to 4 Apr 1989. Cereal program pathologist, as well as other ICARDA scientists, contributed to the course. Prof Stubbs, whose visit to ICARDA coincided with the course, was invited to lecture. Twelve trainees from Algeria, Egypt, Ethiopia, Morocco, Tunisia, Turkey, Sudan, and Syria attended this course which also included a field day at the Latakia nursery on 1 Apr.

Dr Philippe Monneveux from the Chaire de Phytotechnie, Station d'Amelioration des Plantes, ENSA/INRA, Montpellier, France, visited ICARDA 20-28 Mar 1989. He worked mainly with Dr Acevedo on finalizing technical aspects of the Physiology and Cereal Breeding Training Workshop for North African Scientists to be held in 1990. Dr Monneveux also discussed durum germplasm evaluation for salinity with Dr A.B. Damania as tests at Montpellier showed several lines from germplasm collection supplied last year to confirm salinity tolerance. Dr Monneveux has requested more of the same germplasm for further more sophisticated tests on rapid screening for salinity tolerance in the laboratory. Lastly, his discussion also touched on the INRA/ICARDA collaboration including administrative aspects.

New releases in Morocco. Four barley, two durum, and two bread wheat cultivars were released in Mar 1989 to Moroccan farmers. The barley cultivars were 1729 (pedigree ER/APM, named "Aglou"), 1730 (pedigree Arupo 'S', named "Tiddas"), 1745 (pedigree Harmal, named "Tessaout"), and 1749 (pedigree AS46/AVT/Athenias-03, named "Rihane"); the durum cultivars were 1715 (named "Sebou") and 1718 (named "Oum Rabia"); and the bread wheat cultivars were 1710 (pedigree Nesma/Potam, named "Saba"), and 1712 (pedigree Pavon 'S', named "Kanz"). On the other hand, two durum and three bread wheat cultivars were registered in the Moroccan catalog. They were 1727 (named "Tensift") and 1728 (named "Massa") for durum; and 1723 (pedigree Hork/...//KAL/BB, named "Achtar"), 1724 (pedigree Pavon 76=RCB 81-82, no.8, named "Baraka"), and 1725 (pedigree Maya/LR64, named "Khair") for bread wheat.

Dr Ross H. Miller, Cereal Entomologist, travelled to Egypt, Morocco, Algeria, and France, 18 Mar-1 Apr 1989. In Egypt, he visited aphid screening trials in the Giza aphid laboratory, and field trials in lower, middle, and upper Egypt. Heavy aphid infestations were observed on wheat this year from Assiut southward. Morocco was the site of a Hessian fly training workshop jointly sponsored by ICARDA, INRA, and MIAC/USAID. Trainees from Tunisia, Algeria, and Morocco spent a week in Morocco receiving instruction on how to recognize and develop Hessian fly resistant germplasm. The workshop then split into groups that surveyed the extent of Hessian fly infestation in each country. Following the Hessian fly survey, Dr Miller travelled to Behoust, France, to visit the USDA European Parasite Laboratory and discuss possible collaboration on the Russian wheat aphid, *Diuraphis noxia*. USDA scientists showed interest in studying parasites and pathogens that might be developed for control of the Russian wheat aphid in the USA and Ethiopia.

Dr Omar F. Mamluk visited Jordan 9 to 11 Apr 1989 together with research assistants Mounzir Naimi and Amir Makki. They took notes on disease nurseries planted in Deir Alla in the Jordan Valley. Powdery mildew and net blotch on barley were well developed, whereas leaf rust infection had just commenced. There was no expectation of rust development before crop maturity. Dr Mamluk also visited NCRTT in Baga'a near Amman and the research station at Ramtha where the season was dry and a number of barley genotypes have shown promise.

Prof Dr J.E. Parlevliet and Dr T. Jacobs from the Plant Breeding Department, Agricultural University of Wageningen, The Netherlands, visited ICARDA 6-19 Apr. They discussed the possibility of collaborative projects on long term resistance in barley with scientists of the Cereal Improvement Program, and the progress of Mr E. van Oosterom's Ph. D. project on "Adaptation to Drought in Barley." Dr Jacobs also gave a lecture on "Partial Resistance in Wheat to Leaf Rust."

A Training Workshop on Methodologies of Physiological Trait Assessment for Cereal Improvement was held at ICARDA headquarters at Tel Hadya, Syria, from 5 to 15 April 1989. Seven researchers from Algeria, Ethiopia, Iran, Morocco, Syria, and Tunisia participated in the training workshop, which covered various topics relating to physiology/breeding aspects including water relations, drought and heat tolerance, genotype x environmental interaction, varietal stability, use of weather data, and simulation and analysis of crop growth. Scientists from the Cereal Improvement Program and the Farm Resource Management Program delivered lectures and took part in animated discussions with the participants.

Dr Ahmed Bassouni, Cereal Pathologist from ARC, Sakha, Egypt, and scientist in charge of the Network on Leaf and Stem Rust in the Nile Valley Regional Program (NVRP), visited ICARDA from 13 to 27 Apr

1989. The purpose of his visit was principally to get acquainted with the cereal disease research work, and to discuss on-going activities between ICARDA and ARC and the implementation of this season's work plan of NVRP. During his stay he was mainly with Dr O.F. Mamluk touring Tel Hadya and Latakia screening sites and facilities.

Dr Peter Ruckenbaeur, Professor of Genetics and Plant Breeding at the University of Hohenheim's Institute of Plant Breeding, Seed Production and Population Genetics, visited ICARDA 23 Apr-3 May. He discussed with Dr M. Nachit durum wheat breeding, and thesis research with Mr Peter Stephany, graduate student from Hohenheim University. The draft of a collaborative agreement between ICARDA and the University of Hohenheim was finalized in consultation with Drs J.P. Srivastava, Acting Deputy Director General for International Cooperation, ICARDA, and H. Ketata, Acting Leader, Cereal Improvement Program.

A Short Training Course on Seed Testing Techniques was organized, 23 Apr-4 May 1989, at ICARDA headquarters, Aleppo, Syria. This course was the first to be held in the new laboratories of the Seed Production Unit, and was attended by twelve participants from Egypt (1), Lebanon (3), People's Democratic Republic of Yemen (1), Yemen Arab Republic (2), Syria (3), and ICARDA (2).

Dr E. Picard, biotechnologist, GIS-Moulon, Paris, visited the Cereal Improvement Program from 10 to 13 May 1989. He observed the on-going work of the biotechnology project with Dr Philip Lashermes and discussed with Dr J.P. Srivastava, Dr H. Ketata, and other scientists the development of the UNDP funded project on the "Use of Biotechnology for Improvement of ICARDA Mandated Crops."

Dr John Gorham from the the Center for Arid Zone Studies (CAZS) of the University College of North Wales (UCNW), Bangor, UK, visited ICARDA 10-21 May 1989. He held discussions with scientists of the Cereal Improvement Program on on-going research at ICARDA and CAZS and formulated with Dr J.P. Srivastava a work plan for the Ph. D. research project of Mr. Luciano Pecetti. He also presented a paper on "Utilization of *Triticeae* for improving Salt Tolerance." Dr Gorham also assisted Mr George Kashour in setting up the hydroponic technique for screening against salt tolerance.

Dr Osman Abdallah, Head, Durum Section, CIMMYT, visited ICARDA from 22 to 28 May for a general overview and a comprehensive look at the durum breeding work with Dr M. Nachit, CIMMYT/ICARDA Durum Wheat Breeder. After his stay at ICARDA, Dr Abdallah left for Turkey to visit the CIMMYT/Turkey winter wheat program.

Dr S. Rajaram, Senior Wheat Breeder at CIMMYT, visited ICARDA 25-29 May to have program discussions with Drs M. Nachit and G. Ortiz-Ferrara, CIMMYT/ICARDA Wheat Breeders. He also met Dr Aart van Schoonhoven, Deputy Director General for Research, Dr H. Ketata, Acting Leader, Cereal Improvement Program, and other scientists to discuss the implementation of joint research activities.

News from Latin America. Dr Hugo Vivar, CIMMYT-based breeder of ICARDA's Cereal Improvement Program said that the Chilean Barley Program has released in June 1989 a new variety with the name Leo-Inia/CCU. The variety is a result of a direct introduction from material sent from Mexico. The cross and pedigree of the variety are Aramir/Pitayo-Cambrinus x Arivat-RM1508, and CM77A-359-2B-1Y-1B-1Y-1B-0Y, respectively. In Ecuador, he said that seed of the line Lignee 640/Kober//Teran has been sown at Catalina Experiment Station before release by the Ecuadorian government. Finally, in Mexico, stripe rust resistant lines that were provided by ICARDA and that were found to have very good malting quality will be planted on several locations in yield trials and large scale demonstration plots. in 1989, farmers in Mexico will most probably have to apply fungicides to control the disease, last year losses were estimated at 50%.

Forthcoming Events

International Workshop on Policy, Planing, and Strategies for Irrigated Agriculture, 3-16 Dec 1989. The 2-week Symposium will be organized by the Department of Agricultural and Irrigation Engineering, Utah State University, Logan. The first week will be spent at the campus of the University where the workshop will use a seminar approach and focus on: (i) identification of the critical uses, (ii) development of a frame of reference, (iii) simulated case studies, (iv) water source and delivery emphasis, (v) comparing the on-farm management and farming system approaches, (vi) operation and maintenance learning process. The second week of the workshop will consist of a study tour to the Sacramento and San Joaquin Valleys of California and will provide insights into advanced technological applications in commercial agriculture.

The Second International Symposium on Plant- Soil Interactions at Low pH, 24-29 June 1990. This symposium will provide an opportunity for attendants to exchange information and ideas on solving problems of plant growth in acid soils. It will consist of four days of technical sessions and one day tour. The technical sessions will include invited and contributed presentations and posters addressing the following topics: chemistry and fertility of acid soils, management of acid soils, plant-microbial relations in acid soils, physiological and biochemical basis of acid stress tolerance in plants, genetics and breeding of acid tolerant plants, and identification of plants adaptable to low pH conditions. Internationally recognized speakers will be invited to head the program in each of the major topic areas. The Symposium will be held at the Pipestem Resort State Park in southeastern West Virginia, USA. For additional information please contact: Dr. R. Paul Murrmann, Conference Chairman, USDA-ARS, Appalachian Soil and Water Conservation, Research Laboratory, P.O. Box 1061, Beckley, West Virginia 25802-1061, USA.

The Sixth International Barley Genetics Symposium, 15-20 July 1991, will be held by the Nordic Countries in Helsingborg, Sweden. The duration of the Symposium will be extended a few days more than the above mentioned period for holding, before and after the Conference, some business meetings as well as organizing tours in the area. A first circular will be distributed in fall 1989 to participants in earlier IBGS. The Symposium will be organized as earlier meetings, however, more emphasis would probably be placed on poster sessions. The Symposium will also include, as previous ones, workshops, business meetings, etc. Suggestions and comments on the organization of the Symposium are most welcome and should be mailed to the Local Organizing Committee of the Sixth IBGS, Prof Roland von Bothmer, Chairman, Department of Crop Genetics and Breeding, Swedish University of Agricultural Sciences, S-268 Svalov, Sweden; or to Dr Lars Munck, Secretary, Biotechnology Department, Calsberg Laboratory, Gamle Calsberg vej 10; DK-2500 Valby, Denmark.

International Congress of Seed Science and Technology, 21-25 Feb 1990, New Delhi, India, will be organized by the Indian Society of Seed Technology. The Organizing Committee have decided to hold symposia on the following topics during the Congress: (i) seed production (including stand establishment under stress condition like moisture, temperature, etc.), seed genetics, and quality control; (ii) varietal identification; (iii) seed drying, processing, packaging, and storage including cryopreservation; (iv) seed pathology and seed health tests; (v) biotechnology for crop improvement and quality seed production; (vi) international dimension of seed industry development, seed marketing, and management of the seed enterprise. The program will include presentation of invited papers, contributed papers, and posters in each symposium.

Courses in Agriculture and Rural Development, 1990, Skills and Training in the United States for Foreign Profesionals. In 1990, the U.S. Department of Agriculture (USDA) will be offering participants from developing nations 37 courses in agriculture and rural development. These courses cover a broad range of subject matter, from technical agricultural fields to management, communication, and trainer development. The courses last from 2 to 13 weeks and include a mix of practical experience, field observation, and classroom activity. The courses are highly interactive so participants can share ideas with each other as they gain knowledge and practical skills. For more information please contact Short Course Coordinator, International Training Division, Office of International Cooperation and Development (OICD), United States Department of Agriculture, Washington, D.C. 20250-4300. Telex 7400228 CDOP UC.

Symposium on Land Drainage for Salinity Control in Arid and Semi-arid Regions, Cairo, 26 Feb-3 Mar 1990. The Symposium, sponsored by the Ministry of Public Work, Egypt, and the Ministry of Foreign Affairs, The Netherlands, will be organized under five sessions, namely (i) physical features of areas in need of drainage; (ii) design of drainage systems; (iii) drainage technology; (iv) ecological aspects, including re-use of drainage water; (v) economy of drainage. Each session will be introduced by a keynote speaker followed by a presentation of papers and a discussion. The official language of the Symposium is English and the proceedings will be published in book format. Secreteriat and mailing address: (i) Drainage Research Institute (DRI), Irrigation Building, 13 Giza Street, El Giza, Cairo, Egypt. Telex 94014 EXWAP UN. (ii) International Institute for Land Reclamation and Improvement (ILRI), P.O. Box 45, 6700 AA Wageningen, The Netherlands. Telex 75230 VISI NL.

Aphid-Plant Interaction: Populations to Molecules-An International Symposium, 12-17 Aug 1990. Sponsored by the Oklahoma State University and USDA, Agricultural Research Service, and held at Stillwater, Oklahoma, the Symposium will provide a forum for international scientists to present their latest results in aphid related research. Leading scientists in the respective fields will give keynote addresses, and voluntary papers will highlight research activities from many parts of the world. The main topics of the Symposium will be: (i) tritrophic aspects of aphid/host interaction, (ii) genetics and host plant resistance to aphids, (iii) molecular basis for aphid/plant interaction, (iv) aphids as virus vectors, and (v) synthesis of new strategies for aphid management. More information can be obtained from: Aphid Symposium Committee, Oklahoma State University, Department of Entomology, 501 Life Science West, Stillwater, Oklahoma 74078.

CONTRIBUTORS' STYLE GUIDE

Policy
The aim of the newsletter is to publish quickly the results of recent research. Articles should normally be confined to a single subject, short and precise, and be of good quality and of primary interest to research, extension and production workers, administrators and policy makers. Articles for publishing in the newsletter should not be submitted to or published in any other journal.

Editing
Articles will be edited to preserve uniform style but substantial editing will be referred to the author for his approval. Occasionally, papers may be returned for revision. Rejected papers will not be returned.

Disclaimers
The views expressed and the results presented in the newsletter are those of the author(s) and not the responsibility of ICARDA. Similarly, the use of trade names does not constitute endorsement of or discrimination against any product by ICARDA.

Manuscript
Articles should be typed double spaced on one side of the page only. The original and two other legible copies should be submitted. The contributor should include his name and initials, title, program or department, institute and postal address and telex number if available. Photographs, figures, tables etc. should be either 8.5 cm wide (single column) or 17.5 cm wide (double column including space). Figures and diagrams should be drawn in India ink; send original artwork, not photocopies. Define in footnotes or legends any unusual abbreviations or symbols used in a figure or table.

Units of measurement are to be in the metric system, e.g., t/ha, kg, g, m, km, ml, m^2, (=mililiter).

The numbers one to nine should be written as words except in combination with units of measure; all other numbers should be written as numerals, e.g., Nine plants, 10 leaves, 9 g, ninth, 10th, 0700h hr.

Examples of common expressions and abbreviations
3g, 18 mm, 300 m^2, 4 Mar 1983; 27%; 50 five-day old plants; 1.6 million; 23 μg; 5°C; 1980/81 season; 1981-83; Fig., No.; FAO, USA. *Fertilizers*: 1 kg N or P_2O_5 or K_2O/ha.

Mon, Tues, Wed, Thurs, Fri, Sat, Sun; Jan, Feb, Mar, Apr, May, June, July, Aug, Sept, Oct, Nov, Dec.

Versus = vs, least significant difference = LSD, standard error = SE ±, coefficient(s) of variation = CV(s). *Probability:* Use asterisks to denote probability * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$.

Botanical. Include the authority name at the first mention of scientific names. Cultivar(s) = cv(s), variety = var(s), species = sp./spp., subspecies = subsp., subgenus = subg., forma = f., forma specialis = f.sp.

Reference
Journal articles: Baker, R.J. and Briggs, K.G. 1983. Relationship between plant density and yield in barley. Crop Science 23(3): 590-592.

Books: Evans, L.T. and Peacock, W.J. (eds.). 1981. Wheat science - today and tomorrow. Cambridge University Press, Cambridge. 290 pp.

Articles from books: Zadoks, J.C. and van Leur, J.A.G. 1983. Durable resistance and host pathogen environment reactions. Pages 125-140 *in* Durable Resistance in Crops. Plenum Publications Corporation, New York.

Papers in proceedings: Srivastava, J.P. 1983. Status of seed production in the ICARDA region. Pages 1-16 *in* Seed Production Technology. Proceedings of the Seed Production Technology Training Course-1, ICARDA/the Government of Netherlands, 20 Apr - 6 May 1982, Aleppo, Syria. Available from ICARDA.

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