

RACHIS

NO. 1

Barley, Wheat and Triticale Newsletter

November 1982



The International Center for Agricultural Research in the Dry Areas
(ICARDA)

P. O. Box 5466 Aleppo - Syria

FOREWORD

The creation and distribution of this Newsletter is an occasion for deep satisfaction and pleasure. The basic function of RACHIS is to provide a more rapid system of knowledge exchange and transfer than is possible via established scientific journals. I am sure that wheat, barley and triticale researchers will find this new information service helpful.

I am equally certain that contributions from all those interested in RACHIS will bring forth new perspectives, ideas and achievements and also reveal fresh problems.

This interchange of knowledge could prove to be a significant thrust towards improving winter cereal production, and thus improved economic and social well-being in the ICARDA region of the Near East and North Africa.

It is with much pleasure that ICARDA introduces the first issue of the RACHIS Newsletter. I commend it to wheat, barley and triticale research workers nationally and internationally, and hope that you will support it and use it to the fullest extent by being a regular reader and contributor.

Mohamed A. Nour
Director General
ICARDA

November, 1982

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CONTRIBUTIONS FOR RACHIS

The RACHIS newsletter forms part of an information service which is aimed at improving communications between cereal scientists of the Near East and North Africa region.

This first issue of the newsletter is intended to give a general introduction to the cereal research being carried out in the region. It consists of news items, short communications, review and other research projects being conducted in the region, latest results and accomplishments of national and international cereal research efforts.

However this first issue is dominated by contributions from ICARDA's main research station, but we expect to publish more information from the national programs in future issues under a section entitled short communications. Please make sure that you follow the points indicated in the style guide for RACHIS contributions in the last page. All future contributions for the section **short communications** should be up to 150 words in length and articles of the **research and production** section should be approximately 650 words in length and should preferably contain one table and/or one diagram or plate. We invite contributions from all readers and expect details of new publications and books relevant to cereal crops for the article and book review section. Notices of future training courses or conferences and meetings and news of cereal scientists, their visits, moves and retirements are also needed.

It is our intention to publish the newsletter bi-annually i.e. in November and in May; thus the second issue of RACHIS will be published in May 1983. Accordingly **the deadline for submission of articles for the May 1983 issue will be Feb. 28th 1983.** Any contributions received after this date are liable to be deferred until the next issue i.e. November 1983.

We hope that every one feels free to make suggestions for the contents of future issues and that you will let us have your views and comments on all aspects of this issue of RACHIS to lead to the improvement of this new service, and to bring it to the attention of as many cereal researchers as possible.

INTRODUCTION

The RACHIS information service has been initiated by ICARDA to meet the information needs of barley, wheat and triticale research workers in the Near East and North Africa region. RACHIS will seek to accelerate information exchange between scientists and others working both in the region and in other Mediterranean-type environments. RACHIS seeks to report research results in a rapid manner, to highlight achievements and new ideas, and to stimulate an open discussion of problems. In this way RACHIS seeks to contribute to the improvement of barley, breadwheat, durum wheat and triticale production in the Near East and North Africa region.

This first issue of the RACHIS Newsletter is dominated by contributions from scientists at ICARDA's main research station, Tel Hadya, in Northern Syria. However, in the future we expect to publish more and more information submitted by scientists in the national programs, universities and other institutions of the region.

The major section of the Newsletter is entitled '**Research and Production**'. This section comprises reports of research and production work of relevance to cereal improvement in the Region. Each contribution for this section in future issues should be approximately 650 words in length, and should preferably contain one Table and/or one Plate or Diagram. We invite contributions from all readers of this first issue.

Another important section of the Newsletter is entitled '**Short Communications**'. Contributions for this section in future issues should be up to 150 words in length. This section is intended to give very short news items of interest to other researchers in the Region.

A section on '**Training, Conferences and Meetings**' seeks to report on past training courses and conferences and to give notice of forthcoming meetings. Please send us notice of any future training courses or conferences so that we can include the details in this section.

The section '**Article and Book Review**' seeks to review articles (in the form of abstracts) and selected books of relevance to cereal improvement in the Near East and North Africa region. Please send us details of any new publications of which you think the readers of RACHIS should be made aware.

The section '**News of Cereal Scientists**' is reports of staff movements throughout the region. Please send details of any personnel changes to RACHIS as soon as you know about them. Thankyou.

The final section of the Newsletter comprises the list of cooperators of ICARDA's wheat and barley international nurseries. Please review this list, and let us know if your names and addresses are incorrect so that this can be corrected in future issues. In the near future we intend to publish the full **RACHIS Mailing List** as a separate RACHIS publication, which will include details of all scientists, research interests, projects and projected future work. So please fill in the Questionnaire enclosed with this first issue of the Newsletter so that we can compile this Directory. Thankyou.

We hope you find **RACHIS** informative. Please do not hesitate to send us your criticisms and comments. The service is for you, so we need your feedback.

ICARDA

The International Center for Agricultural Research in the Dry Areas (ICARDA) is an autonomous, non-profit making, scientific institution chartered under the laws of Syria and Lebanon. ICARDA was established by the CGIAR (the Consultative Group for International Agricultural Research) which was itself set up by the World Bank in 1971. The CGIAR was charged with the formation of agricultural research centers throughout the world to help eradicate hunger and alleviate malnutrition as part of a global drive by the developed world to help poorer countries.

ICARDA is principally involved with rainfed agricultural systems and its mandate assigns to the Center a responsibility for research which is aimed at increasing the agricultural productivity in the areas of the Near East and North Africa where there is limited winter rainfall (between 200 and 600 mm rainfall annually). The Center's research is organized into four Programs: the three commodity programs are concerned with the improvement of **cereals, food legumes and pasture and forage crops**. The fourth program, the **Farming Systems Program**, is concerned with the Center's wider research aim, which is to develop more productive systems of farming which will make the best use of the limited rainfall available for crop and livestock production, and which offer improved ways of life for the small and near subsistence farmers of the Region.

ICARDA has been designated as a world international center for research on barley, lentils and faba beans, and serves in co-operation with CIMMYT and ICRISAT as a regional center for the improvement of wheat and chickpeas respectively. The Region that ICARDA serves is large, and extends from Morocco in the west to Pakistan in the east, and from Sudan in the south to Turkey in the north. It includes Cyprus and Afghanistan and comprises some 22 countries with a total population of more than 300 million people. Food shortages which are intensified by political tensions are a continuing fact of life throughout the Region, which in spite of considerable mineral wealth remains a major food deficit area.

WANTED

For RACHIS Newsletter No. 2 we urgently need:

Articles for the **Research and Production** section of RACHIS (around 650 words with 1 table and/or 1 Figure).

Short Communications (up to 150 words) on any aspect of cereal research and production of relevance to the Near East and North Africa region.

Any other information of interest to cereal researchers in the Near East and North Africa region.

RESEARCH & PRODUCTION

NEW BREADWHEAT FROM PAKISTAN TESTED IN ICARDA REGION

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In 1979, the National Approval Committee in Pakistan gave the name Zarghoon 79 to the line (CC-India/Tob-Cfn x Bb) 7C, CM 8237-G-IM-3Y-2M-4Y-OM. This variety/ line had been selected at the stable/bulk stage from CIMMYT material in 1974. The line was raised and studied at the Agricultural Research Institute, Sariab, Quetta, Pakistan.

It is recommended for general cultivation in Pakistan in high elevated regions where frost, drought and stripe rust are the main problems. From 1976 to 79 it was widely tested in Pakistan. Averaged data recorded were: yield 4649 kg/ha; protein 13.6 %; Pelshenke Test 120; grain colour amber white; grain size 1M; disease reactions were MR for stripe rust, MR-MS

for leaf rust, good frost and drought tolerance, and high tillering capacity with a medium height stem.

This line has been named Zarghoon 79 and has remained under observation in the ICARDA region from 1977 to 80 along with six outstanding commercial varieties/lines of breadwheat. In the Preliminary Observation Nursery (PON) it was tested at 30 locations in 22 countries, including Pakistan. In the 1978-79 season, it was tested in the Regional Wheat Yield Trials (RWYT) at 33 locations in 19 countries. In 1979-80 it was in the RWYT which was distributed to 20 locations in 14 countries.

Table 1 shows the average data recorded from 1977 to 80 in the RWYT and PON in the ICARDA Region. In the RWYT 1978-79, it gave yields of 9249, 7275 and 6497 kg/ha in Greece (Thessaloniki), Spain (Mahissa) and Turkey (Izmir), respectively. These figures reflect on its yielding ability and its adaptation under different climatic conditions in the region. In the 1979-80 RWYT, Zarghoon 79 again showed its high yield potential with 4323 kg/ha.

Table 1. Comparative statement showing the overall performance of some varieties/lines of breadwheat tested in RWYT and PON in the ICARDA Region from 1977 - 80.

Variety/line	Yield (kg/ha)	Rank	Frequ- ency	Protein (%)	PK . T	Yellow rust	Leaf rust	Stem rust
Mexipak 65	3809	6	13	9.8	115	13.0	16.0	26.0
Jup 73 x Y50E - Kal ³	3981	2	15	11.4	108	12.0	7.0	12.0
Pavon 's'	3919	4	12	11.4	71	6.5	21.0	10.5
HD 2127	3849	5	15	11.0	115	2.5	4.5	7.5
II 12300 - Tob x Cno 's' /S X	3701	7	13	10.9	125	2.0	1.5	6.0
7C x Tob - Cno 's' /Kal	3995	1	14	12.9	166	2.5	0.0	7.0
(CC-Inia/Tob-Cfn x Bb) 7C = Zarghoon 79	3931	3	15	12.5	156	5.5	8.5	7.5

BIRTHDAY CAKE

1 c. barley flour	3 tsp. baking powder
1/4 tsp. salt	4 tsp. shortening
1/2 c. sugar	2/3 c. milk
1 tsp. egg replacer	1/2 tsp. vanilla

Sift flour, baking powder, and salt together. Cream shortening. Add sugar to shortening, continuing to beat. Beat milk, egg replacer, and vanilla. Add milk mixture and then the sifted dry ingredients. Bake in two greased 6-inch pans at 375°F. for about 40 minutes. When cool, smooth on your favorite frosting on both layers. Serve immediately on chill.

from 'Back to Barley for recipes for the world's oldest food crop prepared by Kay Saari and Lorna Hawtin for the Fourth Regional Winter Cereal Workshop-Barley. Amman, Jordan, 1977.

FLOUR FOR BREAD

Bread made of the flour of spring wheat is more nutritious than that from winter wheat, on account of its containing a larger quantity of gluten. The finest flour makes what is termed the best white bread; the second quality the household, or inferior, and the brown bread is made by including the coarser particles as well in the loaf. The husk of wheat contains about 6 per cent of oil, but in fine flour there will not be found more than 1 per cent; it also contains a larger amount of protein compounds. In consequence, bread made of fine flour is not so nutritious as that made from the whole grain.

from Ward and Lock's Book for Farm Management and Country Life. Ward, Lock and Co., London, U.K. Circa 1818.

CONSERVATION OF GENETIC RESOURCES OF WHEAT AND BARLEY AT ICARDA

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For continuing progress in cereal improvement it is essential to have an adequate store of genetic variability, as well as continuous enrichment of existing genetic resources. The genetic conservation project at ICARDA envisages a threefold attempt to meet these aims:

- (i) a systematic assessment of available germplasm under a wide range of environmental conditions.
- (ii) assessment of germplasm under both disease pressure and environmental stresses (e.g. drought and salinity), and
- (iii) a broadening of the genetic base of breeding materials by new collections.

Both wheat and barley are important crops in the Near East and North Africa where natural populations of the ancestors of these cereal crops, as well as primitive cultivars (land races), constitute the major reservoir of genetic variability. This reservoir can be well exploited in cereal breeding. For this reason and because this reservoir is undergoing rapid genetic erosion, the project has assigned high priority to the collection and preservation of wheat and barley germplasm in the region. At the same time, existing germplasm lines are being evaluated and catalogued for traits that are relevant to our present cereal breeding aims. These traits include wide adaptation, disease and insect resistance, and tolerance to environmental stresses such as drought, heat and soil salinity. Several barley and durum wheat lines possessing drought and salt tolerance characteristics have been tentatively identified. Further work is in progress to confirm this finding and also to elucidate the morpho-physiological basis of stress tolerance.

Data on all accessions will be stored in a readily retrievable manner for the information of cereal breeders at ICARDA and elsewhere, and also for estimating the levels of genetic diversity in the areas of collection. The latter analysis is expected to provide useful information for planning future explorations in the region.

The above approach to the identification of useful germplasm and its preservation will assist national and international institutions in better utilization of genetic resources of wheat and barley. The project is an important component of the Cereal Improvement Program of ICARDA. The Crop Science Department of the University of Saskatchewan, Canada has been actively cooperating with ICARDA in this important work on reducing genetic vulnerability of two major crops in the region.

EFFECT OF SOWING DATE ON YIELD OF CULTIVATED BREADWHEAT VARIETIES

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Introduction

In the Pothwar plateau of Punjab-Pakistan, breadwheat is planted as a rainfed crop on approximately one million hectares. At present the average yield is only 700 kg/ha. The annual rainfall varies from 350 to 750 mm, most of which falls during the monsoon season in summer, which finishes by the end of August. Wheat is planted in November, utilising the moisture conserved from the preceding rains. However, during September and October farmers try to keep the moisture in the relatively deep soil profile by shallow cultivation. This reduces evaporative moisture loss due to high temperatures during that period. This practice is not only time consuming but also adds to the total cost of production.

There is also a tendency among farmers to start planting as early as possible to make the best use of the available moisture. However this practice often has proved hazardous, as the early sown wheat crop can fail due to several factors, such as high temperatures causing low tillering, and delayed winter rains and frost damage in the month of February causing mortality. There is a need to study the optimum time of sowing for different cultivated breadwheat varieties in this area. The preliminary results of such a study are discussed below.

Materials and Methods

Five recommended varieties with different maturities [Lyallpur 73 (long duration), Nuri, Arz (medium duration), Sandal (medium to short) and Sonalika (short duration)] were sown on five different dates (Oct. 5, Oct. 20, Nov. 5, Nov. 20 and December 5) in a randomised complete block design. Observations on frost damage, ear length and mortality were made in addition to yield data.

Results and Discussion

The average yield data presented in Table 1 reveal that the varieties with medium maturity, such as Nuri and Arz, as well as the long duration variety Lyallpur 73, gave high yields of 1480, 1588 and 1298 kg/ha, respectively, as compared to 648 kg and 450 kg/ha for Sandal and Sonalika following the earliest planting date of October 5. The higher yields of varieties Arz, Nuri and Lyallpur 73 can be attributed to better plant development and negligible frost damage in February. On the other hand the varieties Sonalika and Sandal were in the heading stage in late January and were badly damaged by frost, damage ranging from complete head injury to partial sterility. Since these two varieties have a relatively short growing season their tillering was also adversely affected due to high temperatures in October and early November.

The optimum time of planting for all varieties was the first week of November, except for Arz which gave the highest yield of 1778 kg/ha when planted on Oct. 20, compared to 1643 kg/ha following its November 5 planting.

The yield of all varieties dropped drastically with the later sowing dates. However, in the case of the December 5 planting date the highest yield of 1043 kg/ha was obtained for the short duration variety Sonalika. This type of response appears to be very logical, as the available moisture in late spring is limited, and

the situation is further aggravated by rapidly rising temperatures. Thus the long duration varieties, if planted late, will be adversely affected due to poor grain filling in comparison to the short duration varieties.

The ear length in different varieties under Islamabad conditions does not seem to be greatly influenced by different sowing dates. However, there is a need to study in greater detail other yield components and environmental factors affecting the overall production.

Table 1: Average ear length (cm) and yield of breadwheat varieties following different sowing dates.

Sowing date	Variety: Lyallpur 73		Nuri		Arz		Sandal		Sonalika	
	Ear length (cm)	Yield (kg/ha)	Ear length (cm)	Yield (kg/ha)	Ear length (cm)	Yield (kg/ha)	Ear length (cm)	Yield (kg/ha)	Ear length (cm)	Yield (kg/ha)
05/10/1979	11.3	1298	13.0	1480	10.5	1588	12.8	648	11.8	450
20/10/1979	12.3	1600	12.3	1500	10.5	1778	12.8	900	12.2	1288
05/11/1979	11.0	1788	12.4	1838	10.3	1643	12.7	1968	12.2	1780
20/11/1979	11.3	1238	11.5	1198	10.6	1113	12.8	1410	11.6	1155
05/12/1979	11.2	838	11.4	758	10.7	900	12.6	843	12.1	1043

OBSERVATION ON THE GROWTH HABIT OF SYRIAN AND JORDANIAN LANDRACES OF BARLEY

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Introduction

In Syria and Jordan the process of genetic erosion has been very slow in the case of barley. Farmers in most parts of these two countries rely mainly on seed which is kept from the previous harvest, a process which might have gone on since the cultivation of barley began. So one may expect the land race of an area to show very good adaptation to the local growing conditions and their yearly fluctuations. Some observations on growth characteristics which apparently contribute to a landrace's adaptation were made when a collection of landraces was grown in ICARDA's summer nursery at Shawbak in Jordan.

Methods

The barley landraces were collected from 33 different locations, mainly in the drier regions of Syria and Jordan in the early summer of 1981. At each location a random sample of 100 plants was taken. They were planted off-season, on 14 and 15 June 1981, to multiply the seed in single plant progeny rows at Shawbak, Jordan (1400m above sea level) and grown under flood irrigation. All observations were taken on October 19, the last harvesting date for the summer nursery.

The growing conditions in summer differ from the normal growing conditions in winter mainly in that the temperature and solar radiation during the germination and crop establishment phases are much higher, and also the daylength is slightly longer.

Observations

Apparently a high degree of dormancy was present in this material, but considerable variability existed both between and within locations. Fig. 1 shows that some germination occurred in almost every sample, but only very few samples showed a high germination percentage. From the map (Fig. 2) it becomes evident that those samples in which a large percentage of progeny rows germinated, originated from very hot, dry and more southerly locations.

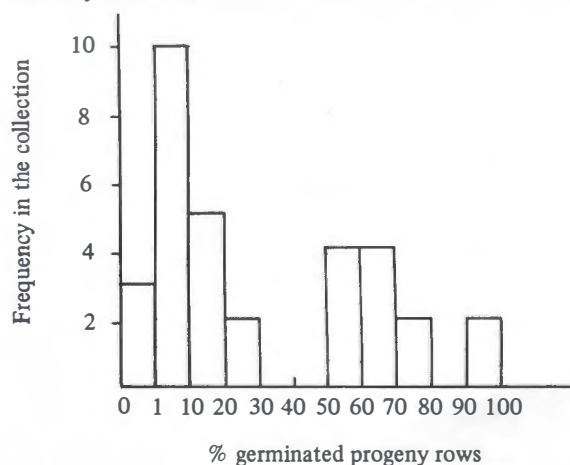


Fig 1. Number of samples which showed a certain percentage of germinated progeny rows at Shawbak.

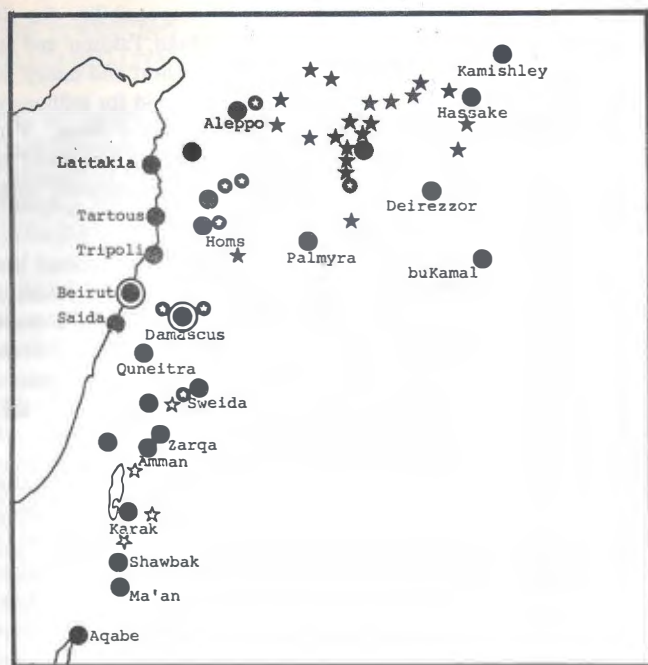


Fig 2. Locations of original sampling
 ★ under 30% rows germinated.
 ● over 50% rows germinated, of which less than 10% headed.
 ★ over 50% rows germinated, of which over 50% headed.

Furthermore, it was observed that only a very limited number of progeny rows actually headed and produced seed. Of the 33 samples, only 11 showed one progeny row or more which headed and only three of these produced a reasonably high number of headed rows (Fig. 3). This shows that variability for the ability to head under these conditions is also present within the material from one location. These results indicate that a large number of those locally adapted barley populations have a cold requirement before the reproductive phase of growth. The question arises as to whether there are any winter types in this collection.

Within the samples which headed there was a great variability in the date of maturation. All stages of seed development from anthesis to maturity could be found in all three samples.

Discussion

One might expect to find dormancy in land races like those described above, but it is remarkable to find such a degree of variability and to find an association with the location from which a sample originated. This indicates differential responses to natural selection in the barley growing areas of Syria and Jordan. For instance, one could imagine that the ability to germinate after the first heavy rain might be of a selective advantage under some conditions but not under others.

The finding that some samples had a definite cold requirement was unexpected. All the material for which this occurred originated from different regions within Syria. This indicates that under Syrian growing conditions it is advantageous for a

barley population to have this characteristic. It may for example contribute to the yield stability by preventing winter kill of early planted material. Information of this kind is valuable for a crop improvement program by showing which characteristics contribute to adaptation but also by indicating what degree of plasticity (the ability to respond to varying growing conditions) is present in the land races of the region for which varietal improvement is undertaken.

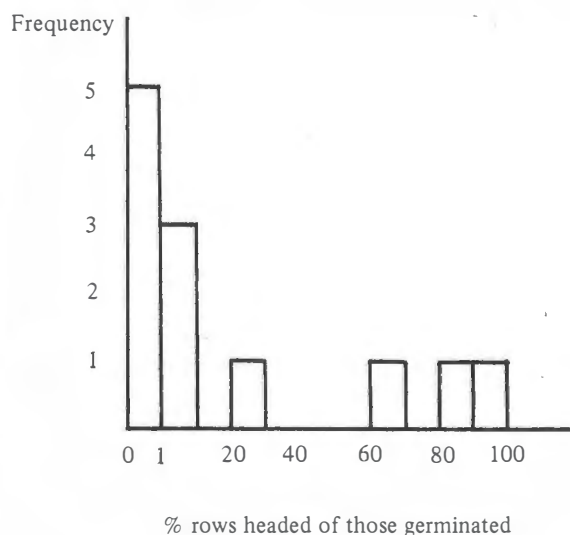


Fig 3. Number of samples which showed a certain percentage of headed rows (only samples with at least 50% germination considered).

Furthermore, the fact that only a very small proportion of the collection produced seed shows how strongly selective the abnormal growing conditions of a summer nursery can be for breeding material. These effects should be taken into consideration by the breeder.

Acknowledgment

The author wishes to thank Evangelisches Studienwerk, Villigst, German Federal Republic for their financial support.

BARLEY FUDGE

Mix together 1 teacupful of flaked barley
 2 tbsp. chopped dates 1/2 tbsp. cocoa
 1 tbsp. golden syrup 1 oz. margarine
 Pinch of salt 4 teacupfuls water

Put into a well-greased pudding bowl and steam for 2 1/2 hours.

from 'Back to Barley for recipes for the world's oldest food crop prepared by Kay Saari and Lorna Hawtin for the Fourth Regional Winter Cereal Workshop-Barley. Amman, Jordan, 1977.

ICARDA's CEREAL IMPROVEMENT PROGRAM

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In the Near East and North Africa the winter cereals, breadwheat, durum wheat and barley, occupy the first position among the cultivated crops. However, the region is still a net annual importer of 15 million metric tons of wheat grain to meet deficit requirements. This region has considerable variation and diversity in agro-climatic conditions and is primarily characterised by low rainfall. Rain falls mainly during the winter months. Broadly speaking the region has two distinct zones: the low elevation or littoral zone and the high elevation areas (1000-3000 meters a.s.l.).

Breadwheat ranks first among the food crops grown in the ICARDA region and is followed by durum wheat. Ninety percent of the breadwheat is grown under rainfed conditions and over 50% of the area receives less than 400 mm of annual precipitation. The recently developed high yielding varieties are more suitable for irrigated and high fertility conditions and, therefore, ICARDA has a special responsibility for developing suitable varieties and appropriate production technology for the lower rainfall areas. In order to stabilise the production potential of higher rainfall zones, research at ICARDA emphasises the incorporation of resistance to the diseases prevalent in the area.

In many of the countries of the Near East and North Africa durum wheat occupies the majority of the wheat acreage, particularly in the drier areas, where it has generally proved to be better adapted than breadwheat. However, little work has been done on durum wheat improvement in the region where local unimproved varieties and traditional agriculture still prevail. There is, therefore, ample scope and opportunity for ICARDA to make an impact on durum production.

After wheat, barley is the next most important cereal crop in the Near East and North Africa. It covers an area of about 10 million hectares and slightly less than 10 million tons of barley grain are produced annually. Barley is especially suitable for the drier areas and is a big source of animal feed and, in many cases, human food.

The low productivity per unit area of the winter cereals can be attributed to many factors. However, the Cereal Improvement Program seeks to assist national research institutions in the region in increasing wheat and barley production through the development and introduction of improved and stable varieties with high yield potential and good resistance to pests and pathogens, together with improved management practices.

The germplasm and production technologies emanating from the Cereal Improvement Program at ICARDA go to national programs where they are first tested at research stations for local adjustments. The national institutions are encouraged to verify the new technologies with local adjustments on farmers fields, for two reasons: (1) to prove whether or not the new technology is actually better than the old, under farmers conditions, and (2) to persuade the farmer that new technology works on his land.

The mandate of ICARDA gives it responsibility for the high plateau areas of Turkey, Iran, Afghanistan, Pakistan and the Maghreb countries of North Africa. Here, wheat and barley are extensively cultivated and provide the basic food for millions of people living at altitudes of 1000-3000 meters and above. Very low winter temperatures occur when snow covers the ground for many weeks. These areas are also characterised, in many cases, by hot summers, shallow soils and low rainfall.

Diseases are of prime importance in limiting cereal production in the ICARDA region. The most effective means of controlling such diseases is through incorporation of desirable genes which confer resistance under field conditions. Cereal research at ICARDA includes the identification of these genes in the germplasm available to the plant breeders and their subsequent incorporation in new cultivars.

ICARDA has a responsibility for the collection, maintenance and distribution of germplasm material of cereals and other crops covered by its mandate. Ways and means for doing so will continue with the object of creating a germplasm facility to serve the center as a whole. This activity is being carried out in collaboration with other interested organisations, including CIMMYT in Mexico and IBPGR in Italy.

In the development of new wheat, barley and triticale varieties it is important to maintain and, if possible, improve the nutritional and processing quality of the grain. In addition to physical processing quality, it is essential to breed for improved nutritional quality because of the prominence of cereal products in the human diets in the region. The main nutritional factors are improved quantity and quality of grain protein.

The specific objectives of the Cereal Improvement Program are:

- (a) To provide improved types of wheat (both durum and bread types) and barley suitable for the wide range of conditions in the region. To this end, ICARDA cereal breeders are making use of selection criteria which recognize:
 - (i) increased water-use efficiency.
 - (ii) maturation periods appropriate to the various lengths of growth cycles needed throughout the region.
 - (iii) resistance to prevalent diseases and insects.
 - (iv) resistance to lodging, grain shattering, and ear-breakage.
 - (v) improved grain quality in respect of nutritive value and physical properties.
- (b) To develop efficient crop management in the region. This is a factor of major importance affecting cereal yields in the region. Research is carried out in cooperation with the Farming Systems Program at ICARDA on the agronomy and field aspects of crop physiology of cereal production.
- (c) To undertake or commission research where needed in genetics, pathology, entomology, weed control, food quality and cereal agronomy; to assist in the development of improved cereal types with appropriate management practices.
- (d) To train research workers in national programs and to disseminate research results.

THE SCREENING AND EVALUATION OF CEREALS FOR GRAIN QUALITY AT ICARDA

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The four cereal crops which are included in ICARDA's mandate are breadwheat, durum wheat, barley and triticale. Evaluation procedures are aimed at the selection of germplasm which results in the maintenance and improvement of processing and nutritional quality. The initial step is the identification of the chemical, physical and physico-chemical properties associated with traditional cereal-based foods within the region. The most important foods are as follows:—

Wheat: 2-layer breads (*khobz baladi*), single layer breads (*tannour*, *saaj*, *mountain bread*, *merahrah*), raised breads (*baguettes*, *sponge bread*), *patisserie*, *cous-cous*, *feed*.

Triticale: Unknown, but generally as for wheat, *feed*.

Durum: Pasta, *cous-cous*, *bread*, *feed*.

Barley: *Feed*, *soups*, *cous-cous*, *bread*s, *malting*.

Other foods and food materials such as *freke*, *kishke* and *burgul* are important but minor factors on the international and regional menu. For the purpose of screening genetic material, triticale is regarded as being similar to breadwheat in its potential uses.

Work carried out at the Grain Research Laboratory Winnipeg (GRL), using bakery flours from Lebanon, Syria and Egypt, identified the type of flour predominant among bakeries to be a relatively weak flour with a farinograph stability of about 2 to 4 minutes, and a breakdown after 15 minutes equivalent to about 50-100 Brabender units. Thirty wheat samples were subsequently collected from six countries of the ICARDA region and were milled into flour using an Allis-Chalmers experimental mill. They were then subjected to a wide range of chemical and physico-chemical tests, in order to establish the correlations between the different parameters and farinograph stability, which was employed as the primary standard. At that time it was not possible to bake *khobz*-type flat breads, since the baking ovens at the GRL would not achieve the normal *khobz* baking temperature of 450°C. High correlations ($r = 0.7$ to 0.9) were observed between the wheatmeal fermentation time test (WMFT) and the farinograph stability. The 10 g mixograph development time was also correlated with farinograph stability ($r = 0.68$). None of the other tests applied were closely correlated with farinograph stability. Kernel hardness, as measured by the particle size index system, is an important parameter, since it affects the fermentation capacity of flours. Accordingly, the screening of bread

wheats and triticales involves tests for hardness, protein, kernel weight and appearance, WMFT and farinograph (Table 1). Advanced lines are baked into *khobz* in the laboratory using a specially-built furnace-type oven. Flours are obtained by means of a Buhler Laboratory mill. Triticale is baked into *tannours* in Tel Hadya village in Aleppo Province, Syria, using 100% whole-meal flour milled in the Tel Hadya store mill. The test procedure enables the selection of weaker types suitable for *khobz*. The stronger flours are needed for baking raised breads, such as the 'pain francais baguettes' preferred in Tunisia.

Table 1. Quality evaluation tests for breadwheat and triticale

Test	F2 - F4	F5 - advanced and parental
Kernel weight	*	*
Appearance (1)	*	*
Hardness	*	*
Protein	*	*
Wheatmeal Ferm.	*	*
Mill flour (2)		*
Mixograph (3)		*
Farinograph		*
Flour colour		*
Bake khobz		*
Mill wholemeal (1)		*
Bake Tannour (1)		*
Damaged starch		*

1. Triticale only.

2. Milling carried out on Buhler normally, but Quadrumat Junior if sample size restricted.

3. Mixograph used only if sample size restricted.

Durum wheat is used in making pasta and *cous-cous* in North Africa, and is also widely used in *khobz* baking. For pasta and *cous-cous* fairly high protein durum is needed, with high vitreous kernel counts. Lower protein and vitreous kernel counts can be tolerated for *khobz* baking. Durum wheat is evaluated for potential bread baking properties as well as pasta properties, and the WMFT test is used to screen for strength. Durum wheat is characterised by weak gluten strength, and if they are too weak they are difficult to process into *khobz* and *tannours*, because of poor dough-handling properties. Lines with stronger gluten strength are preferable for bread baking. A "strong" durum gluten is only about as strong as a fair to medium strength breadwheat. Test procedures applied to durum wheat are summarised in Table 2. Pasta (spaghetti)-making will commence soon in the laboratory.

Barley is used mainly as feed grain in the Middle East, although in North Africa a significant proportion is used as human food, in the form of soups, flat breads and *cous-cous*. The malting industry accounts for about 5% of the total barley consumption, and practically all of the malting barley is imported. Barley is evaluated for its malting potential, and also as feed. Plump kernel count and uniformity of distribution, protein

Table 2. Quality evaluation tests for durum wheat

Test	F2 - F4	F5 - advanced and parental
Kernel weight	*	*
Vitreous count	*	*
Protein	*	*
Pigment	*	*
Wheatmeal ferm.	*	*
Mill flour (1)		*
Mill semolina		*
Farinograph		*
Bake khobz		*
Colour (semolina)		*
Make pasta		*

1. Only on types with stronger gluten.

content and diastatic potential are the most important parameters. Low husk percentage is also preferred. The tests used in screening and evaluation of barley are given in Table 3. A high correlation ($r = 0.80$) exists between protein content and diastatic potential in barley. On the other hand correlations of kernel weight and kernel size with diastatic potential are not high ($r = 0.3$ to 0.4). It appears that several factors involved with growing conditions and parental material individually affect diastatic potential, protein content and kernel size.

Table 3. Quality evaluation tests for barley

Tests	F2 - F4	F5 - advanced and parental
Kernel size	*	*
Kernel distribution	*	*
Protein	*	*
Pearling index (1)	*	*
Diastatic power	*	*
Malt (2)		*

1. May be replaced by fibre test.

2. Only on very advanced material. This testing is contracted.

Cereal screening and evaluation for grain and straw commenced during June, 1980, and crops from three full seasons have now been evaluated for most of the test procedures. During 1981 about 9000 tests were completed. By the end of 1982 it is anticipated that all cereal test processing equipment will have been installed. Details of all test procedures, together with a brief description of the principles of the tests, are included in a comprehensive operations manual. In addition to the development of baking procedures for *khobz*, systems have been developed for judging differences between *khobz* samples. These are employed on the basis of texture (internal crumb, and "bitability"), colour, smell and taste. Taste panels are sometimes used to distinguish between up to four types. *Tannours* are judged by the village bakers (usually women) using the same criteria except for internal crumb, *tannours* being single-layered.

DIFFERENCES IN NITROGEN USE EFFICIENCY IN CEREAL GENOTYPES

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The search for crop genotypes capable of responding economically to high levels of soil fertility and to high levels of applied nutrients has long received the attention of both plant breeders and farmers. The introduction of high tillering disease resistant, stiff strawed, semi-dwarf varieties of cereals has contributed significantly to these goals and the urgency of the search for varieties that can respond to high fertility conditions has perhaps temporarily diminished.

Relatively less effort has been devoted to producing varieties that can yield well under lower fertility conditions. Such varieties could be useful in areas where fertilizers are currently unavailable or relatively expensive. The cost factor for artificial fertilizers will probably become more important as finite natural resources of phosphate are depleted and as the cost of fossil fuels for nitrogen fertilizer manufacture increases.

Farmers faced with high or low fertility conditions can both benefit, however, from an improvement in the yield of grain produced per unit of fertilizer applied or taken up by the crop. If this increased efficiency of fertilizer use is accompanied by an increase in yield then it could contribute to reducing the current shortages of grain in some areas.

Work at ICARDA commenced in the 1979/80 season to characterise the nitrogen response of a small number of cereal genotypes. The first step was to determine if significant differences did exist amongst the genotypes currently in use in the breeding programs at ICARDA and a few of the varieties commonly used in the region. Differences were found in the first and second years in the yield obtained when no N fertilizer was added, in the yield per unit of N applied, and in the maximum yield response to N fertilizer. Some examples of these differences in the 1980/81 season are given in Figures 1 and 2. All the data quoted here were obtained under relatively low soil N conditions following removal of an unfertilized, irrigated maize crop in each case.

Such differences in N response imply that differences in the economic optimum fertilizer rates between varieties will also be found. An indication of such differences is given (Table 1) for some barley varieties grown in the 1980 - 81 season at Tel Hadya, Syria. These data show that N-responsiveness and economic efficiency (yield/unit of N applied) were not necessarily related to yielding ability.

In 1980-81 a group of 45 genotypes likely to be used in the durum wheat breeding program at ICARDA were also tested over a wide range of nitrogen rates. Some of the contrasting response types are demonstrated by the data in Table 2.

These observed differences in N response could, in general terms, be due to differences in efficiency of uptake of applied nutrients (N uptake/N applied) or in differences in efficiency of utilization of N within the plant (grain produced/N uptake). It

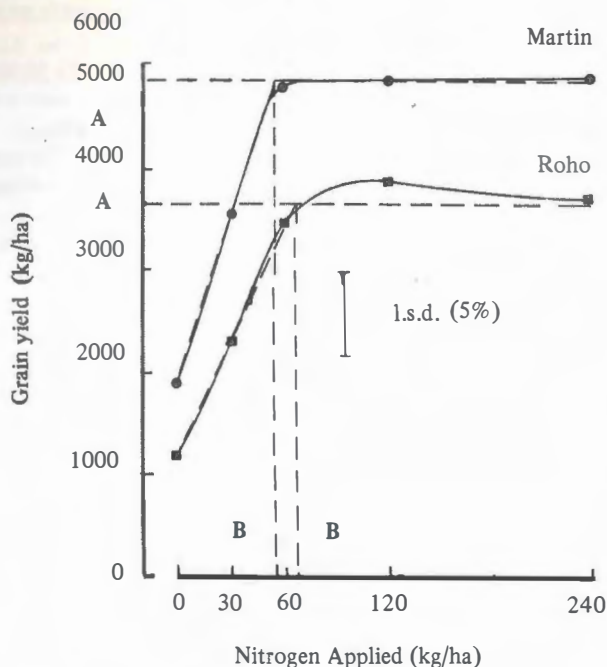


Fig 1. The effect of applied N level on grain yield of two barley varieties.

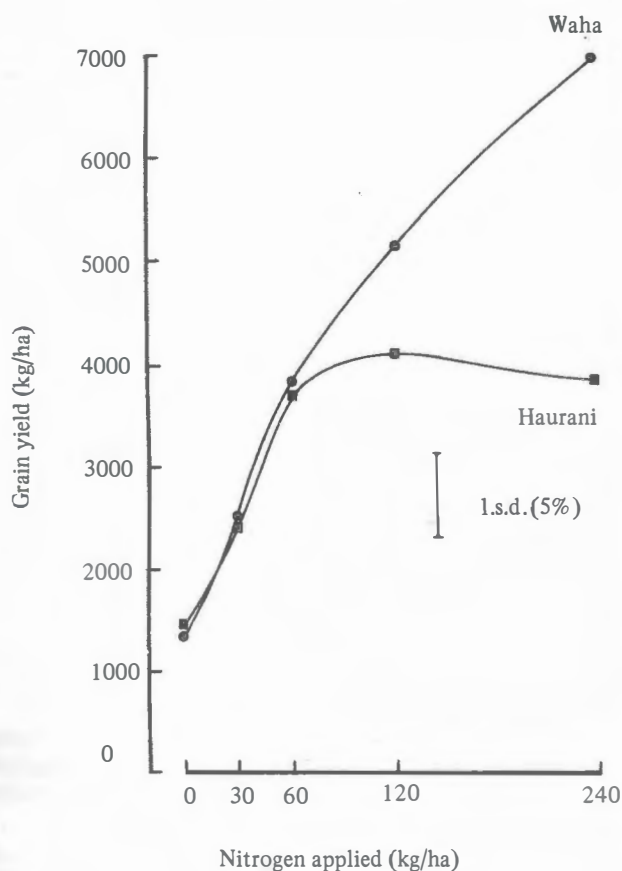


Fig 2. The effect of applied N on grain yield of two durum wheat varieties.

appears from the data in Table 2 that varieties that have a high yield when no N fertilizer is applied have a low efficiency of utilization of applied fertilizer and a higher N requirement for maximum yield and vice versa.

Data illustrating these differences were also found in the 1979-80 season and an example is given for two contrasting barley genotypes in Tables 3 and 4.

It can be observed from the data in these two tables that utilization efficiency (yield/N uptake) was quite different when no fertilizer N was added (Table 3) compared to the result with added N fertilizer (Table 4). In the unfertilized condition (Table 3) the variety Martin failed to translocate over half of the N taken up from the straw to the grain. However, at the N levels required for maximum grain yields (Table 4) the uptake efficiency (N uptake/N applied) of both varieties was similar but the utilization efficiencies (yield/N uptake) were much greater for Martin resulting in a much greater 'economic' efficiency (yield/N applied).

It is possible that the differences illustrated above were due to some kind of inhibition of N uptake or utilization in the presence or absence of applied N. Perhaps mycorrhizal associations are involved in some varieties that are inhibited when fertilizer N is applied. However, these results can be influenced in the field by factors such as variations in seasonal rainfall, temperature extremes during growth and perhaps deficiencies of other elements and extensive verification is required before they are fully understood. Meanwhile, plant breeders at ICARDA are making the first crosses between contrasting genotypes to determine the heritability of N responses and their usefulness in breeding varieties suitable for the region.

CREME D'ORGE (CREAM OF BARLEY SOUP)

1 1/2 pints well-flavoured jellied veal stock (fond blanc)
 2 oz. pearl barley 1/2 pint water
 1 oz. butter 1/2 oz. flour
 1/2 gill cream
 Garnish: one carrot, one turnip, 2-3 tablespoons green peas.

Soak the barley in the water overnight. Next day add broth to the stock, cover, and simmer gently until the barley is tender, about one hour. Strain, reserving the liquid and about a tablespoon of the barley. Prepare garnish by cutting pea shapes from the carrot and turnip with a vegetable scoop. Cook these with the green peas until tender in boiling salted water. Drain and set aside.

Melt butter, stir in the flour, and pour on the barley stock. Stir until thickening, then add the milk. Bring to boil, season, and add cream. Simmer for a few minutes before adding the barley and vegetable garnish. (The root vegetables may be diced if a pea scoop is not available).

form 'Back to Barley for recipes for the world's oldest food crop' prepared by Kay Saari and Lorna Hawtin for the Fourth Regional Winter Cereal Workshop-Barley. Amman, Jordan, 1977.

Table 1: Maximum N response level, maximum grain yield and 'economic efficiency' of some barley varieties as estimated from their yield response to applied N. *

Variety	Maximum N response level (kg/ha)	Maximum grain yield (kg/ha)	Grain yield/N applied (kg/kg)
Martin	60	4800	48
Beecher	60	4200	47
R.T.Ramage 11-13	70	4100	45
C-63	90	4800	33
Roho	70	3600	32
Esp./1808 - 4L	90	4500	31

* 1980-81 season, 340 mm rainfall + approx. 80 mm irrigation.

Table 2: Selected yield response characteristics to N fertilizer in durum wheats at Tel Hadya 1980-81.

Variety	Yield with zero applied N (g/m ²)	Maximum yield (g/m ²)	N rate at maximum yield (g/m ²)	Grain yield/N applied (g/g)
Cando	450	725	8.5	32
Bittern 'S'	400	850	18.0	25
Faisca	450	725	22.5	12
D-Dwarf-S15-Cr "S"	250	725	6.5	73
Oviachic/Amarelejo	350	775	7.0	61
Timgad 73	300	625	5.5	59

Table 3: Yield, N uptake and efficiency of utilization of N of two barley varieties with zero N application. *

Variety	Grain yield (kg/ha)	Total N uptake (kg/ha)	Grain N (kg/ha)	Straw N (kg/ha)	Yield/N uptake (kg/kg)
Arabic Abiad	4055	90	61	29	45
Martin	3350	114	44	70	29

* 1979-80 season, 420 mm rainfall + approx. 100 mm irrigation.

Table 4: Maximum yield, N rate for maximum yield, N uptake and N efficiencies of two barley varieties. *

Variety	Maximum yield (kg/ha)	N applied for max. yield (kg/ha)	N uptake at max. yield (kg/ha)	Yield/N applied (kg/kg)	Yield/N uptake (kg/kg)	N uptake/N applied (kg/kg)
Arabic Abiad	4450	100	110	4	20	0.20
Martin	5500	120	142	18	77	0.23

* 1979-80 season, 420 mm rainfall + approx. 100 mm irrigation.

ECONOMIC AND NUTRITIONAL IMPORTANCE OF CEREALS AND FOOD LEGUMES IN THE NEAR EAST AND NORTH AFRICA.

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This analysis shows the production, import and export as well as the nutritional importance of wheat, barley and food legumes during the last five years (1976-1980) in the following countries: Morocco, Algeria, Tunisia, Libya, Egypt, Sudan, Jordan, Lebanon, Syria, Cyprus, Turkey, Iraq, Iran, Afghanistan, Pakistan.

The annual production for all these countries is ca. 40 million metric tons, i.e. 10% of the world wheat production. The import is ca. 15 million tons, the export ca. 0.5 million tons. The actual production has to be increased by more than one third to meet the needs of the region (Fig. 1).

The barley production in the region is ca. 11 million tons, i.e. 7% of the world production. The region as a whole exports 0.6 million tons and imports 1.4 million tons of barley.

The annual food legume (faba beans, lentils, chickpeas, and peas) production in the region is ca. 3 million tons, i.e. 12% of the world production. The region is exporting 0.3 million tons and importing 0.2 million tons of these legumes.

The largest producers of wheat in the region are Turkey with 17 million tons, Pakistan with 10 million tons, Iran with 6 million tons, Morocco and Egypt with 2 million tons each, and Syria and Algeria with 1.5 million tons each. Egypt is the largest net importer of wheat with 4 million tons every year. Morocco, Algeria, Iraq and Iran are each importing a little over 1.5 million tons, and Tunisia and Pakistan are importing over 1.5 million tons, yearly. Syria and Turkey are the only countries in the region that are self sufficient in wheat.

The largest barley producers are Turkey with 5, Morocco with 2 and Iran with 1 million tons per year. In no country of the region did the import of barley exceed 0.5 million tons per year. Iran and Algeria are the countries that are importing most, while Pakistan, Syria and Turkey are exporting most.

The countries that produce the largest amounts of food legumes in the region are Pakistan and Turkey with 0.8 million tons each. Morocco and Egypt come next with 0.3 million tons each. Many countries in the region are exporting food legume grain. The biggest exporters are Syria with 49%, Morocco with 30%, Tunisia with 18% and Turkey with 15% of their production.

Wheat consumption per capita per year is around 130 kg in the region, and in the Maghreb countries around 200 kg. The total amount of calories consumed in the region per capita and per day is 2500, of which 43% comes from wheat and 2% from food legumes. The amount of protein consumed per capita per day in the region is 70 g.; 50% of this comes from wheat and 5% from food legumes (Fig. 2).

Wheat production is around 40 million tons, but 15 million tons are added yearly through import to meet the needs of the

region. Barley production is about 11 million tons, this being balanced by consumption. The production of food legumes is around 3 million tons.

Wheat contributes to the available calorie and protein consumption in the region by 43% and 50% respectively; food legumes contribute by 2% and 5% respectively.

Source: FAO Agricultural Production and Trade Yearbooks, 1976 to 1980.

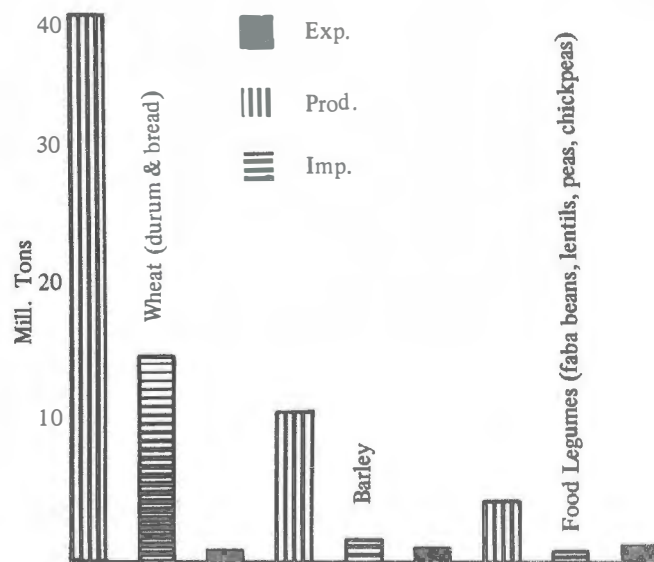


Fig 1. Wheat, barley, and food legumes production, import and export in the region of North Africa and Middle East.

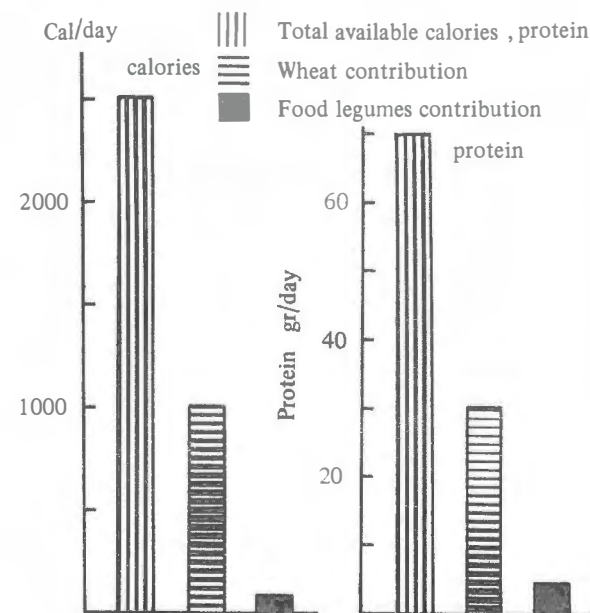


Fig 2.1. Contribution of wheat and food legumes to calories consumed per capita and per day.

Fig 2.2. Contribution of wheat and food legumes to protein consumed per capita and per day.

FARMERS' FIELD VERIFICATION TRIALS IN SYRIA

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The objective of the farmers' field verification trials is to test the yielding ability and disease resistance of promising breadwheat, durum and barley lines and their relative performance and adaptability under on-farm conditions.

There are many advantages in having these verification trials. The farmers get a close look at new and improved farming practices which are being tested. They get acquainted with new cultivars and develop personal relationships with the scientists and officials of the Ministry of Agriculture. Neighbours and other farmers of the area also observe the growth and follow the development of the new lines. Farmers constitute an important element in the running of the trials because of their evaluations, observations, reactions and discussions about the new lines, cultivars and practices being tested.

The trials are conducted in four climatic zones in Syria:

Irrigated Zone

Zone A: precipitation more than 350 mm.

Zone B: precipitation 250 to 350 mm.

Zone C: precipitation 250 mm and less.

Results and Discussion

Irrigated areas

Breadwheat: Two locations were harvested - Lattakieh and Meslemieh. Both were irrigated once and both received rainfall during the season.

The Meslemieh site was heavily infected with wild barley (*H. spontaneum*) and wild oats. The production was decreased in comparison with the other sites.

All new lines were superior to the local check (Mexipak) in yield and disease resistance. The improved variety Golan (S311 x Norteno) gave 14% higher yield than Mexipak in Lattakieh and 33% more in Meslemieh. It maintained good performance in three consecutive years.

Durum wheat: One durum variety, Sahl (Cr ' S ' // - T.dic. V. vernum/Gil ' S), was outstanding and superior to the check for the third year.

The yield increase was 32% at Lattakieh site and 25% at Meslemieh site over Gezira 17 (local improved check) during the 1979-80 season.

Zone A:

Breadwheat: All the new lines were superior to the local check (Mexipak) in yielding ability; varieties Jup 73 x Y50E-Kal, Cm 15517-1L-2L-OSK and QT4081-PWTH/3 were the best.

Table 1. A summary of the yield data from four zones over the seasons 1977-78 to 1979-80.

Variety		Yield (kg/ha)				
		1977-78	1978-79	1979-80	Average	
Irrigated	Golan	3400	4439	4323	4054	
	Mexipak	3000	4056	3635	3564	
	Sahl	3950	4951	5031	4644	
	Gezira 17	-	4484	3883	4183	two years
	Jori C69	3408	4025		3714	two years
Zone A	Mexipak	2512	2118	3147	2592	
	Golan	2650	2322	3414	2795	
	Sahl	2964	2391	3629	2995	
	Gezira 17	-	2271	3210	2740	two years
	Jori C69	2687	2056	-	2371	two years
Zone B	Mexipak	1835	1185	2547	1856	
	Florence Aurore	-	1170	2107	1636	
	Golan	-	-	2709	2709	one year
	Sahl	1931	1345	2555	1944	
	Haurani	-	1185	2254	1719	two years
	Beecher	3177	1761	3298	2745	
	Arabic Abiad	2641	1643	3292	2525	
Zone C	Beecher	1850	1126	2769	1915	
	Arabic Abiad	1550	1133	2628	1770	

Durum wheat: Under zone A conditions, all the new lines gave better yield than the check (Gezira 17). The best was Sahl at 3629 kg/ha (averaged over 12 locations) which is approximately 113% of the check.

Zone B:

Breadwheat: Both varieties Golan and Mexipak (local check) outyielded the other varieties under these conditions. Golan was superior in yield to Mexipak by 6% ; the difference was not significant.

Durum wheat: All the new lines gave a better yield than the check (Haurani). Cimmaron/Sari-Bursa 7113 outyielded the check by 24%, Waha by 21% and Sahl by 13%.

Barley: There were no significant differences between the varieties under these climatic conditions. However, Beecher and Martin were the most promising. They had the best disease resistance, the best morphological and technological characteristics and significantly higher amounts of straw.

Zone C:

No significant differences were observed in the entries this year; all gave good yields. The local check Arabic Abiad was the most susceptible to disease in this area. In the drier areas, Arabic Abiad was too short for combine harvesting. It is generally either hand harvested or grazed.

Table 1 represents a summary of the yield data for the seasons 1977-78 to 1979-80.

QUOTATION FROM THE HOLY QURAN (THE COW SURA, CHAPTER 261)

The parable of those
Who spend their substance
In the way of God is that
Of a grain of wheat: it groweth
Seven ears, and each ear
Hath a hundred grains.
God giveth manifold increase
To whom He pleaseth:
And God careth for all
And He knoweth all things

from 'The Holy Quran' Text. Translation and
Commentary by A. Yusuf Ali.

MALE STERILE FACILITATED RECURRENT SELECTION POPULATIONS (MSFRSP's).

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The work with MSFRSP's involves use of genetic male sterility. Male sterility in barley is controlled by a single recessive gene. The objective is to decrease losses caused by major diseases and to ensure stable resistance by simultaneously utilising a large number of genes for resistance. The male sterile character allows a large percentage of genetic recombination with only limited crossing; therefore the MSFRSP's are used for pyramiding genes for resistance to specific diseases.

The establishment of MSFRSP's requires the following:

1. Genetic male sterility.
2. A base population composed of 10-12 or more cultivars, selected on the basis of their performance, adaptability as well as certain traits desired by the breeder (e.g. earliness, kernel weight, stem strength etc..).
3. Sources of resistance to be crossed to the base population using male sterility.

Each cycle of recurrent selection consists of two parts:

- a. Selection for resistance. This selection is usually done in several locations each representing a different virulence spectrum of races of the pathogen. Seed selected on resistant plants from the various "hot spot" locations is mixed, assuring therefore a multigenic resistance in the pool.
- b. Recombination. The recombination portion of the cycle consists of growing the resistant plants selected over locations and then harvesting seeds only from the male sterile plants, thus assuring recombination.

For possible use in the ICARDA region, the RSP's, after recombination are being exploited at Tel Hadya in a dynamic manner. The RSP's are grown alternating with fertile pollinator barleys having good agronomic performance and acceptable resistance to the major diseases. The outcrossed seed produced is then planted anew, cross pollinated, and so on. The process is discontinued when the outcross seed produces plants presenting the desired character on combination of characters. The seed is then increased and yield tested. The last step is a unique feature of the MSFRSP's of the barley program at ICARDA.

EFFECT OF SEEDLING GROWTH VIGOUR ON YIELD OF TRITICALE

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Introduction

There is interaction between each growth stage and the factors of the environment. Much of the North African and West Asian wheat is sown in the fall, a period with an erratic and less reliable amount of rainfall; it grows through winter and spring, when frost can be a limiting factor, especially on the higher plains, and the harvest is in late spring or early summer under rapidly rising temperatures when premature desiccation can harm the grain.

Drought in the early stage of plant development adversely affects the stand establishment in many rainfed areas (Johnson and Asay, 1978). To ensure stable yield in cereals under stress-prone environments, seedling vigour is considered as an important trait for early establishment of the crop. The aim of this study was to determine the importance of growth vigour during the seedling stage for grain yield in triticale.

Materials and Methods

152 genotypes of triticale were yield tested in eight yield trials at Tel Hadya, Syria; in each trial there were 19 genotypes and five checks, with three replications, each plot being 5m long and containing six rows, 30 cm apart.

Only the inner four rows were harvested. The notes for growth vigour were taken using the scale 1 to 9, during the seedling stage: 1. very weak and small, 3. less vigorous than normal, 5. normal, intermediate, 7. vigorous, 9. extra-vigorous.

The notes for tillering ability were taken during the flowering stage using the screening scale 1 - 9: 1. very poor, 3. poor, 5. normal, 7. good, 9. very prolific.

The climatic conditions for the 1980-81 season in Northern Syria were dry during the seedling stage, normal during the tillering and jointing stages and rainy during the flowering and grain filling stages.

The correlation coefficients between grain yield, growth vigour, tillering capacity and 1000 kernel weight were calculated on mean values across replications.

Results and Discussion

Triticale sensitivity during the early growth stage to moisture stress and its negative influence on grain yield has already been demonstrated. The pre-anthesis water deficiency greatly reduced the yield per plant from tillers (Sutton and Dubbelde, 1980). This work was done on only one variety, Drira; however, here a large number of ICARDA triticale genotypes were used to determine the relationship between growth vigour in the seedling stage and grain yield. Genotypic differences in relation to growth vigour were significant.

Triticale genotypes with good early growth vigour were high grain yielders. The close relationship between growth vigour

and grain yield shows the importance of this parameter in yield determination in areas where the rainfall amounts and distribution are erratic and unreliable. Growth vigour also shows a positive and highly significant correlation ($r = + 0.74$) with tillering and shows the importance of plant vigour in the seedling stage to the formation of the first yield component, the tiller number.

Large seeded genotypes gave better stand and growth vigour than small seeded ones. The 1000-kernel weight was positively correlated with the grain yield and growth vigour (Table 1). The strength of the correlation was not as high as that of the tiller number, possibly due to the masking of the varietal differences by the late rainfall in the season. The importance of 1000-kernel weight in a rainfed environment has also been stressed in other studies (Hadjichristodoulou, 1981).

Table 1: Correlation coefficients between grain yield, growth vigour, tillering capacity and 1000-kernel weight (TKW)

	Grain yield	Growth vigour	Tillering capacity	TKW
Grain yield	1	+ 0.71	+ 0.39	+ 0.29
Growth vigour		1	+ 0.74	+ 0.31
Tillering capacity			1	0.27
TKW				1

Total no. of observations, $n = 152$.

Coefficients greater than 0.26 are significant at the 1% level.

Identifying triticale genotypes with better early growth vigour is important in developing cultivars with high yield potential and yield stability in the rainfed areas.

Summary

Important genetic variability with regard to growth vigour was found in ICARDA triticale germplasm. Growth vigour in the seedling stage correlated significantly with grain yield and tillering ability. Large seeded cultivars produced better stands and growth vigour than small-seeded ones.

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THE BUILDING OF A KHOBZ FURNACE-TYPE OVEN AT ICARDA

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Although there has been an increase in the number of automated ovens, most of the flat two layered breads in urban areas of the Middle East are baked in fairly small bakeries, which employ furnace-type ovens. The ovens are built of stone, fired by *mazout* (occasionally wood) and reach baking temperatures of 420- 480°C. Baking times range from 30 to 40 seconds. To save expense, while at the same time to provide an oven which conforms to local and regional practices, it was decided that a furnace-type oven would be installed in the Cereal Quality Laboratory at Tel Hadya, for the evaluation of *khobz* baking quality of bread and durum wheats and triticale, and to investigate factors influencing *khobz* baking quality.

The furnace was erected on a two metre square at the north-east corner of the milling and baking laboratory. The base was natural rock, and the outer and inner walls of the furnace were built out of concrete building blocks which were formed at Tel Hadya, of the type pierced with two rectangular holes. The outer retaining wall was square, with a side of about 1.8 metres, and a 15 cm space was left between this wall and the walls of the laboratory, to provide insulation against heat. The inner wall of the furnace was circular, the same shape as the final baking area. The diameter was about 1.1 metres. Inside the inner wall a layer of 100 kg of dry absorbent brick-clay was laid, about 20 cm deep. This material has the appearance of light reddish-brown soil, and serves to absorb moisture during the early operation of the furnace. The triangular spaces between the inner and outer walls were filled with pieces of broken building blocks, on a base of brick-clay.

Inside the inner wall and on top of the absorbent brick-clay 200 kg of broken glass was placed, forming a layer about 30 cm deep. Finally, on top of this was placed a layer of salt which extended almost to the baking floor level of the furnace. The salt layer was about 80 cm deep, and consumed 800 kg of salt. The salt was consolidated by repeated tamping, using a large stone. The salt is a heat retainer, and retains the heat developed in the furnace. The heat is retained for a long time after the heater is extinguished, and in commercial bakeries enables the baking of alternate types of breads, confectionary and other items such as potato chips. The purpose of the broken glass layer is partly to act as an insulation between the heat absorbent salt and the ground, and partly a filtration layer which allows moisture to percolate from the salt to be absorbed by the brick-clay. The moisture is present in the salt at the time of purchase, and is driven off by the heat during the early operation of the furnace. If there is no absorbent layer and glass, the moisture corrodes its way through the base of the furnace wall. A schematic diagram of the oven is given in Fig. 1.



Fig. 1. A schematic diagram of the *khobz* baking oven at Tel Hadya.

After the addition of the salt the inner wall of the baking chamber was built out of black basalt stones. These are very hard and heat resistant, and do not expand and contract to an extent sufficient to cause cracking. A round chamber was thus created. The baking floor is of flattened dressed basalt, and slopes slightly towards the door-way. A steel frame was inserted to make the doorway, and the base of the doorway consisted of a single block of smooth, yellow limestone. Fig. 2 illustrates the shape of the doorway. The purpose of this shape is to allow access of the heating system at one side, to allow free access with peels to all parts of the baking chamber, and to facilitate easy withdrawal of the baked *khobz*, which is often 20 cm high before collapsing.

The baking chamber was round, with a domed roof. This was created by building a dome-shaped form of wood, the interstices being filled by small pieces of stone and broken building blocks. A cement layer was added. The ceiling of the baking chamber was built of 300 firebricks laid end-wise, and keyed in on the same principle as the traditional archways. This ceiling rested on the wall of the chamber which was of a single layer of black basalt stones about 35 cm high.

A layer of cement about 20 cm thick was then laid above the firebrick ceiling, and a heat-retaining layer of 200 kg of salt interposed between the firebrick and the cement. The cement itself contained about 20% of the brick-clay to increase its moisture absorbing capacity, which prevents moisture from the salt soaking through to the outer wall of the furnace. A gap between the outside of the entrance to the baking chamber and the chamber itself extended up through the walls and ceiling, and formed the flue. When the cement outer layer of the baking chamber had hardened, cement was applied to the top of the furnace to form a flat roof over the entire furnace. Finally a 20 cm thick retaining wall was built around the furnace. This was of reinforced concrete which was faced with fine cement plaster to give a finished appearance. The flue was connected to a steel exhaust stack, which vented to the exterior of the building.

The heat source of the furnace is a three burner *mazout* vaporiser. *Mazout* or fuel-oil, enters the vaporiser via the feed pipe and evaporates in the upper tube, which is of larger diameter than the lower tube. The lower tube carries the burner jets, and is closed at one end. The vaporised oil burns at pressure at the jets, and the flames play on the upper tube which, as a result, acts as a continuous vaporisation chamber. The domed roof and circular shape causes instant transfer of heat to all parts of the baking chamber. At the beginning of a bake it is necessary to prime the burner by burning paper and wood chips to commence the vaporisation. Once the burners start to function vaporisation is self propagating. The chamber takes about two hours to reach 450°C from room temperature. *Khobz*-type bread which



Fig. 2. The doorway of the *khobz* oven.

duplicates the type of bread commercially baked in Aleppo has been prepared in this way. The furnace is to be used to evaluate bread, to evaluate durum wheats and triticales for the baking of *khobz*, and also to study the factors affecting the baking of *khobz* breads. Using burners with a different number of jets it will also be possible to bake raised breads, at lower temperatures, with provision of steam in the oven (see Fig. 3).



Fig. 3. *Khobz* bread being removed from the *khobz* oven.

ORIGINS OF CEREAL AGRICULTURE

Seeds of grasses evidently were an important source of food for pre-agricultural societies. Of the sixty of more species known to have been harvested in Africa, eight were developed into domesticated cereals. We have less information in the harvesting of wild grass seed in Eurasia, but certainly more species were harvested than domesticated, and the Eurasian domesticates number about fifteen. Thus, at least twenty-three members of the grass family were taken into the domestic fold in the Old World because their seeds were important in the human diet.

Archaeological evidence suggests that wheat was domesticated in the Near East before 9000 B.C., and rice was grown in China more than 7000 years ago.

from 'The origins of cereal agriculture in the Old World', by Jack R. Harlan. In 'Origins of Agriculture', Mouton Publishers, the Hague, the Netherlands, 1977.

AREA, POPULATION, WHEAT AND BARLEY VARIETIES IN THE HIGH ELEVATIONS OF THE ICARDA REGION.

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Eight countries (Afghanistan, Iran, Pakistan, Iraq, Turkey, Algeria, Morocco and Tunisia) in the ICARDA region have a significant proportion of their land area at high elevation (1000 m and above). The total reported area of these countries is 730.9 million hectares, of which 94.5 million hectares (12.6 %) are arable. Of this arable area, 30.3 million hectares are under wheat, i.e. approximately one third of the arable area (Table 1). One half (15.9 million hectares) of the total wheat hectareage comes from high elevation areas in these countries. However, in the whole ICARDA region wheat is planted on 33.62 million hectares. These figures clearly indicate the importance of wheat production in those eight countries having high elevation areas as the wheat is planted on only 3.62 million hectares in the remaining countries.

Although half of the wheat area falls into the high elevation class, the production contribution of those areas is barely 20% of the total as the production per unit area is only on average 700 kg/ha. This low production per unit area can be attributed to several biological factors such as the absence of modern high yielding varieties, out dated old production technology, harsh environments (cold and heat), diseases, moisture deficiency, problematic soils and socio-economic factors.

From these statistics it appears that the scope for increasing wheat production in the ICARDA region lies primarily in the high elevation areas. Increases in production can be achieved by:

a) vertical improvement

The present cultivars in high elevation areas are mainly traditional land race varieties which are disease susceptible and unsuited to modern high input technology. The appropriate production technologies, including a balanced use of fertilizers, time and dose, seeding method and rate etc., are not known. Therefore the present yield level of approximately 700 kg/ha can be greatly increased by developing suitable varieties and production technologies suited to the existing cropping/farming systems.

In most lowland areas modern improved varieties and more exacting production technologies are already used; thus to enhance further yield levels in these areas more concentrated efforts at the national and international levels are needed with a relatively low cost: benefit ratio. Contrary to this a small increase in production per unit area at high elevation can be achieved at relatively minimal cost and efforts which are likely to have a far greater impact on the overall production.

b) horizontal increase

The scope for the expansion of the area under cereal crops in the lowland areas is minimal in most of the countries of the region. Such an expansion would also be at the risk of upsetting the existing cropping systems. However, there is plenty of culturable wasteland in the high elevation areas. For example, the Baluchistan province of Pakistan alone has 5.4 million hectares of culturable wasteland. Under the present situation of increased demand for food with increasing populations and higher returns from horticultural crops, the competition for land use in the low elevation areas has dominated the cropping pattern. National programs are therefore extending cereal production to the unused buffer zones in the high elevation areas. However, the present varieties and production technologies, which were primarily developed for the low elevation areas, are unsuitable for high elevation land. Consequently the farmers at high elevation are getting low returns.

Population

Out of a total population of 378 million people in the ICARDA region, 246 million are living in the eight countries having high elevation areas (Table 2).

Approximately 111 million people are living in the high elevation areas. Fifty-three percent of the total population in the Region are engaged in agriculture. However, in the high elevation areas this figure is much higher, as very few other industries exist in those areas. Since the population in these countries is increasing at an average annual rate of 2.5 %, the pressure on the existing land resources is also increasing. This trend demands that more attention be paid to developing efficient and functional production technology for the high elevation areas where farming is based on a cereal-pasture system and sheep husbandry.

Table 1: Total area, area and production of wheat in the high elevation countries of the ICARDA region.

Country	Total area (M.ha)	Arable area (M.ha)	Total wheat area (M.ha)	Wheat area (above 1000m)	Total wheat production (M.T.)	Yield (kg/ha)
Afghanistan	64.5	8.0	2.5	1.1	2.8	1132
Iran	164.8	15.7	5.5	4.6	5.8	1055
Iraq	43.5	5.0	1.3	1.0	1.1	917
Pakistan	80.4	19.3	6.9	1.2	11.3	1680
Turkey	78.1	27.6	9.4	6.6	17.0	1813
Algeria	238.2	6.9	2.0	0.7	1.4	700
Morocco	44.7	7.5	1.7	0.7	0.9	991
Tunisia	16.4	4.5	1.0	N.S.	0.96	1230
Total:	730.9	94.5	30.3	15.9	41.26	

* (M = Million)

Sources: FAO Production Year Book (1980) and Monthly Bulletin of Statistics (1982).

CIMMYT World Wheat Facts and Trends (1981).

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Table 2: Population in countries of the ICARDA region with high elevation areas (1980).

Country	Population			
	Total (1000)	In Agriculture (1000)	% in Agriculture	High Elevation (1000)
Algeria	18.594	9.174	49.3	1.900
Morocco	20.296	10.381	51.2	2.000
Tunisia	6.363	2.582	40.6	N.S.
Afghanistan	22.038	17.148	77.8	12.900
Iran	38.082	14.303	37.6	32.000
Iraq	13.084	5.265	40.2	2.600
Pakistan	82.441	44.113	53.5	27.900
Turkey	45.346	24.691	54.4	31.700
Total	246.244	127.657	52.9	111.400

Total population in ICARDA region = 377.598

% Population in high elevation countries = 29.5.

Plant ideotype and distribution of winter cereals and their wild relatives

Several studies have been conducted on the distribution and plant ideotype of winter cereals (wheat, barley, rye and *Aegilops*) in Western Asia, including Pakistan, Afghanistan, Iran and Turkey. These countries are considered primary centers of origin of these species. Kihara *et al.* (1965) made a detailed study on the distribution of *T. vulgare* Vill. (*T. aestivum*) and *T. compactum* Host in nine ecological regions [Quetta (Pakistan), Kabul, Pul-i-khumri, Maimana (Afghanistan), Tehran, Isfahan, Gorgan, Pahlavi and Tabriz (Iran)]. The distribution pattern of different varieties of *T. vulgare* in these regions suggests the adaptation of several characters for high elevation. With the exception of a few varieties, such as var. *suberythroleucon*, var. *velutinum*, *lutescens-compactoides* which were found only in the Quetta region, there were several varieties which had high distribution frequencies throughout these regions. However, in some of the species the frequency of distribution diminished steadily from one region to the other.

T. compactum varieties were found mainly in the mountain areas in the Kabul and Pahlavi regions. The collected strains were referred to as var. *erinaceum* Korn from Armenia, Transcaucasia, Afghanistan, Turkestan and China.

T. durum var. *obscurum* Korn was found in Tehran and var. *muriciense* in Ghosnavi. *Ae. squarrosa* spp. *strangulata* has been observed growing in the same fields. *T. turgidum* var. *linnaeanum* Alef. and *T. polonicum* var. *eredivianum* have their natural habitat in Isfahan.

Kihara *et al.* (1965) reported that among the *Aegilops* species *squarrosa* was very well distributed in all the nine regions listed above, except in Isfahan where no *Aegilops* was observed. On the other hand, other *Aegilops* species, such as *crassa*, *cylinarica*, *triuncialis* and *culminaris*, were found in all regions except for Quetta.

Growth habit in *Triticum* and *Aegilops*

There is a gradual gradation in the growth habit of *Triticum* and *Aegilops* varieties from the Tabriz to Quetta regions. In Tabriz

almost all the varieties are of winter habit with long duration and with a gradual gradation of facultative and spring habit towards the east. As in Afghanistan, all three types (i.e. winter, intermediate and spring) were observed; in Quetta primarily the intermediate and spring growth habits were observed. The land race varieties from Quetta, Afghanistan and Iran indicated the same type of behaviour when studied at ICARDA's Tel Hadya site. The studies of Kihara *et al.* (1965), and our observations on the germ-plasm from these countries, suggest that varieties for these regions have to be either short duration winter types or intermediate or spring types with good cold tolerance.

Barley

There is a great similarity in the distribution of varieties of *H. vulgare* and *H. spontaneum* throughout this region starting from Kashmir (Himalayan belt) up to Tabriz. Barley throughout this belt is grown at an elevation of 2000 meters and above mainly in the spring Takahshi *et al.* (1965). Therefore all the varieties in Iran, Afghanistan, Pakistan and Kashmir are spring types with a few exceptions of intermediate types in Iran. However, it was also reported that winter types do exist in wild species of *H. spontaneum* and *H. murinum*.

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RESPONSE OF BARLEY TO PHOSPHORUS FERTILIZATION

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Aleppo, SYRIA.

As part of a series of cereal agronomy trials, Beecher barley was grown at five sites across the rainfall gradient in Aleppo Province in North-west Syria. The average annual rainfall at the sites ranged from 525mm to 220mm. At the two drier sites, Arabic Aswad (a local, unimproved variety) was included in the trials. Treatments covered a range of seed (30 to 150 kg/ha), nitrogen (0 to 120 kg N/ha) and phosphorus (0 to 120 kg P_2O_5 /ha) rates. A split plot, modified central composite factorial design was used.

Results from these trials were used to estimate the response of barley to changes in seed and fertilizer rates. The response to phosphorus application, when a seeding rate of 90 kg/ha was used and 60 kg of N was applied, was particularly striking (Table 1). The agronomic results were subjected to analysis to determine the economic optimal phosphate use at each site.

Straw is a valuable by-product in barley production, and thus the responses to seed and fertilizer rates were calculated for both total dry matter and grain. The response of total dry matter was mixed; maximum yield was achieved with 90 kg P_2O_5 /ha at Breda and Khanasser, 120 kg P_2O_5 /ha at Kafr Antoon and 60 kg P_2O_5 /ha at Jindiress and Tel Hadya. Arabic Aswad showed a maximum yield corresponding to 120 kg P_2O_5 /ha at Breda and Khanasser. At Breda, the yield responses were numerically very similar, there being no more than 60 kg/ha difference between the two varieties at any point.

At Jindiress and the two driest sites, maximum grain yield of Beecher corresponded to 120 kg P_2O_5 /ha; while maximum yields at Kafr Antoon and Tel Hadya were achieved with 90 and 60 kg P_2O_5 /ha respectively. The response of Arabic Aswad to phosphorus at Breda was very small, but significant at the 5 percent level. Peak yields were in the range of 60 to 90 kg P_2O_5 /ha. At Khanasser this variety showed a highly significant response, giving maximum yield with maximum (120 kg/ha) phosphorus application. It is worth noting that the yields achieved by Arabic Aswad with 120 kg P_2O_5 /ha were somewhat less than those achieved by Beecher with only half that rate of phosphorus application. Thus, assuming there to be no cost or productivity penalties associated with the growing of Beecher as opposed to Arabic Aswad, it would appear that the former would be more profitable to the farmer.

Economic analysis shows that 60 kg P_2O_5 /ha is indeed an optimal rate. In Table 2, a partial budget is shown which compares no phosphate with an application of 60 kg P_2O_5 /ha on Beecher barley. The increase in the net benefit of adding this amount of fertilizer is 959 SL. Thus, the benefit-cost ratio is more than 4.5 SL, i.e. for every Syrian lira spent, 4.5 Syrian liras were earned.

Figure 1 illustrates the increase in net benefits at Breda at different levels of phosphorus application. The most profitable level is 60 kg P_2O_5 /ha. In Table 3, the increases in net benefits at all five sites and at five different levels of P_2O_5 /ha are given. At three sites the optimum rate was 60 kg P_2O_5 /ha and at the other two, Kafr Antoon and Khanasser, the farmer would probably also choose to apply 60 kg P_2O_5 /ha. At higher levels of phosphorus use he would increase his net revenue, but only by a very small amount. It is unlikely that he would accept the greater risks of doing so.

Table 1. Barley yields at different levels of phosphorus application. (90 kg/ha seed rate and 60 kg/ha of nitrogen).

P ₂ O ₅ (kg/ha)	Barley yield (t/ha)						
	Jindiress (525 mm)	Kafr Antoon (465 mm)	Tel Hadya (335 mm)	Breda (290 mm)		Khanasser (220 mm)	
				Beecher	Arabic Aswad	Beecher	Arabic Aswad
Total dry matter							
0	5.10	6.90	9.43	2.50	2.71	0.78	0.02
30	6.62	7.44	10.54	3.89	2.93	1.63	0.82
60	7.36	7.74	11.03	4.55	3.15	2.08	1.38
90	7.32	7.99	10.09	4.57	3.37	2.13	1.70
120	6.50	8.26	10.15	3.95	3.59	1.78	1.78
Grain yield							
0	2.63	3.12	2.84	1.52	1.11	0.69	0.00
30	2.90	3.67	3.21	1.64	1.19	0.86	0.41
60	3.09	3.68	3.34	1.74	1.23	0.95	0.70
90	3.20	3.69	3.23	1.82	1.23	1.12	0.87
120	3.23	3.52	2.86	1.88	1.19	1.37	0.92

Figures in parentheses are average annual precipitation (mm).

Table 2. Partial budget for Beecher barley at Breda (receiving 60 kg N/ha and 0 or 60 kg P₂O₅/ha).

	0 kg P ₂ O ₅ /ha	60 kg P ₂ O ₅ /ha
Income		
Grain yield	1.52 t/ha	1.74 t/ha
Grain revenue	1.444 SL	1.653 SL
Straw yield	1.07 t/ha	2.81 t/ha
Straw revenue	588.00 SL	1.545 SL
TOTAL REVENUE	2.032 SL	3.198 SL
Expenses		
Fertilizer		
P ₂ O ₅ x price	—	144.00 SL
Labour for application	—	10.00 SL
Credit	—	15.00 SL
Harvesting		
Labour, equipment, transport, bags, etc.	—	38.00 SL
TOTAL CHANGE IN EXPENSES		207.00 SL
NET BENEFIT	2.032 SL	2.991 SL

Notes:

- Cost of P₂O₅ = 2.4 SL per kg
- Price of barley grain = 0.95 SL per kg
- Price of barley straw = 0.55 SL per kg
- Labour for broadcasting fertilizer = 10.00 SL per 120 kg of triple super phosphate
- Both trials received 60 kg N/ha at a seed rate of 90 kg/ha for Beecher barley.

This very profitable response of Beecher barley to phosphorus application is encouraging. There is an immediate need to consider ways of increasing fertilizer use by farmers, particularly in the drier zones.

N.B. 1US\$ = 3.9 S.L. official rate.
1US\$ = 5.6 S.L. international rate.

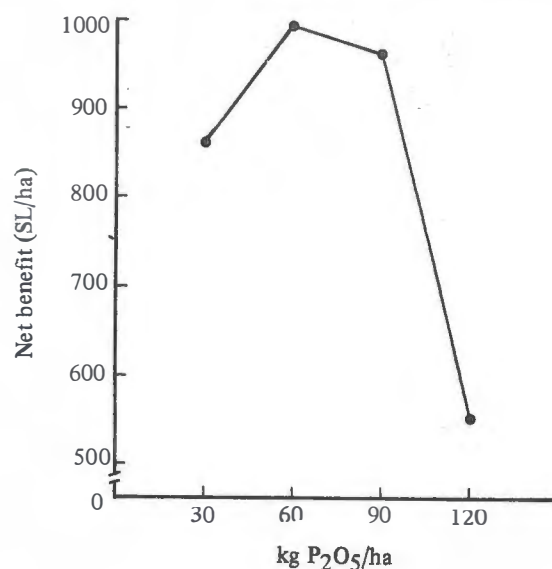


Fig 1. Increase in net benefit of P₂O₅ applied to Beecher barley at Breda, 1981/82 (in Syrian Lira).

Table 3. Increase in net benefit from using P₂O₅ on Beecher barley in 1981/82 (in Syrian Lira).

Site	Net benefit (SL)			
	30 kg/P ₂ O ₅ /ha	60	90	120
Jindiress	689	1005	935	482
Kafr Antoon	293	359	405	418
Tel Hadya	557	757	591	53
Breda	851	996	951	548
Khanasser	284	567	569	657



WANTED

For RACHIS Newsletter No. 2 we urgently need:

- * News of National Program Cereal Scientists in the Near East and North Africa.
- * News of Meetings and Conferences in the Near East and North Africa.
- * News of Training activities in the Near East and North Africa.

SHORT COMMUNICATIONS

Wheat in Maharashtra, INDIA

The Wheat Research Station, Niphad (Nasik), India is making efforts for the development of high yielding, disease resistant, dwarf, fertilizer responsive, well adaptable, early maturing, good grain quality varieties of *T.durum* and *T.aestivum*. Several varieties have been released for general cultivation in Maharashtra, since 1931. Nearly 50-60 % of the area is sown to durum wheat, which is locally known as Bansi (when grown under rainfed) and Baxi (when grown under irrigated conditions). This research station has a large amount of land races of durum and would be pleased to provide seed of durum land races through NBPCR, I.A.R.I. Campus, New Delhi on request.

from *Dr. PUNKAR, Agricultural Research Station, Niphad, District Nasik, Maharashtra, INDIA.*

Wheat and Barley Production in Baluchistan, PAKISTAN

The province of Baluchistan is located between latitudes 28.5° - 32° N and longitudes 61° - 70° E in Pakistan. The total geographical area is 34.72 million ha of which the cultivated area, including current fallow and unsown areas, is reported to be only 1.18 million ha.

There is considerable variation in the climate in Baluchistan. North and north western high mountainous ranges are extremely cold in winter, with the temperature usually remaining below freezing in December, January and February. Rainfall is mainly received in winter. The south and south east region is extremely hot during the summer. Monsoon rains come in the months of June and July.

The total wheat crop area is reported to be 168,000 ha, with a total grain production of 209,000 tons. The average yield is 1244 kg/ha. Barley covers only 6000 ha, with a total production of 37,000 t and an average yield of 617 kg/ha.

The high elevation areas range from 1000 to 2700 meters above sea level. Wheat and barley are mainly grown under rainfed conditions and Salaba (moisture preserved during monsoon rainfall). In the lowlands, the crop is generally grown under canal irrigation systems.

The main problems in both cold dry areas are frost damage, drought, yellow rust and bunt, whereas in the lowlands, the wheat yield is usually reduced by leaf and stem rust diseases.

Farmers in high altitude areas are using the seed of their local indigenous composites to the extent of 60-70 %. These are mostly winter or semi-winter types, with a good tolerance to frost, drought and good tillering capacity, but these local races are susceptible to all three rusts, and bunt. In the lowlands, 65.1 % of the area is sown with high yielding (improved) spring type varieties.

The lack of disease, frost and drought resistant varieties and inappropriate seeding rates, fertilization, sowing, and harvesting are factors causing poor yields.

from *Sher MUHAMMAD, Wheat Botanist, Agricultural Research Institute, Sariab, Quetta, PAKISTAN.*

Malting Barley Varieties in Kenya

For over 25 years Kenya's malting barley production has relied on only two varieties, viz. Proctor (ex England) and Kenya Research (a selection from Research ex Australia) which were introduced through the National Plant Breeding Station, Njoro. However in 1979 a new variety Tumaini (the Swahili word for hope) was provisionally released and grown on approx. 800 ha. In the 1980/81 season it occupied approx. 12,000 ha (almost half the barley hectareage). It is a selection from the French variety Mammie and out-yields Proctor by over 20% at altitudes above 2400m. Below this altitude its susceptibility to brown rust limits its use.

Two lines received through the CIMMYT/ICARDA program show considerable promise with good disease resistance (especially to scald, net blotch and yellow rust) and good malting quality in micro-malting tests. These lines are coded MPYT 169-2y and MN/RNR/7/78 and are at present under multiplication.

Other varieties in advanced stages of testing are:-

E.H.8B/F ₄ E.L.6.L	C1
Medusa	WI 2392
Cerro Prieto	PI 2900 x (Plata-Sv.Mari), OSK = B268
PI 2900	

The lines will soon be entering national trials from the breeding programs of both the Kenya Breweries and National Plant Breeding Station.

from *R. LITTLE, Kenya Breweries Ltd. P.O.Box 707, Nakuru, KENYA.*

Survey of Sap Transmissible Viruses affecting Wheat and Barley in Jordan, Lebanon and Syria

Wheat and barley samples collected from fields in Jordan, Lebanon and Syria were tested by the double-immunodiffusion (DID) and enzyme linked immunosorbent assay (ELISA) tests for barley stripe mosaic virus (BSMV), brome grass mosaic virus (BMV), and wheat streak mosaic virus (WSMV) antisera. Both the DID and ELISA test procedures easily detected BMV and BSMV in leaf extracts. Barley stripe mosaic virus (BSMV) was detected in one out of 25 samples collected from Lebanon using both the DID and ELISA tests; in 10 out of 29 samples collected from Syria by the DID test; and 11 out of the 29 samples by ELISA.

Brome mosaic virus (BMV) was detected in 11 out of 25 samples collected from Lebanon by both the DID and ELISA tests. Wheat streak mosaic virus (WSMV) was not detected in any of the samples collected by either test.

The ELISA test was more sensitive than the DID test in detecting BSMV and BMV in the extracts of the diseased samples collected. In testing leaf extracts and purified virus preparations, the ELISA test was more sensitive than was DID in detecting WSMV but they were equally sensitive in detecting BMV and BSMV. Our tests indicated that fresh enzyme conjugated gamma-globulin, which is the most expensive component of the ELISA test, is reusable.

from *U. JARIKJI, Faculty of Agriculture, American University of Beirut, Beirut, LEBANON.*

ARTICLE AND BOOK REVIEWS

Peterson, G.; Sander, D.; Grabovski, P. and Hooker, M. 1981. A new look at row and broadcast phosphate recommendations for winter wheat. *Agronomy Journal* 73 (1): 13-17.

For years agronomists have recognized the superiority of row application over broadcast application of P fertilizer for wheat. The benchmark study of Duley (1930) demonstrated a grain yield advantage of 400 to 1000 kg/ha for row application over broadcast. Currently, the University of Nebraska recommends using the row application method for phosphate fertilization whenever possible. If broadcast is substituted for row application, double the row rate is recommended.

A search of the Nebraska archives failed to reveal the data base for this statewide recommendation. However a search of the literature from 1930 to the present revealed several places where it was recommended that the row applied rate be doubled for broadcast purposes.

The experiments reported were conducted to determine if there is a consistent relationship between broadcast and row applied P rates for winter wheat.

Results contradicted the concept of a 2:1 ratio of broadcast to row P application as standard practice. The relative effectiveness of row and broadcast methods changed with changing soil test P levels.

Blum, A. and Ebercon, A. 1981. Cell membrane stability as a measure of drought and heat tolerance in wheat. *Crop Science* 21 (1): 43 - 47.

Drought and heat tolerance tests that were developed for sorghum (*Sorghum bicolor* L. Moench) were adopted and evaluated in field grown wheat (*Triticum aestivum* L. and *T. durum* Desf.).

The drought tolerance test is based on the measurement of the electroconductivity of aqueous media containing leaf discs that were previously stressed *in vivo*.

When plants were sampled during a period of water stress, they were more drought tolerant than well-watered plants, indicating adjustment of cell membrane stability to drought stress. In this respect, wheat cultivars varied in their ability to adjust.

There was no correlation between drought and heat tolerance in wheat, but there was in sorghum.

Whingwiri, E.E.; Kuo, J. and Stern, W.R. 1980. The vascular system in the rachis of a wheat ear. *Ann. Bot.* 48: 189-201.

The vascular system in the rachis of ears of wheat (*Triticum aestivum* L. cvs. Gamenya, Olympic and Bungulla) was examined on material grown in the field and in a growth cabinet. In the internodes, central and peripheral bundles were observed and their mean number and size were determined. A significant 1:1

relationship between the number of spikelets on the ear and the number of central bundles at the base of the rachis was established. The number of both central and peripheral bundles declined acropetally along the length of the rachis. The decline in peripheral bundles occurred mainly between internodes 1 and 6, numbered from the base. The decline in central bundles occurred at a rate of less than one bundle per internode between internodes 1 and 4, though in some ears there was no decline; in larger ears, central bundles declined at a rate of one to two bundles per internode between internodes 5 and 11. Above internode 11, the rate of decline varied with ear size. Three central bundles consistently reached the terminal spikelet. The number and cross-sectional surface area of xylem vessels and sieve tubes and the total vascular size also declined acropetally along the rachis. The decline in total vascular size was due to (a) some bundles branching and to reductions in size, (b) the diversion or dropping of bundles into spikelets, or (c) a combination of (a) and (b). These observations are discussed in relation to the distribution of grain number and weight on the ear.

Shehata, A. and El-Arab, Q. 1981. Local and Mexican wheats in Syria. Agricultural Research Center publication No. 220 Douma, Damascus, Syria. 15 pp.

The Agricultural Research Center in Damascus in co-operation with the Ministry of Agriculture and Agrarian Reform and the Information Center produced an extension pamphlet in Arabic stressing the importance and nutritional value of wheat in the world and in Syria. The paper reviews the most important local varieties used in Syria, the durum varieties Gezira 17, Haurani, Senator Capelli and the breadwheat Florence Aurore. Land preparation, fertilizer application, irrigation systems and seed quality testing are reviewed. The Mexican wheats used in Syria are the breadwheats Mexipak and Siete Cerros and the durum wheat Jori C69. The environmental conditions needed for these varieties and the best sowing dates are discussed.

(Abstracted by Jouhayna Issa).

IBPGR Secretariat, 1981. *Directory of Germplasm Collections. Cereals 1. Wheat*. IBPGR, Rome, Italy. 28pp.

This is a directory of *Triticum* and *Aegilops* species for use by scientists involved in generic resources and by curators.

IBPGR Secretariat, 1982. *Directory of Germplasm Collections. Cereals. IV. Barley*. IBPGR, Rome, Italy. 26pp.

The names and addresses of 63 collections, names of curators, details of samples, geographical representation, evaluation, documentation and of storage are given for 43 countries. The directory was compiled by N. Murthi Anishetty, Jane Toll, W.G. Ayad and J.R. Whitcombe.

Croston, R.P. and Williams, J.T. 1981. *A World Survey of Wheat Genetic Resources*. IBPGR, Rome Italy. Publication No. IBPGR/80/59. 43pp.

IBPGR Secretariat. 1979. *Seed Technology for Genebanks*. IBPGR, Rome, Italy. 127pp.

This book presents information on practical procedures relating to seed bank work. The book is available from the IBPGR Secretariat, via delle Terme di Caracalla, 00100 Rome, Italy.

Jenkins, J.F. and Plumb, R.T. 1981. **Strategies for the Control of Cereal Diseases** Blackwell Scientific Publications, Oxford, U.K. 219pp.

The Federation of British Plant Pathologists organised a programme entitled 'Strategies for the Control of Cereal Diseases' as part of a meeting of international biologists. This book represents a selection of the papers which provided coverage of the present status of disease control in temperate small grain cereals. The papers are presented under the headings Host Resistance, Chemical Control and Husbandry.

ICARDA. 1982. **Proceedings of the Seed Production Symposium, March, 1981.** ICARDA, Aleppo, Syria. 120pp.

ICARDA. 1979, 1980, 1981. **Cereal International Nursery Reports, 1977 to 1980.** ICARDA, Aleppo, Syria.

QUESTIONS AND ANSWERS

Question: Where can I get 5 tonnes of seed of the durum variety Waha?

Answer: ICARDA can provide small quantities of nucleus seed of this variety, on request. The pedigree of Waha is Plc 's-Ruff 's x Gta "S"-Rtte. CM 17904 - B - 3M - 1Y - 1Y - OSK.

It has been tested in Regional Yield Trials for more than 3 years and has given a very good yield in many countries. Some countries are testing this durum variety on a large scale in national level trials and farmers fields.

(J.P. SRIVASTAVA, *Cereal Improvement Program, ICARDA*)

Question: What is a dual purpose barley? Can you suggest some varieties and provide seeds?

Answer: Barley which is grown for both forage and grain. Some barley genotypes can be grazed once or twice without a significant loss of grain or total dry matter yield. Examples of such lines are C-63, Lignee 131 (Montpellier) and Martin. Seed in small quantities can be provided.

(M.S. MEKNI, *Cereal Improvement Program, ICARDA*)

Question: Please give some information on wheat varieties resistant to *Septoria* in North Africa.

Answer: A) Wheat varieties resistant to *Septoria tritici* in North Africa:

Durum

Reichenbachi, Kyperounda, Zenaty Bouteille (+ *Septoria nodorum*), Lobeiro, Balaluta, PI 298547, Crosby, Ward, Giorgio 331CI15108 (+ *S. nodorum*).

Bread wheat

Perico (+ *S. nodorum*), Purple straw (+ *S. nodorum*), Knox (+ *S. nodorum*), Arthur, Egret, (+ *S. nodorum*) and Kondut. Seabreeze, Veranopolis and IAS - 20 are sources of resistance to *Septoria tritici* in western Australia.

B) From Regional Data - Bread wheats.

Aepoglon/II-64-27 = MN 72131

Inia-Napo x Tob/Spr (Cr.43-E.L.) , L17-5S-6S-OAP

Kvz (Cc-Inia/Cno x El Gau-Son.64) SE 381- 4S-1S-6S-OS-OKE + YR, LR, SR, Spot Blotch

Strampelli

Kvz-Cj

SWM1430-4Y-3Y-1M-1Y-100B-500Y-OM

Ald "S" - Gjo

CM 32589-1M-6Y-1M-1Y-1B-1Y-OM

Bow "S"

CM 33203-N-1M-2Y-500M-OY

(A.H. KAMEL, *Cereal Improvement Program, ICARDA*)

Question: In what countries is triticale being grown as a commercial crop?

Answer: The following countries are planting triticale as commercial crop and have released some varieties.

Country	Hectares
USSR	200.000
USA	80.000
Canada	20.000
Argentina	20.000
China	20.000
South Africa	15.000
Hungary	3.000
France	2.000
Mexico	1.500
Australia	1.000
Spain	350
Portugal	200
Italy	120
GDR	100
Czechoslovakia	100

(M. NACHIT, *Cereal Improvement Program, ICARDA*)

Question: Are there any barley varieties resistant to Barley Yellow Dwarf Virus and Barley Stripe Mosaic Virus?

Answer: Sources of resistance to BYDV : Benton, CM 67, CM 72, Coracle, Abate, UC 566, Sutter, Atlas 68, Numar, Briggs, Prato. [They all carry the Yd2 - gene for resistance (Tolerance) to BYDV].

Sources of resistance to BSMV (Barley Stripe Mosaic Virus): Modjo 1, Imperial, CI 4219, CI 4429.

(A.H. KAMEL, *Cereal Improvement Program, ICARDA*).

Question: Can triticale be grown in drought prone areas ?

Answer: Yes, many triticale lines show tolerance to drought. ICARDA is screening for this characteristic in drought susceptible areas. Tolerance to drought is concentrated in the triticale germplasm which has a complete set of rye chromosome or in triticale with Turkish rye germplasm in their pedigree.

(M. NACHIT, Cereal Improvement Program, ICARDA)

NEWS OF CEREAL SCIENTISTS

Drs. R. Havener, B. Curtis, A. Klatt and T. Harris (CIMMYT, Mexico) visited ICARDA and the Cereal Improvement Program and had useful discussions with ICARDA staff on areas of mutual interest to the two Centers.

Dr. Georg Popow (team member of the Quinquennial Review committee for CIMMYT, and formerly head of plant breeding at the Swiss Federal Research Station, Zurich) visited ICARDA and the Cereal Improvement Program from August 29 to September 2, 1982 to acquaint himself with the cereal research work done at ICARDA.

Other visitors to ICARDA's Cereal Improvement Program during 1982 included:

L. Boss (Netherlands); R. Rodriguez, M. Alcala (CIMMYT, Mexico); A.A. Gomaa, R. Abou El Einein, V. Smail (Egypt); S. Jana (Canada); B.A. Pisarev, N.S. Vasilchuk, R.M. Razakov (U.S.S.R.); S. Yesilsoy, I. Genic, Y. Kirtak (Turkey); C.D. Sands, D. Yount (Montana State University, U.S.A.) ; Shaller, D. Rasmusson (U.S.A.); R. Sikora (GTZ, West Germany); Y.E. Kramm (Chile); G. Fischbeck (West Germany); Khalifa Mahmoud (ARC Tripoli, Libya); P. Portman (Australia); M. Deghais (Tunisia); Dr. Nasrat Fadda (Director of Operation, Arab Fund for Economic and Social Development (AOAD, Kuwait) visited ICARDA from March 17 to 18, 1982.

Dr. Richard Sikora (plant pathologist/nematologist, Institute of Plant Pathology, University of Bonn, West Germany) visited ICARDA's research programs to define areas of mutual importance to Bonn University and ICARDA. Graduate students from Bonn may take up additional research projects with ICARDA.

A review mission, comprising Drs. J.P. Srivastava (ICARDA), D. Rasmusson and C. Schaller (U.S.A.) visited Morocco to review the cereal research work carried out in the past and to identify current problems and future strategies. A report was submitted by the mission to the Moroccan authorities.

Other News:

Dr. Frank Zillinsky has retired as Head of the Triticale Breeding Program at CIMMYT and has returned to his home country, Canada.

Dr. Miloudi Nachit (ICARDA) has been transferred to durum wheat breeding in the Cereal Improvement Program. He will, however, continue to spend part of his time on triticale breeding work.

Dr. Caesar Cardona (ex CIAT) has joined the Food Legume Improvement Program of ICARDA as Entomologist. Part of his time will be used to direct the cereal entomology group in their work on wheat stem sawfly, suni bug, hessian fly and aphid resistance in cereal crops.

Dr. Severin Kukula (ex IITA) has joined the Farming Systems Program of ICARDA as Weed Control Specialist.

Dr. J.P. Srivastava (Cereal Improvement Program, ICARDA) is on sabbatical leave at Oregon State University, Corvallis, U.S.A. until July, 1983.

The following job vacancies exist in the Cereal Improvement Program at ICARDA:

Senior Physiologist/Breeder
Post Doctoral Barley Breeder
Cereal Training Officer

WHEAT: ITS NATURAL HISTORY

The attention of naturalists has, at various times, been directed to the nature and origin of wheat; which some have conjectured to be improved grass of the *Triticum* order, a genus in which the spikelets are sessile on the axis of a single spike, containing each two or more florets, which are either all fertile, or having the terminal one rudimentary, or barren, having two glumes to the spikelet, and two pales to each floret.

from *Ward and Lock's Book of Farm Management and Country Life. Ward, Lock and Co., London, U.K. Circa 1818.*

BARLEY PUDDING

1 1/3 c. barley, large or medium grain	4 c. water
6 c. boiling milk	1 tsp. salt
1/2 tsp. pepper	1/3 c. butter or margarine

Soak barley overnight in water. Cook in same water. As water is absorbed, add boiling milk and seasoning. Cook over very low heat, stirring frequently, for 30 minutes. Pour into buttered 3-quart baking dish. Dot with butter. Bake in preheated very slow oven (250°F.) about 2 hours until golden brown.

Serves 6-8.

from *'Back to Barley for recipes for the world's oldest food crop' prepared by Kay Saari and Lorna Hawtin for the Fourth Regional Winter Cereal Workshop-Barley. Amman, Jordan, 1977.*

TRAINING, CONFERENCES AND MEETINGS

LIST OF ICARDA 1982 TRAINEES

Training at ICARDA

The Cereal Training Program of ICARDA offers a 6 months training course which covers many aspects of the improvement and production of breadwheat, durum wheat, barley and triticale. The course is mainly field oriented with more than 60% of the course being field training; the other 40% involves class and laboratory activities. Visits to different national programs in the region and to other organisations involved in agricultural development are also included in this training course. The next course begins in January, 1983.

Since its beginning in 1978, the ICARDA Cereal Training Program has trained 71 young scientists from Afghanistan, Algeria, Bangladesh, Cyprus, Egypt, Ethiopia, India, Iraq, Jordan, Lebanon, Libya, Morocco, Oman, Pakistan, Peoples Democratic Republic of Yemen, Saudi Arabia, Sudan, Syria, Tunisia, Turkey and Yemen Arab Republic.

The most recent 6 months Cereal Training Course commenced in February 1982. It was held at ICARDA's Tel Hadya research station, 30 km south of Aleppo in Northern Syria. The course was field oriented and designed to provide basic background information and the necessary field research skills for wheat and barley research workers in national programs. Lectures, manuals, reference books and other educational materials were given to the trainees. Trainees had a good opportunity to work closely with ICARDA's research scientists and actively participated in research activities at ICARDA's main station and in the cereals on-farm trials. Several visits to some national programs and organisations were also arranged.

ICARDA's Cereal Training Program also offers other types of training such as short courses (1 week to 2 months), opportunities for scientists to visit ICARDA (from a few days to one year) and national and/or regional level training courses. Graduate study training is also offered; at present this is limited to persons from the University of Aleppo, Syria.

Apart from the regular 6 months residential training course at ICARDA, the following short term courses were organised at the national level:

1. A national 'in-service' training course on cereal research was held in Rabat in Morocco from April 13th to 23rd, 1982. This was organised by national program scientists from Morocco with the assistance of Dr. M. Tahir (ICARDA) and Dr. G. Varughese (CIMMYT). Twenty-four trainees from various research stations and institutions in Morocco successfully completed this practical-orientated course on cereal research and production.

2. A national research training course was held in Kamishly, Syria from March 27 to April 9, 1982. This course was organised by national program scientists with the help of Dr. Samir Ahmed (ICARDA). This practical training course was held for 16 trainees on breeding, production, cereal disease identification, experimental design, data recording and farm machinery.

NAMES

COUNTRY

Mouhammad Al Hamoud Al-Abed	Syria
Fowzi Al Ghaith	Syria
* Turkey Al Obied	Syria
Hassna Awad	Syria
* Mouhammad Bardan	Syria
* Toufik Makhoul	Syria
Mowaffak Mouhammad	Syria
* Abdel Baki Sheik Mous	Syria
* Aminullah Rahimi	Afghanistan
Lal Mouhammad Salimi	Afghanistan
Darwish Sabt Salman	Bahrain
* Andreas Demetriou (Katsazos)	Cyprus
* Abdel Rahman Mansour	Egypt
* Gh. R. Cyrus Ghomi	Iran
* Lahcen Faid	Morocco
Mouha Amezziane	Morocco
Sakr Bou Azza	Morocco
Mouhammad Yousef	Pakistan
M. Ashraf Zahid	Pakistan
* Ahmad Badr	Sudan
Mouhammad Rajab	Sudan
Sadok Kouka	Tunisia
* Mouhammad Saleh Yousfi	Tunisia

* = Cereal trainees

Recent Conferences and Meetings

During 1982.

February 1982

Cereal Co-ordination Meeting between CIMMYT and ICARDA. Held in Athens, Greece. ICARDA attendees included Drs. J.P.Srivastava, A.H.Kamel, M.S.Mekni, W.K.Anderson and W.Nelson. FAO, ACSAD, The Ford Foundation, the Rockefeller Foundation, IADS, IDRC, Oregon State University and the University of Saskatchewan were also represented at this meeting. It was agreed to held the next meeting at Aleppo in 1984.

February 1982

The Interfaces Between Agriculture, Food Science and Human Nutrition in The Middle East. An ICARDA/UNU workshop was held in February, 1982 at Aleppo University for selected scientists and research workers concerned with agricultural production. The purpose was to establish links and areas of common interest between agricultural scientists, food scientists and nutritionists as related to socio-economic development.

The workshop sought to open up channels of communications by devoting a large amount of time to discussion. It was organized into six sessions each with two main speakers and one discussant.

UNU, The United Nations University, is an academic institution established by the United Nations to mobilize international scholarly resources for collaboration on global problems that transcend national boundaries.

April 1982

Seed Production Symposium. 20 April-10 May, 1982 Aleppo. Sponsored jointly by the Netherlands government and ICARDA, the course covered practical training, theory and organisation of seed production, variety release, crop certification and seed testing (mainly in the self-pollinated crops barley, wheat, lentils, chickpeas, forage peas). Seed production problems were also discussed and some recommendations were made.

May 3-4, 1982

International Symposium on Durum Wheat Production. Held in Foggia, Italy. The conference aimed to review research and production trends in durum wheat in the Mediterranean region. Papers were presented on all aspects of durum wheat work including processing, quality, plant breeding and production practices. Dr. W.K. Anderson (ICARDA) attended and presented a paper.

May 1982

Nitrogen in Crop Production Symposium. Held at Muscle Shoals, Alabama, U.S.A., 25 - 28 May.

June 1982

Seminar on Wheat and Barley Quality. Held in Nairobi, Kenya. Organised by FAO/SIDA/SARE.

August 1982

International Plant Nutrition Colloquium. 22 - 27 August. Warwick University, Coventry, England.

September 1982

2nd International Symposium on Nitrogen Fixation with Non-legumes, Banff, Alberta, Canada. 5 - 10 Sept.

October 10-16, 1982

FAO European Durum Wheat Network Meeting. Held in Paris, France. Attended by Dr. M.S. Mekni (ICARDA).

Forthcoming Conferences and Meetings

During 1983:

January 16-17, 1983

Second International Conference on Soil Erosion and Conservation. Honolulu, Hawaii, U.S.A.

April 25-28, 1983

International Symposium on Foothills for Food and Forests. Corvallis, Oregon, U.S.A.

November 20-25, 1983

Tenth International Congress of Plant Protection. Brighton, England U.K.

November 28-December 3, 1983

Sixth International Wheat Genetics Symposium. Kyoto, Japan. Will include pre- and post-symposium study tours.

BIBLICAL ACCOUNT

In the biblical account furnished in Genesis, special allusion is made to "seed-time and harvest", and Joseph's dream of the sheaves doubtless represented wheat sheaves, for the "seven ears on one stalk, which the earth brought forth by handfulls", corresponds with the *Triticum compositum* at present grown in Egypt, which is styled clog wheat, still bearing seven ears on one stalk, the produce being used by London bakers, when made into coarse flour, for dusting their kneading boards.

from *Ward and Lock's Book of Farm Management and Country Life.* Ward, Lock and Co., London, U.K. Circa 1818.

BARLEY-ALMOND CASSEROLE

1/2 c. butter	1/2 c. almonds
1 c. onions; finely chopped	1 c. pearl barley
1 c. parsley, finely chopped	1 tsp. salt
6 c. beef bouillon	Dash of pepper
1/2 c. Chives, finely chopped	

Saute almonds in butter for 5 minutes. Remove 1/2 of the nuts. Add the onions to the nuts in the pan and brown. Add the barley. Stir constantly until slightly brown. Add remaining ingredients except nuts. Bake, covered, at 350°F. for 1 hour stirring after 1/2 hour. Add remaining nuts and bake uncovered for another hour.

from 'Back to Barley for recipes for the world's oldest food crop' prepared by Kay Saari and Lorna Hawtin for the Fourth Regional Winter Cereal Workshop-Barley. Amman, Jordan, 1977.

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Barley Breeder
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Durum wheat Breeder
Post Doc. Durum wheat Breeder
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Research Associate

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Weed Control Specialist
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Caesar Cardona

Entomologist

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All contributors are requested to use the following guidelines in order to speed editing and to improve communications.

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The Newsletter will be published in English. ICARDA will endeavour to translate articles which are submitted in other languages.

Editing

All articles will be edited in order to preserve uniform style. If any contributions have to be shortened, the scientific content and meaning will not be changed. If substantial editing is required, ICARDA will send the author a draft for his approval before printing.

Manuscript

Articles are to be typed and double spaced. The original and one legible copy should be submitted. The contributor should include his name, title, program or department, institute and postal address.

The article should normally be confined to a single subject and should be of primary interest to cereal workers in research, extension, production and to administrators and policy makers.

Articles for the '**RESEARCH AND PRODUCTION**' section should be approximately 650 words in length. A maximum of two well prepared tables/figures/diagrams/or glossy black and white photos will be reproduced. The photos, figures etc., should be either 9.3 cm wide for a single column or 19.3 cm wide for a double column. Figures and diagrams should be drawn in India ink; if possible send original artwork.

Articles for the '**SHORT COMMUNICATIONS**' section should be up to 150 words in length.

All measurement units are to be in the metric system. Avoid national units e.g. quintals. Report yields as kg/ha. State measurements, time, money and percentages in numbers e.g. 480 g/l, 6 hr, U.S.\$ 75, 10%. With chemicals, place the name next to the unit of measure e.g. 50 kg P/ha and not 50 kg/ha P. Convert all national currencies into U.S.\$.

All numbers should be written as figures (e.g. 6, 34) not words except at the beginning of a sentence.

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The editors reserve the right to shorten the text and to alter it should it not conform to the above rules.

