RACHIS

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Dear Readers,

Beginning this year, RACHIS will be published half-yearly, in January and June. The two issues in 1984 will constitute Vol. 3; issue 1 (November 1982) and issue 2 (May 1983) are to be treated as Vol. 1 and 2, respectively.

A new feature from this issue onward is a full article in one of the areas of cereals research—a review article or a discussion of a topic—with the objective of providing maximum possible information on that topic. We invite you to contribute such articles to RACHIS.

For our Arab readers, active efforts are under way to produce Arabic versions of RACHIS.

While we constantly strive to report every possible cereals news accessible to us, we are aware that there is always some news that escapes our notice. Please keep us informed of developments in cereals research, including new publications, conferences and seminars, and about cereals scientists so, through RACHIS, we can share that information with all others.

Please note that the deadline for contributions to the June 1984 issue of RACHIS is 15 April 1984.

Happy New Year.

Editorial Committee

CONTENTS

RACHIS -the Barley, Wheat, and Triticale Newsletter—is published by the International Center for Agricultural Research in the Dry Areas (ICARDA). The newsletter is a part of ICARDA's Scientific News Service and is aimed at improving communication among cereal scientists. It contains mainly short scientific articles but also includes book reviews and news about training, conferences, and scientists in barley, wheat, and triticale.

Published half-yearly in January and June, RACHIS can be obtained free by writing to the Distribution Unit, Communications and Documentation Program, ICARDA, P.O. Box 5466, Aleppo, Syria. Contributions to RACHIS should be sent to Dr. Habib Ketata.

COVER

Women baking *Tannour* bread (local flat bread) from durum wheat in a Syrian village.

SHORT COMMUNICATIONS:

Review Article

DURUM WHEAT - ITS WORLD STATUS AND POTENTIAL IN THE MIDDLE EAST AND NORTH AFRICA

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Introduction

Of the several species of wheat generally recognized, bread *(Triticum aestivum)* and durum *(T. durum)* wheats are the two most prominent in commercial production. Bread and durum wheats cover approximately 92 and 8%, respectively, of the 240 million hectares (m.ha) presently under wheat cultivation in the world. Durum production and consumption is mainly concentrated in the countries around the Mediterranean sea (Fig. 1). The Middle East and North Africa account for 80% of the durum wheat cultivation in the developing countries.

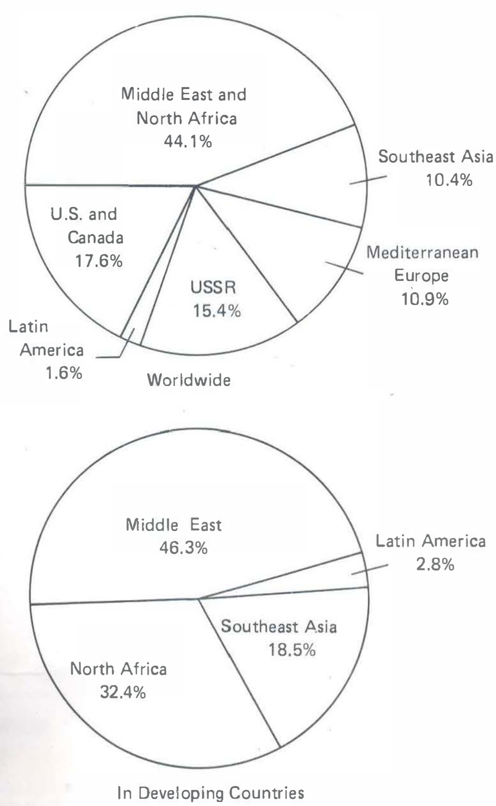

Fig. 1. World distribution of durum wheat.

In most reports, durum and bread wheat data are combined and therefore individual and reliable statistics on durum wheat are difficult to obtain. Little information is available from the USSR, China, and a number of East European countries.

Origin of Durum and Bread Wheats

All wheats belong to the genus *Triticum* of the family Gramineae. Wheat species differ from one another cytologically, morphologically, and physiologically. Cytologically they are classified as diploids (AA), tetraploids (AABB) and hexaploid (AABBDD). The three differing chromosome sets (genomes) derived from wild progenitors of present day-wheats are designated as AA, BB, and DD.

The wheat species *Triticum boeoticum* possessing the genome AA grew in western Asia as a wild grass during prehistoric times. The Einkorn wheat, *T. monococcum* descended from *T. boeoticum* and is believed to have been domesticated in that region around 8000 B.C. or even earlier. The genome AA exists in all present-day wheat species.

The Emmer wheats possess the A and B genomes, and the B genome is believed to have come from *Aegilops searsii* or similar grasses. Of the Emmer wheats, *T. dicoccum* became the predominant wheat in the fertile crescent and spread into much of Asia, North Africa, and Europe. It remained as the main wheat for several thousand years. Around 300 B.C., *T. durum,* an easy threshing large-seeded variant from *T. dicoccum,* is known to have been cultivated in SW Asia. Around the beginning of the Christian era, *T. durum* had replaced *T. dicoccum* in most of the wheat growing areas of Asia, Africa, and Europe.

Hexaploid wheats possessing genomes AABBDD probably arose in the same general area, from natural crossing of *T. durum* or *T. dicoccoides* with *Aegilops squarrosa* (DD) followed by chromosome doubling. Thus the hexaploid wheats (bread wheats) have the D genome in addition to the AB genomes (tetraploid complex) present in durum wheats. Where the free-threshing hexaploid wheats first became a commercial crop is not known; however, it is speculated that they became a major crop in Europe and Central Asia where winters were more severe. From there bread wheat moved with the migration of man to new habitats as a major source of food.

In present-day agriculture, *T. aestivum* (bread wheat or soft wheat) and *T. durum* (hard wheat or macaroni wheat) are cultivated over most of the world wheat area.

Characteristics of Durum Wheat

Desfontaines (1798) distinguished *T. durum* from the Mediterranean forms of *T. turgidum* and *T. aestivum,* mentioning solid straw, pubscent glumes and long flinty grain as its specific characters. Durum is better suited than bread wheat to the Middle East, North Africa, and parts of Mediterranean Europe having low average annual rainfall (300-450 mm). In central India where there is usually little rainfall between seeding and harvest time, durum performance is superior to that of bread wheat. Good yields can be obtained under irrigation and high levels of fertilizer; however, there is normally a reduction in quality of grain. Wet weather at harvest time can also cause serious losses in grain quality because the grain sprouts readily. High summer temperatures and low humidity improve grain quality, but durum is susceptible to low temperatures and severe frosts. Durum wheat thrives best where a considerable proportion of the annual rainfall occurs during the vegetative phase and when occasional showers alternate with bright sunshine and hot dry conditions during the grain filling period. While good quality durum cannot be produced in many areas where bread wheat is cultivated, the reverse may not hold true. Agroclimatic conditions under which durum wheat is grown in the Middle East and North Africa are indicated in Table 1.

Most durum wheat varieties are spring or semi-winter types. Only a few true winter-habit durums are known. In general, durum wheat is low tillering, grows rapidly and normally matures later than many bread wheats. In some areas the crop is lightly grazed during winter without reducing the yield of grain at harvest. The stems are either solid or hollow with thick walls, providing some resistance to several insects such as the stem sawfly.

Table 1. Agroclimatic conditions under which durum wheat is grown in the Middle East and North Africa.

Country	Precipitation (mm) Range	Mean	Type of agric. T = traditional M = modern (%)	Rainfed (R) or irrigated (I) (%)	Yield kg/ha
Afghanistan	250 - 500	350	T = 100	R = 50 I = 50	1100
Algeria	300 - 700	500	T = 70 M = 30	R = 100	620
Cyprus	100 - 450	300	T = 5 M = 95	R = 90 I = 10	1130
Iraq	300 - 700	400	T = 80 M = 20	R = 100	1130
Jordan	250 - 400	350	T = 95 M = 5	R = 95 I = 5	740
Libya		300		R = 100	550
Morocco	250 - 650	400	T = 75 M = 25	R = 99 I = 4	1000
Syria	250 - 450	350	T = 65 M = 35	R = 95 I = 5	900
Tunisia	200 - 700	400	T = 70 M = 30	R = 100	700
Turkey (Central Plateau)	275 - 600	350	T = 80 M = 20	R = 100	1100
Turkey (Southeast)	300 - 600	480	T = 60 M = 40	R = 99	1050
Ethiopia	400 - 1000	750	T = 90 M = 10	R = 100	700

Based on: G. Varughese 1975. Proceedings of the Third Regional Wheat Workshop, Tunis, Tunisia.

Kernels of durum wheat are golden amber, large, translucent, hard and difficult to grind. Durum dough is less elastic than that of bread wheat and therefore inferior for producing loaf bread. The physical and chemical characteristics of durum gluten provide greater stability of the dough and make it especially suited for pasta products. For preparation of pasta, the grain is milled only as far as the 'semolina' stage; a finely ground flour is not required. The dough formed from the semolina is subsequently forced through tubes or openings of various forms and sizes and then dried. In the process of cooking, pasta products of good quality do not disintegrate, become soft, mushy, starchy or sticky.

In the developing countries durum wheat is primarily used to make unleavened bread, couscous, burghul and freke (Table 7). In North America, Europe, and particularly Italy, durum wheat is used in manufacturing macaroni, spaghetti and other pasta products.

In general, durum wheat is considered to possess higher nutritional value than bread wheats, particularly the soft wheats. Durum grains contain less starch but more protein, aminoacids, vitamins and fatty acids than bread wheats (Scarascia Mugnozza 1975).

Annual world durum wheat production for the 1979-81 period is estimated to be around 27.5 million metric tonnes (Table 2).

Table 2. Estimated durum wheat area, production, and yield by major growing regions in 1979-81.

Region	Area x 10^6 ha	Yield 100 kg/ha	Production x 10^6 tonnes
North Africa	3.5	8	2.8
West Asia	5.0	15	7.5
SE Asia	2.0	13	2.6
USSR	3.0	12	3.6
Mediterranean Europe	2.1	21	4.6
Latin America	0.3	20	0.6
North America	3.4	17	5.8
World	19.3	13.7	27.5
% of all wheat	8.1	76.1	6.1

Area and Production

Although bread wheat dominates world wheat production (92% of the total wheat area), the diets of millions of people in such semi-arid areas as North Africa, the Middle East, Central India and Ethiopia are based on durum wheat. Durum wheat occupies a total of approximately 20 million hectares distributed in all countries bordering the Mediterranean sea, in Iraq, Iran, Afghanistan, Ethiopia, India and the USSR. In the western hemisphere durum is mainly grown in the USA, Canada, and Argentina.

Production of durum wheat has been on an upward trend despite considerable year-to-year fluctuations. However, the modest global increase in durum production between 1969-71 and 1979-81 has been far outpaced by the growth in bread wheat production during the same period. The area, yield, and production of durum wheat compared with all wheat for the ICARDA region (Morocco to Pakistan and Turkey to Sudan) is presented in Table 3.

Table 3. Yield and production of durum wheat compared with all wheat in the ICARDA region for the periods 1969-71 and 1979-81.

	Area harvested x 10^6 ha		Yield 100 kg/ha		Production x 10^6 tonnes	
	1969-71	1979-81	1969-71	1979-81	1969-71	1979-81
Durum wheat	8.9	8.5	9.5	11.3	8.3	10.3
All wheat	30.6	31.8	10.3	14.2	31.6	45.1
Durum as % of all wheat	29.1	26.7	92.2	79.6	26.3	22.8

North Africa and West Asia

Of the land planted to durum wheat in the developing world, four-fifths is in North Africa and the Middle East. In Morocco, Algeria, Tunisia, Jordan, and Syria, durum wheat is grown on two out of every three hectares planted to wheat. The region's largest producer is Turkey, where durum occupies 2.4 m.ha (Table 4).

Table 4. Estimated durum wheat area in the developing countries.

Country	Area thousands of hectares	Durum wheat area % of all wheat
Middle East and North Africa:		
Algeria	1270	65
Cyprus	40	70
Egypt	17	3
Ethiopia	982	90
Iraq	404	24
Jordan	134	95
Lebanon	17	50
Libya	130	46
Morocco	1252	74
Saudi Arabia	30	50
Syria	993	67
Tunisia	865	92
Turkey	2349	25
Southeast Asia:		
Afghanistan	215	9
Chile	45	8
China	388	1
India	1532	7
Iran	328	7
Latin America:		
Argentina	235	5
Mexico	35	5
Peru	38	40

Although extensive areas are sown in North Africa, yields are low, and production is now lagging considerably behind consumption requirements. North Africa has gone from a net exporting region in the 1950's to the main importer of durum wheats. The shortfall in durum production in North Africa is serious in view of the rapid increase in local demand and the cost of imports. Production has increased in West Asia, particularly in Turkey and Syria. In 1981, West Asia produced 7.5 m.tonnes from about 5 m.ha (Table 2).

Mediterranean Europe

Durum occupies over two million hectares in southern Europe. Italy grows 1.7 million hectares and produces over three million tonnes of grain. In Italy, farmers have switched from bread wheat to durum wheat in some areas. During the sixties and early seventies, durum production increased in France but declined after termination of premium support prices in 1977. In 1979, Greece produced around 385,393 metric tonnes of durum wheat; its production jumped to 656,587 in 1980 and to a record of 737,728 in 1981.

USSR

It is known that large quantities of durum wheat are grown in the USSR. The most favourable area for durum is east of the Ural mountains including Kazakhastan. It was reported in 1978 that durum wheat was grown on three million hectares (half as much as in the 1930's) and that average durum wheat yields were significantly lower than those of bread wheat.

Southeast Asia

India grows around 1.5 to 2.0 million hectares of durum wheat. Its cultivation is confined to central and Peninsular India which are characterized by moisture stress and a hot dry climate. The yields are low and the area sown to durum wheat has been declining. Recently there has been an attempt to grow durum in North India under irrigation. In China, durum occupies less than 1% of the wheat area.

Latin America

Argentina is the main producer of durum wheat in Latin America. In the sixties, Argentina produced around 700,000 tonnes; however, in the last few years most farmers have switched to soft bread wheat. In 1981, Argentina harvested only 100,000 tonnes of durum wheat. Small quantities of durum wheat are grown in Chile, Peru, and Mexico (Table 4).

North America

North America is one of the main centers of durum wheat production and the principal source of exports. In

1981, the combined production of Canada and the United States was approximatley eight million tonnes. Saskatchewan province in Canada and the State of North Dakota in the United States produce the bulk of durum wheat in North America. Cultivation of durum wheat in Canada increased after 1916. At that time it was planted in Manitoba to replace bread wheat varieties which had been severely attacked by stem rust. The appearance in 1954 of a new strain of rust, to which durum itself was susceptible, virtually eliminated its production in Manitoba and production moved further west into Saskatchewan and Alberta. However, there has been an upward trend in recent years in both area and production of durum wheat in Canada. Canada's durum wheat production in the 1950's averaged 500,000 metric tonnes, doubling to over one million tonnes in the 1960's and doubling again in the 1970's to two million tonnes.

In the United States, the outbreak of stem rust in 1954 reduced durum production to less than 150,000 tonnes. However, development of stem-rust resistant varieties resulted in a rapid increase in the durum area, primarily in North Dakota but also in nearby Minnesota, Montana and South Dakota. In the 1960's, production averaged 1.8 million tonnes, and in the 1970's. 2.6 million tonnes. In 1981, the USA produced 5.1 million tonnes. Recently, Arizona and California have started to grow durum wheat under irrigation, and in 1981 they accounted for 16% of the production in the USA. Production of durum wheat in North America is subject to wide fluctuations, as farmers switch between durum and bread wheat in response to price changes and prospects for durum exports.

Grain Yield

The yield levels for major durum growing areas are presented in Table 2. Much of the recent increase in production was due to higher yields, particularly in Europe and Turkey. The overall average in 1979-81 was 1400 kg/ha, compared with 1200 kg/ha in 1969-71 and 900 kg/ha in 1959-61 (Table 5). In spite of the gains, durum yields, in general, continued to lag behind yields of bread wheat. In the period 1979-81, the world durum yield was 73% of that for all wheat, whereas the proportion in 1969-71 had been 79% and in the 1960's over 80%. In the ICARDA region there has been an upward trend in durum yields, but this is largely due to increases in Turkey and Syria. The regional average yield has risen from 950 to 1130 kg/ha in the ten-year period from 1969-71 to 1979-81. However, during the same period improvement in yield levels of bread wheat has been much greater (from 1030 to 1420 kg/ha). In 1969-71 the regional durum yield was 92% of that of all wheat, while in 1979-81 it was down to around 80% (Table 3). Durum is grown under less favourable environments, and this explains most of the difference.

Durum yield in North Africa is the lowest, averaging 500-800 kg/ha, and there has been little change since 1969-71. The reasons for the low yields are many. Most durum varieties planted in the region are local cultivars traditionally adapted to survive unfavourable crop growing conditions. They lack satisfactory resistance to prevalent diseases, yield potential and responsiveness to improved moisture and nutrient levels. Poor agronomic practices, wide environmental fluctuations and unimproved varieties contribute to low yields in this area.

Apart from a small area of durum grown under irrigation and high fertilizer application, the highest yields are in France and Italy where they average over three tonnes/ha. In Canada and the United States, they are in the range of 1.5 - 2.0 tonnes/ha, not much higher than a decade ago. Yields of 5-6 tonnes can be obtained under irrigation with improved varieties and production technologies.

Table 5. Estimated yield gains in durum wheat.

	1959-61	1964-66	1969-71	1974-76	1979-81
	Yield (100 kg/ha)				
North Africa	5	5	7	8	8
Middle East	7	10	10	13	15
Europe	10	12	18	20	21
North America	11	18	19	17	17
World (including others)	9	11	12	13	14

Consumption

During the 1970's, world durum wheat consumption increased by an average of approximately 2.2% per annum, whereas total wheat use went up at an annual rate of nearly 3% . Usage is heavily concentrated in a small number of countries, particularly in North Africa and the Middle East which account for 50% of world durum consumption. Another 25% is consumed in Europe, mostly in Italy.

The majority of durum wheat producing countries in the Mediterranean region are unable to meet their demands from local production. North Africa is the world's largest durum importing area. There has been an increase in the import of finished semolina products, particularly by Algeria. In 1981/82, North Africa imported 2.3 million tonnes, which was more than 40% of the world's durum wheat trade (Table 6).

Table 6. World durum wheat imports by region.

Destination	1977/78	1981/82 (forecast)
	X 1000 tonnes	
Western Europe	1812	1600
Eastern Europe	100	300
USSR	308	500
Latin America	268	400
Asia	61	100
North Africa	1296	2300
Others	37	50
Total	3882	5250
As percentage of total wheat trade	5.4	5.2

Source: International Wheat Council. Secretariat Paper No. 12, 1982.

Many of the traditional durum-consuming developing countries are importing bread wheat, because durum prices have generally been high. Also bread wheat is more readily available on credit, at concessional rates or as food aid. Some of the countries have started to make pasta products from bread wheat, disregarding the loss of quality. Imported bread wheat is being increasingly substituted for durum needs and if this trend continues for long, a change in traditional diets can be expected.

Italy is a major user of durum wheat, primarily in the form of pasta products. Per capita pasta consumption in Italy and Greece is around 25 kg/year. In Italy, it is prohibited by law to use bread wheat in the manufacture of pasta products.

Some durum wheat is used in most countries in Europe and North America, mainly in the form of pasta products. In countries other than those mentioned, only 20% of the durum wheat is used for pasta and the remainder is used for local bread, couscous, burghul, and freke (Table 7).

Table 7. Major uses of durum wheat in the Middle East and North Africa countries.

Use	Percent of total available
Pastas	15.5
Local bread	50.2
Couscous and burghul	18.5
Others	15.8

Source: Varughese, G. 1975. Proceedings of the Third Regional Wheat Workshop. Tunis, Tunisia.

Two countries, Canada and the United States, account for nearly all durum wheat exports (Table 8). Their combined share of all exports averaged 70% in the 1960's and increased to 89% during the 1970's. In most years the two countries have exported roughly equal amounts. World trade in durum wheat exceeded 4 million tonnes in 1979/80, and rose to 5.1 million tonnes in 1981/82. Future trade will depend on the price and availability of durum in the world market. The concentration of durum in relatively limited areas increases the vulnerability of world durum output. Heavy disease epidemics, failure of rain or severe frost damage in the durum belt in North America or the Mediterranean basin can make all the difference between ample supplies and shortage of durum wheat.

Durum wheat is priced about 20% higher than bread wheat in most countries in the Middle East and North Africa. However, supply and demand in the international market are not often in balance. Durum wheat prices have exceeded bread wheat by as much as 100 dollars per tonne in some years and have been less than those for bread wheat in other years. These wide fluctuations in prices have caused continued changes in the area sown to bread wheat and amounts of grain produced from year to year, particularly in the exporting countries.

Table 8. World durum wheat exports by source.

Source	1977/78	1981/82 (estimated) 1000 tonnes
Argentina	248	200
Canada	1943	2200
United States	1647	2300
Others	44	650

Source: International Wheat Council. Secretariat Paper No. 12, 1982.

Research Efforts

Italian scientists have played a major role in the development of improved durum germplasm. The work of Strampelli and coworkers resulted in release of outstanding varieties such as Senator Capelli and Capeiti. These varieties are still grown in several countries. Subsequently, the research work on durum wheat by a number of Italian scientists increased basic knowledge and produced a number of improved varieties. Gerardo, Creso, Castel del Monte, CAB125, and a number of other varieties have been widely evaluated and used. In France, the work of Grignac resulted in increased durum production. Release of early maturing and drought tolerant durum varieties improved production in Central India; however, these varieties suffered from disease susceptibility. In the USA, North Dakota State University, and the University of California, Davis are actively engaged in durum improvement research. In Canada, durum research is mainly conducted at the University of Saskatchewan and at the Swift Current and Winnipeg Research Stations of the Canada Department of Agriculture. Since the mid 1960's, CIMMYT-developed durum wheat germplasm has been tested in most of the durum-growing areas, and some lines such as Jori 69, Cocorit, Stork, and Bittern'S' have performed well under moderate-to-favourable crop growing conditions. They are being cultivated in some countries.

Within the ICARDA region, historically, durum wheat has received less research input than bread wheat. However, a number of countries in the past decade have increased their research efforts to improve national durum wheat production. Tunisia, Algeria, and Morocco in North Africa and Turkey, Syria, Jordan, Egypt, and Cyprus have released new durum varieties that perform better than the old cultivars. The area sown to improved varieties is slowly increasing, particularly under irrigated or high-rainfall conditions. However, susceptibility to diseases and poor-grain quality restrict their acceptance.

Durum wheat is grown mostly in the zones receiving 300 to 450 mm of annual rainfall. The area is characterized by unpredictable and scanty rainfall and hot dry summers. Successful varieties must possess tolerance to drought and desiccating winds as well as resistance to various diseases and insects. Most of this area is still sown to either indigenous local cultivars or selections thereof.

In general, the present varieties are somewhat late in maturity and do not have adequate cold and frost tolerance. Resistance to stem rust, septoria, barley yellow dwarf, and scab are still inadequate. Spike fertility, earliness of maturity, tillering capacity, and the ability to withstand soil moisture stress and wind desiccation must be improved. One of the most critical needs is an increase in grain yield without a decrease in grain quality. Factors such as poor plant stand, late planting, weeds, low nutrient availability, and frost often contribute to low yields in the region.

Durum Research at ICARDA

The ALAD durum improvement work was continued as a base program when ICARDA was established in 1977. Keeping in view the importance of durum wheats in the diets of people in the region, ICARDA intensified its multidisciplinary effort to improve both the yield and quality of grain produced in rainfed areas.

In the first few years the ICARDA Durum Program obtained durum strains from national programs as well as international collections. Over 14,000 durum accessions have been evaluated for key agronomic characters and the superior ones have been utilized to broaden the genetic base of the breeding material. The use of genetically diverse lines aimed at correcting known deficiencies in the existing breeding material has resulted in an improved germplasm base. Screening of these lines under the varying conditions, where they will be ultimately grown, has accelerated the identification of promising lines better adapted to the actual crop growing conditions of the region. A major objective is to develop germplasm that performs satisfactorily with limited moisture and nutrients, but that can yield well in seasons when moisture and nutrients are less limiting.

Despite the relatively short period in which ICARDA has had an intensified durum improvement program, progress has been made in the development of germplasm with improved disease resistance, grain quality and yielding ability. These lines are supplied to the national programs through International Nurseries. A crossing block composed of genetic stocks identified as good parental material for different traits such as yield potential, combining ability, disease and insect resistance, tolerance to stress (i.e. drought, cold, and salt), superior grain quality, earliness, etc., is provided to scientists upon request. Studies of the mechanisms of tolerance to drought, salinity, heat, cold and frost in durum wheat are being undertaken by ICARDA in co-operation with several institutions of excellence in the field. An understanding of the physiology of yield and tolerance to stresses will accelerate the development of methods for screening to obtain tolerant lines. Agronomic research is directed to finding economic ways of increasing yield on farmers' fields. Overcoming low yields in less favoured environments, where resources are scarce and good management lacking, are important research thrusts. Agronomists are developing techniques to screen for moisture and nutrient use efficiency. Entomologists have identified durum lines possessing resistance to insects such as stem sawfly, aphids and Hessian fly which cause considerable damage in some areas. Weed control scientists are looking at methods of controlling weeds which are a significant cause of low durum yields, and in addition to other control methods, are seeking plant types that compete well with weeds.

The long-term and large-scale worldwide research and development work on bread wheat has resulted in high yielding, disease resistant and better adapted varieties. These varieties have replaced disease susceptible, unimproved durum wheat cultivars, particularly in irrigated and higher rainfall areas. A country like Egypt which grew only durum wheat before 1920, now hardly grows any durum wheat. Throughout the Middle East and North Africa, the area sown to bread wheat increased at the cost of durum wheat, particularly after the First World War. However, this region is still the world's largest producer and consumer of durum wheat. Durum wheat is specifically adapted to the semi-arid and arid environments of the region, is more nutritious than soft wheat and is highly prized and preferred by the masses in their traditional diets.

It is necessary to strengthen durum wheat research at national as well as international levels. The production potential of durum wheat is larger than current utilization implies. The large-scale cultivation of durum wheat will maintain diversification of *Triticum* species and may provide natural barriers to the spread of diseases and insects among regions. If only one species is used, the inter-species barrier will be eliminated.

ICARDA, in co-operation with CIMMYT, national programs of the region and other durum producing countries and institutions working on durum wheat in the world, hopes to strengthen research aiming at sustaining durum as one of the most viable crops of the ICARDA region.

References

Byerlee, D. 1981. Wheat facts and trends. CIMMYT, Mexico.

Dalrymple, D.G. 1978. Development and spread of high-yielding varieties of wheat and rice in the less developed countries. Foreign Agricultural Economic Report, No. 95, USDA, Washington, USA.

FAO. 1972-1980. FAO Production Yearbooks, Rome, Italy.

FAO. 1972-1980. FAO Trade Yearbooks, Rome, Italy.

Haldore Hanson, N.E. Borlaug, and R.G. Anderson, 1982. Wheat in the third world. Westview Press, Boulder, Colorado, USA.

ICARDA (International Center for Agricultural Research in the Dry Areas). 1982. Cereal improvement. Pages 38-81 in ICARDA Annual Report 1981. Aleppo, Syria.

ICARDA (International Center for Agricultural Research in the Dry Areas). 1983. Cereal improvement. Pages 59-106 in ICARDA Annual Report 1982. Aleppo, Syria.

International Wheat Council, 1982. The world durum wheat situation. Secretariat Paper No. 12, 28 Haymarket, London.

Percival, J., 1921. The wheat plant. Duckworth and Co., London.

Peterson, R.F. 1965. Wheat. Leonard Hill Books, London.

Scarascia-Mugnozza, G.T. (ed.). 1975. Proceedings of the EUCARPIA Symposium on Genetics and Breeding of Durum Wheat, 1973. University of Bari, Italy. 696 pp

Scarascia Mugnozza, G.T. 1975. Importance of durum wheat in the world food supply. Proceedings of the Third Regional Wheat Workshop, Tunis, Tunisia.

Srivastava, J.P. and Varughese, G. 1979. Varietal adequacy for different agroclimatic conditions of the regions. Proceedings of the Workshop on the Gap between: Present Farm Yield and the Potential, Algiers, Algeria.

Varughese, G. 1975. Needs of durum wheat in the North African and Near and Middle East regions. Proceedings of the Third Regional Wheat Workshop, Tunis, Tunisia.

DEVELOPMENT OF MULTILINES IN DURUM WHEAT CULTIVARS[1]

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Three species of wheat, namely, *Triticum aestivum* L., *T. durum* Desf., and *T. dicoccum* Schr. are cultivated in India at present and respectively account for 85, 14, and 1% of the wheat cultivated area. The "Wheat Revolution" which India witnessed after 1965, is exclusively due to one species of wheat, i.e. *T. aestivum* L. (bread wheat).

India is one of the largest durum growing countries of the world. In spite of the fact that about 3 million hectares are under cultivation with this species, the yield and production are very low for several reasons. In international markets prices are generally higher for durum than for bread wheat. Thus durum wheat or its products offer good potential as an item of export from India, provided its yield and quality can be improved.

Narrow genetic base, poor adaptability, and lack of stability for resistance to rust, particularly stem rust, of most of the Indian durum cultivars led to the introduction of intravarietal diversification for resistance to stem and leaf rusts in this species. Therefore, three durum agronomic bases, two conventional tall, viz., NI 146 (Gaza x Baxi 23) and 'Bijaga Yellow' (Local Red x Gaza) and one semi-dwarf, HD 4519[HI-35-196 (Yt 54-N 10B) Bell 116) TC^2], were selected as recurrent parents to develop their component lines through backcrossing. Fourteen varieties belonging to six different species of *Triticum* were selected as donor parents to provide the diverse sources of resistance to rust. Since this has been the first attempt in the world to produce multilines of durum wheat cultivars, the individual component lines representing homogeneous populations and their mechanical mixtures (to form the multilines), representing heterogeneous populations, were tested for (i) reactions to rust, (ii) rate of rust spread and (iii) effect of rust on yield and yield components.

Rate of rust spread was computed in terms of "Area Under Disease Progress Curve (AUDPC)," using the following formula:

$$AUDPC = D \quad (\tfrac{1}{2}(\text{Sum of first and last observations}) + \text{Sum of all in between observations}).$$

where, D is the constant interval between two consecutive recordings.

Susceptible components in pure stand showed a high rate of rust spread leading to high rust incidence. When the same susceptible lines occurred in the mixed populations, they showed very low rate of rust spread and less infection than in the pure stand.

Multilines showed a significantly low rate of rust spread and maintained a high degree of population resistance. The susceptibility level of the multilines did not increase proportionately with the increase in the number of susceptible components in the population, and appeared to be independent of the susceptibility level of the individual components. Even when 40% of the components were susceptible, their composite population behaved like a resistant line.

Multilines showed as high as 9.6% increase in yield over the mean yields of their components and gave significantly higher yields than a highly stem rust-susceptible component. Thousand-grain weight and harvest index consistently improved in the heterogeneous populations and in certain cases this improvement was significant over the average of their components. Rust incidence showed a negative and significant correlation with yield and harvest index and caused a significant reduction in the 1000-grain weight of susceptible components.

It is possible to select lines as good as recurrent parents even in the BC2 generation involving intervarietal crosses and in BC3 involving interspecific crosses.

In case of the spread of rust from the source, the horizontal spread of inoculum through plants is limited; vertical deposition of the inoculum through the air appears to play the major role.

A "dirty multiline" appears to be more practical and more scientifically accepted than a "clean multiline" since it has a stabilizing effect on the pathogen and gives greater flexibility in selection of component lines.

[1] Abstract of Ph.D. thesis: "Studies on the effect of rust-resistant genes of diverse origin on yield and rate of rust spread in homogeneous and heterogeneous populations of *Triticum durum*. Desf.," conducted at the Indian Agricultural Research Institute, New Delhi 110012, India. 1981 215pp. bibl., tabs., figs.

Based on the above findings, the development and utilization of rust-resistant durum multilines will increase and stabilize the yield and production of durum wheat.

CONCEPTS IN THE USE OF RECURRENT SELECTION TO IMPROVE DISEASE RESISTANCE IN BARLEY

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Recurrent selection is usually employed for the improvement of cross-pollinated species. The incorporation of the male-sterile gene (msg), found in Manchuria, Betzes, and other cultivars, into barley genotypes has facilitated cross-pollination in barley. There are at least 28 separate loci for male sterility in this species (Hockett and Eslick 1968).

A recurrent selection program begins with the establishment of a base population, usually of varieties well adapted to the area, with as much genetic variability as possible. This requires a preliminary screening and evaluation of lines or varieties for their potential as sources of resistance. This step is important to obtain a durable or a multigenic resistance. Thus, there is a need to identify different genes present in the cultivars and their expression in different genetic backgrounds.

Once the base population is established, the recombination cycle should help in accumulating the resistance genes. Thus, the recombination cycle assumes random mating, but it is important that varieties with resistance genes should not vary in height and earliness. A replicated field design, if appropriate, should facilitate random mating.

Another important factor in recurrent selection is the population size. A minimum of 500 g of seed is required to avoid genetic drift and possible erosion of resistance.

Once the recurrent selection population is established, the breeder has an opportunity to apply extreme selection pressure. In disease resistance screening, this is usually achieved by inducing artificial disease epidemics with one race of a specific pathogen that is important in the area. If, however, more than one pathogen is important in the area, one may choose to inoculate with different pathogens at alternating selection cycles, or with two pathogens at the same time. Mixing of races of the same pathogen of some fungi imperfecti should however be avoided, especially with variable pathogens such as *Rhynchosporium secalis.* A population of *R. secalis,* prepared by mixing of spores of four races in equal amounts, resulted in 18 races after only two successive disease cycles on a susceptible host (Jackson and Webster 1976). After inoculation, the breeder should shift the population mean, using different rating scales, either by roguing the undesirable types or selecting only the desired ones. This may be accomplished for any trait that can be evaluated on a single-plant basis, by space planting the population.

Continued crossing and selfing of the population will tend to break long established linkage blocks. Harrabi (1982), Starling *et al.* (1971), Jackson and Webster (1976), and others have found evidence of a linkage block or multiple alleles at the Rh - Rh3 - Rh4 - rh6 locus for scald resistance. Multiple alleles are advantageous in recurrent selection populations and reduce genetic vulnerability.

A recurrent selection population also takes advantage of transgressive segregation or the accumulation of minor additive genes, thus resulting in maximum amount of gene recombination and increase in genetic variability to facilitate selection.

Once a recurrent selection population is developed to a high percentage (about 80%) of resistance, the matter of gene deployment is important. For example, a breeder may use this population to establish a "polymultiline." Plants in this population should, on the average, possess more than one gene for resistance to any one particular disease for which the population was set up, hence it could be termed polygenic multi-line or polymultiline. Resistant plants with similar height, maturity, and seed color are harvested and bulked. Polymulti-line breeding, if properly conceived and organized, may have great flexibility and advantages over the usual multi-line breeding.

The Montana/USAID Barley Project has set up four populations for resistance to powdery mildew, leaf rust, scald, and net blotch. The populations are screened every year in Morocco, Tunisia, Egypt, Syria, and Turkey against different races of these diseases. If a collaborative program could be established between these countries and others of the region, then recurrent selection could offer a great potential for breeding for multigenic resistance in the area.

References

Harrabi, M. 1982. The inheritance of resistance of barley to *Rhynchosporium secalis.* Ph.D. Thesis. Montana State University.

Hockett, E.A. and Eslick, R.F. 1968. Genetic male sterility in barley II. Available spring and winter stocks. Crop Science 8: 154 - 155.

Jackson, L.F. and Webster, R.K. 1976. Race differentiation, distribution and frequency of *Rhynchosporium secalis* in California. Phytopathology 66: 719 - 725.

Starling, T.M., Roane, C.W. and Kuo-Ruey Chi. 1971. Inheritance of reaction to *Rhynchosporium secalis* in winter barley. Pages 513 - 519 *in* Proceedings, Second International Barley Genetics Symposium, 1969, Pullman, Washington.

A SIMPLE TEST FOR THE DEGREE OF DAMAGE CAUSED IN WHEAT BY SUNI BUG (*EURYGASTER* SP.) INFESTATION

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An earlier communication drew attention to the incidence of Suni bug in northern Syria, and to some effects of the attack by this insect on the physical dough characteristics of flours in the affected wheat (Cardona *et al.* 1983). Commercially, the ravages of the Suni bug can have serious consequences. It is physically impossible to bake the traditional two-layered flat bread *(Khobz)* from flours which have been milled from wheat containing 20% or more of affected grains. The catastrophic weakening of the dough strength makes it impossible to produce or manipulate the 1-2 mm thick dough pieces which are baked into the familiar two-layered *Khobz.* Inspection of samples drawn from the area adjacent to Aleppo revealed infestation of up to 80% . Normally, damage cannot be suspected or detected until the wheat has already been milled into flour. The flour is routinely tested for wet gluten, at which stage the weakening effect becomes obvious. By the time the damage is detected, the mill may have produced 100 tonnes of flour or more, most of which has to be retained until it can be safely blended in amounts of no more than 5% with sound flour, before being distributed to the bakeries. The economic consequences of this have become serious to the milling industry in Syria. A simple test which enables the detection of Suni bug damage in the wheat before it is milled has been developed at the ICARDA cereal quality laboratory. The test procedure is as follows:

Grind 50 g of cleaned wheat in a Udy Cyclone grinder, fitted with a 1.0 mm screen. Mix the ground wheat thoroughly and sieve for 2 minutes through a 100 mesh (149 μm) sieve. This will yield 20-40 g of flour, depending on the hardness of the wheat. Carry out a wet gluten test on 10 g of the flour. Use a 2% solution of sodium chloride and wash for 10 minutes. Wash the gluten ball in a beaker several times using warm water. When the water remains clear, dry the gluten by using a stream of warm air (a commercial hair dryer is ideal) until the gluten feels slightly sticky to the hands. The drying can be achieved without the use of warm air, but the warm air system gives more consistent results. After the gluten is washed and dried of superfluous water, weigh the wet gluten, record the weight, form the gluten into a ball, stretch it 5 cm along a milimeter scale, then release it allowing it to relax. Normal gluten will immediately relax to about 1.5 - 1.8 cm. This figure is referred to as the elasticity of the gluten. Due to the removal, in washing, of the low molecular weight proteins, which modify elasticity properties, gluten washed from wheat flours with a wide range of physical dough characteristics exhibit a relatively small range of elasticity. Table 1 summarizes a recent study of wet gluten elasticity from Buhler - milled flours ranging from less than 2 to above 20 minutes in Farinograph stability.

Table 1. Elasticity of wheat gluten from flours with different farinograph stability.

Elasticity (cm)	Stability (minutes)
1.0	1.8
1.9	2.0
1.8	2.2
1.8	2.7
1.5	4.0
2.0	6.0
1.7	8.5
1.9	8.7
1.8	9.0
1.7	10.1
1.8	10.5
2.5	21.0
1.6	24.0
1.8	27.0

The Suni bug is believed to secrete a saliva, which contains proteolytic enzymes, into the developing grains. The general effect of this is to cause the protein to disaggregate or dissolve in the presence of water, and this in turn brings about a significant reduction in the elasticity properties of the gluten. As a result, the gluten ball, after stretching to 5 cm, may not return to 1.6 - 1.8 cm, and in some cases of infestation when the gluten possesses no elasticity, it actually "drips" or increases in length after the 5 cm stretching. The presence of as little as 2% of Suni bug damaged grains in an otherwise sound sample causes a remarkable reduction in elasticity; at 5% of damaged grains, the gluten possesses no elasticity, and the stretched gluten usually elongates under its own weight (Table 2 and Fig. 1).

Table 2. Influence of Suni bug damaged wheat on gluten elasticity.

% Damaged kernels in sound sample	Elasticity (cm)
0	1.8
2	2.2
3	3.3
5	> 5

Testing the wheat at the mill laboratory before milling helps to detect Suni bug damage before milling, and thereby greatly simplifies blending of damaged wheat. Probing of 2-3 randomly chosen bags from a truck will enable detection, since all of the wheat on a single truck will almost certainly have arisen from the same areas, and Suni bug infestation tends to be regional. The test equipment consists of a Udy Cyclone or a similar grinder fitted with a 1.0 mm screen, a 100 mesh (149 μm) sieve, a Theby gluten washer, and a scale (balance) to weigh the flour and gluten. The total cost is about U.S. $2000.00.

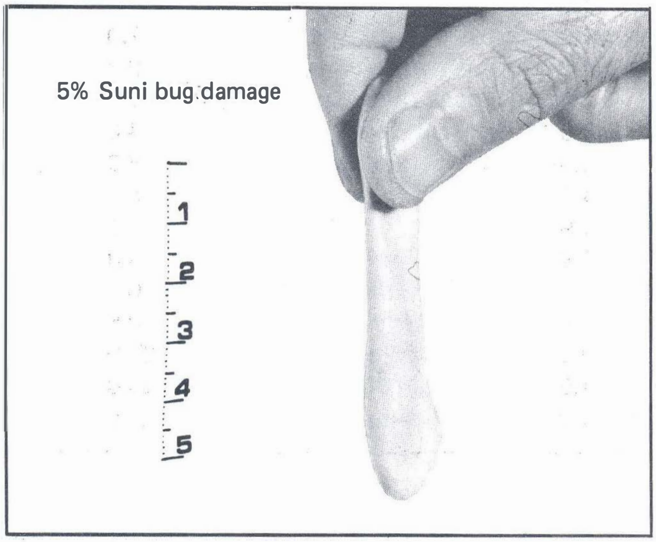

Fig. 1. Poor elasticity of gluten dough due to Suni bug (*Eurygaster* sp.) damage.

References

Cardona, C., Hariri, G., El Haramein, F.J., Rashwani, A., and Williams, P.C. 1983. Infestation of wheat by Suni bug (*Eurygaster* spp.) in Syria. Rachis No. 2: 3 - 5.

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INCORPORATION OF (Me–^{14}C) CHOLINE INTO PHOSPHOLIPIDS OF WHEAT ALEURONE TISSUE

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Introduction

Many workers have investigated the metabolism of membrane phospholipids in cereals, including wheat (Mirbahar and Laidman 1982), and it has been suggested that different parts of the same phospholipid molecule are metabolized at different rates. To study the metabolism of the choline moiety of phosphatidyl choline in wheat aleurone tissue, experiments were conducted to determine the specificity of (Me–^{14}C) choline incorporation into this phosphatide.

Materials and Methods

Batches of 30 sterilized endosperms (de-embryoed seeds) of the soft-grained winter wheat *Triticum aestivum* L. were incubated with 5 uCi of (Me–^{14}C) choline (sp. act. 59 mCi/mmol.), at 25°C for 24 hr. At the end of this incubation (labelling) period, the endosperms were dissected to obtain their aleurone tissues. Total lipids were extracted with hot-water-saturated butanol. After purification on columns of Sephadex G-25, the extract was fractionated over columns of silicic acid and the phospholipid fraction was collected. The labelled phospholipid fraction was separated into individual phosphatides by two-dimensional thin layer chromatography (tlc) and the radioactive spots on the chromatograms were detected. These methods have been described in detail by Mirbahar and Laidman (1982).

The labelled phospholipid fraction was then hydrolyzed with 5 ml of 2N HCl at 37°C with gentle shaking for 6-36 hr (Coulon-Morelec and Faure 1958). At the end of each incubation period, the free fatty acids with unhydrolyzed lipid and the water-soluble products were separately collected, and their radioactivity was determined. Water-soluble degraded products were separated by tlc and the radioactive spots were located. Choline spots were recognized by comparing their Rf values with authentic samples of choline chloride.

Results and Discussion

A significant amount of radioactivity was incorporated into the total phospholipid fraction (about 400,000 dpm/30 endosperms). Visualization of the (Me–^{14}C) choline labelled phospholipid chromatograms revealed that all of the radioactivity chromatographed with the phosphatidyl choline spot and supported the findings of Varty and Laidman (1976). These were further confirmed by liquid scintillation analysis of each phosphatide spot from the developed chromatogram. Of the radioactivity applied to each plate, about 98% was recovered in phosphatidyl choline spots. The remaining radioactivity was probably associated with the glass and residual silica gel of the phosphatidyl choline spot on the plate. It was thus demonstrated that the labelling was highly specific for phosphatidyl choline.

The data regarding degradation experiments, presented in Table 1, show that the phospholipid molecule degraded rapidly during the first 12 hr of hydrolysis. By this time about 90% of the radioactivity disappeared from the phospholipid fraction and appeared quantitatively in the water-soluble fraction. The maximum recovery of the radioactivity was, however, obtained by 24 hr of hydrolysis. Chromatography of the water-soluble degraded products revealed that all of the detectable radioactivity was located in one spot with an Rf value of 0.3 corresponding to that of the authentic sample of choline chloride.

The study thus revealed that incorporation of (Me-^{14}C) choline into phospholipids of wheat aleurone tissue was highly specific. Radioactive choline was incorporated exclusively into the choline moiety of phosphatidyl choline. These results provide a viable base for further studies, such as synthesis and turnover of the choline part of the phosphatidyl choline molecule.

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References

Coulon-Morelec, M.J. and Faure, M. 1958. Compte Rendus des Séances de l'Académie des Sciences. 246: 1936 - 1938.

Mirbahar, R.B. and Laidman, D.L. 1982. Biochemical Journal. 208: 93 - 100.

Varty, K. and Laidman, D.L. 1976. Journal of Experimental Botany. 27: 748 - 758.

EVALUATION OF SOME BARLEY GENES FOR RESISTANCE TO POWDERY MILDEW IN MOROCCO

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Although barley is the most widely grown crop in Morocco, its production is low because the commonly grown land varieties have low yield potential and inadequate level of resistance to diseases. Powdery mildew is one of the major diseases of barley in Morocco.

A few promising lines with good resistance to powdery mildew have recently become available, but little is known about the nature of the genes they carry and those that are efficient in providing good resistance to powdery mildew. Previous screening of lines with known genes for resistance suggested that genes such as M, Ml-p, Ml-y, Ml-cp, Ml-a (Ar), Ml-na, Ml-mw, and JMl-nn could be efficient (Caddel 1976; Metal 1981; Mergoum 1982). However, it remains to be determined whether these genes provide resistance in all locations or only in a certain area, and how durable this resistance would be were they used as sources of resistance.

This paper discusses the reaction of some genes to powdery mildew in several locations in Morocco. The material tested consisted of 10 pairs of isogenic lines developed by Moseman (Moseman 1972; Moseman and Jorgensen 1973). The two members of each pair had almost an identical genotype, but differed in genes for mildew resistance. One member of the pair possessed the gene(s) for resistance while the other had its recessive allele(s). The lines were grown in the 1982/83 season in five different locations of the country. The disease was scored at the flowering stage using a 0 - 9 scale where 0 = no symptom, and 9 = almost complete cover of leaf surface with the fungus; plants near to death.

The data presented in Table 1 indicate that the genes Ml-g, Ml-h, Ml-k, Ml-a, and Ml-a10 are all of no use as sources of resistance in certain locations. Ml-p gene was efficient in three locations; this gene was reported by investigators as effective in some cases. This clearly suggests the existence of different virulence types of the pathogen in the country. Ml-a6 also showed good resistance in three locations. However, the most resistant lines were 16 147, 16 153 and 16 155, with 16 153 being the only line that was resistant in all five locations. Since all three lines contain more than one resistance gene, no definite judgement can be made about which of these genes confer resistance. Similarly, it is not known whether the resistance of line 16 155 is to be attributed to gene Ml-a(Ru1) or to a second gene closely linked to it (both derived from Rupee), or even

Table 1. Reaction of powdery mildew resistance genes in isogenic barley lines in Morocco.

Resistance genes (donor varieties)[a]	Isogenic lines (CI number)[b]	Rabat	Tassaout[c]	Khmis Zmamra[d]	Jemaa Shaim[e]	Fes
		Location				
Ml-a (Algerian)	16 137	6	4	6	5	5
	16 138	6	5	6	5	6
Ml-g (Goldfoil)	16 139	3	4	6	3	5
	16 140	4	6	6	4	5
Ml-h (Hanna)	16 141	4	7	5	3	5
	16 142	6	8	7	5	5
Ml-k (Kwan)	16 143	6	5	7	6	3
	16 144	6	6	6	6	5
Ml-p (Psaknon)	16 145	5	3	2	5	2
	16 146	5	5	4	5	4
Ml-a7 (Multan)	16 147	2	1	2	2	4
+Ml ?	16 148	6	6	6	4	4
Ml-a10 (Durani)	16 149	5	6	5	4	6
+Ml ?	16 150	8	6	5	6	6
Ml-a6 (Franger)	16 151	3	2	2	3	6
	16 152	7	5	6	3	6
Ml-a7 (Long Glumes)	16 153	1	1	1	2	2
+Ml ? IMl ?	16 154	6	7	5	6	6
Ml-a(Rul) (Rupee)	16 155	1	1	2	3	2
+Ml ?	16 156	6	5	5	3	5

a. Donor varieties from which the genes originated.
b. Within each pair, the first CI number refers to the line possessing the resistance gene(s).
c. About 50 km east of Marrakech.
d. 30 km east of Safi.
e. 50 km north-east of Safi.

to both. From a practical point of view, this should not prevent the lines 16 147, 16 153, and 16 155 from being used as sources of resistance since the resistance genes in each of the three lines are closely linked, and can be easily transferred together in crosses with susceptible lines.

Further studies are necessary in Morocco to identify the best sources of resistance to powdery mildew.

References

Caddel, J.L. 1976. Sources of resistance to powdery mildew of barley in Morocco. Plant Disease Reporter 60: 65 - 68.

Matal, N.E. 1981. Contribution à l'étude de la pathogénie des agents des rouilles noire et brune du blé et sources de résistance à l'oidium de l'orge au Maroc. Thesis, Institut Agronomique et Vétérinaire Hassan II, Morocco.

Mergoum, M. 1982. Etudes sur les maladies de l'orge I-Les pertes en rendement causées par l'oidium II-L'hérédité de la résistance à la rouille jaune. Thesis, Institut Agronomique et Vétérinaire Hassan II, Morocco.

Moseman, J.G. 1972. Isogenic barley lines for reaction to *Erysiphe graminis* f. sp. *hordei.* Crop Science 12: 681 - 682.

Moseman, J.G. and Jorgensen, J.H. 1973. Differentiation of resistance genes at the Ml-a locus in six pairs of isogenic barley lines. Euphytica 22: 189 - 196.

USE OF PLANTING DATES TO SELECT STRESS TOLERANT AND YIELD STABLE TRITICALE GENOTYPES FOR THE RAINFED MEDITERRANEAN ENVIRONMENT

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Introduction

The cereal agriculture in the Mediterranean region suffers from several agroclimatic constraints. Early planting exposes the crop to moisture stress during the seedling stage and to frost during the tillering and flowering stages, while late planting negatively affects the tillering capacity and consequently reduces the yield. However, it was possible in two seasons to select triticale genotypes which tolerate the effects of early and late plantings.

Efforts to incorporate stress tolerance into cereals need little justification. The analysis of triticale genotypes grown in rainfed environments has shown the importance of grain size for vigorous plant establishment and good tillering ability (Sutton and Dubbelde 1980; Nachit 1982). Similar results have been found by Nasr and Haddad (1977) on durum wheat, and by Hadjichristodoulou (1981) and Lupton (1982) on barley. The capacity of a crop variety to yield under variable conditions in a range of environments is as important as its yield potential. The heritability and the stability of the yield parameters, under variable environmental conditions were stressed by Alessandroni and Scalfati (1973). Screening techniques, which help to identify high and stable yielding genotypes, are needed to improve selection under the erratic and variable climatic conditions of the Mediterranean rainfed environments.

The two environmental stresses, drought and frost, are major constraints in the Mediterranean climate. Drought checks the crop at any stage of development. Frost occurs during the vegetative stage in several plateaux of the North African and West Asian countries, causing delay in plant growth and exposing the plant to drought and premature desiccation. Tolerance to frost during the cooler months and the ability to grow under relatively low temperatures are desirable traits. The growth and development of the crop during this period are crucial for grain yield.

Materials and Methods

Some 372 genotypes of triticale were planted one month earlier than the normal planting date (mid-Oct), in order to test their tolerance to moisture stress. A little irrigation (30 mm) was applied only to initiate germination. The seedlings were then exposed to moisture stress for three weeks and to frost during the tillering stage. The same lines were planted at the normal date (mid-Nov) and then at a late date (end of Feb). Out of the 372 lines, 194 were tested for grain yield at the three planting dates. The experiment was laid in a randomized block design with a plot size of 9 m^2 and three replications.

Notes on seedling vigour were taken using a 1-9 scale, with 1 = very weak and small, 3 = less vigorous than normal, 5 = normal or intermediate, 7 = vigorous, and 9 = extra vigorous.

Tolerance to frost data were also taken by using the 1-9 scale, with 1 = severe damage, 3 = more than 50% damage, 5 = 50% damage, 7 = less than 50% damage, 9 = no damage.

Heads/m^2, spikelets/head, and grains/spikelet were also recorded. The kernel weight was taken from 1000 kernels for each variety.

Results and Discussion

1. Tolerance to Moisture Stress and Frost

Fig. 1 clearly shows that early planting with partial irrigation and exposure to moisture stress negatively affected seedling vigour in triticale. The majority of the lines in the early planted nursery were in the range of

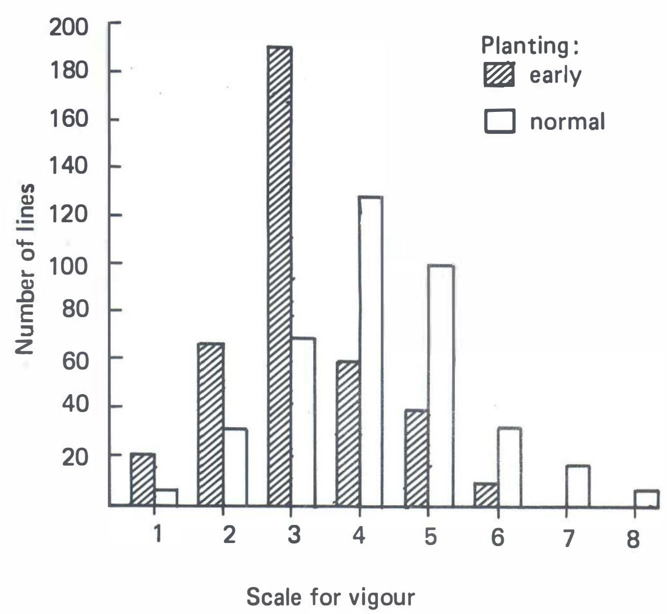

Fig. 1. Effect of moisture stress on triticale seedling vigour.

low-to-medium vigour, i.e. early planting allowed the expression of greater phenotypic variability in the germplasm, and allowed the selection of genotypes with good tolerance to moisture stress during the early seedling stage.

The early planted nursery suffered more frost damage than the normally planted one, as most of the lines were in the low range of frost tolerance, while under normal planting more lines were in the medium-to-high range.

2. Grain Yield and Yield Parameters

Grain yield was increased by early planting and decreased by late planting, as compared to normal planting (Fig. 2).

Generally, late planting reduced the number of heads per unit area. The number of heads/m^2 ranged from 150 to 550, from 100 to 400, and from 50 to 350 for early, normal, and late planting, respectively. Late planting drastically reduced the head number per unit area, however, it was possible to select genotypes which are less affected by late planting. The number of heads/m^2 plays a major role in the development of grain yield under drought stress (Nachit and Malik 1983). Furthermore, the stability of this parameter is of great importance for rainfed agriculture, which has to cope with fluctuating agroclimatic conditions. The number of heads per unit area was the parameter most affected by the different planting dates and largely determined the grain yield. This is in agreement with the findings of Asana (1979) who suggested a variety with high tillering capacity and a high head: tiller ratio as the answer to the problem of improving the yield in rainfed environments.

The influence of the planting dates on the number of spikelets/spike in triticale was not significant. This is in agreement with the results of Atale and Joshi (1979) on triticale and with those of Davidov (1974) on durum wheat.

The grain number per spikelet was unstable across the sowing dates and was drastically reduced by late planting (Fig. 3).

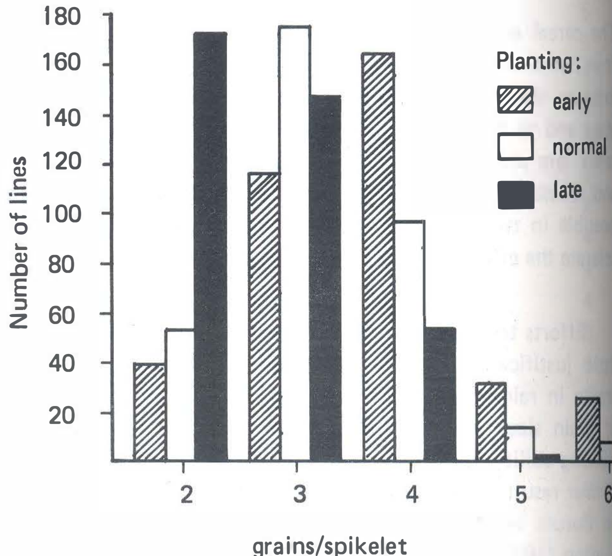

Fig. 3. Effect of different planting dates on grain number/spikelet.

The 1000-kernel weight was slightly but not significantly reduced by late planting, due to the effect of high temperature during the grain filling stage.

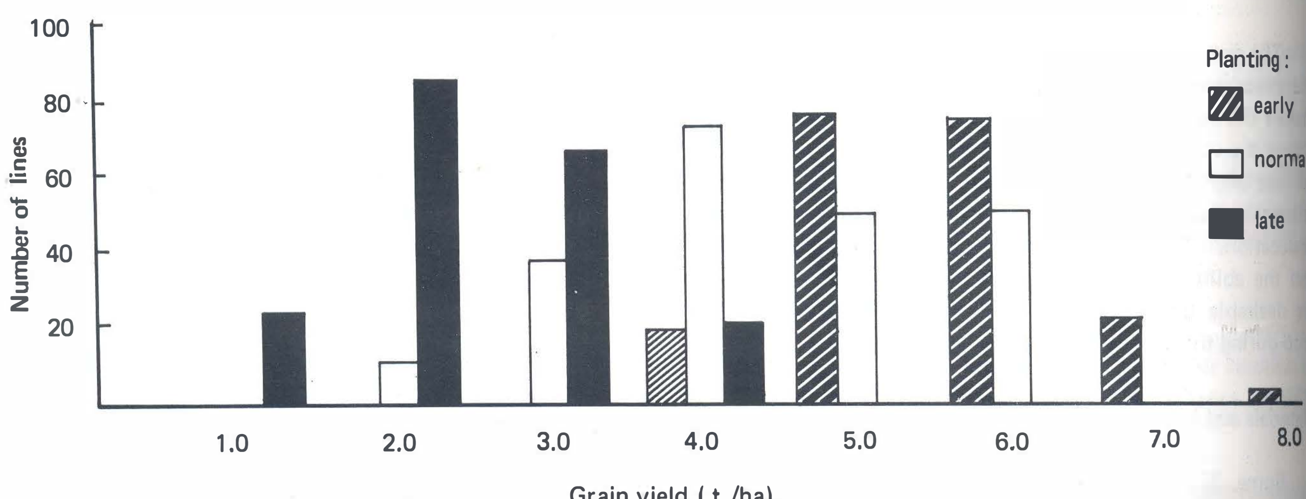

Fig. 2. Effect of different planting dates on grain yield.

Conclusions

Among the traits investigated in this study, the number of heads per unit area and the number of grains/spikelet were the most affected by the environmental conditions, while the 1000-kernel weight and the spikelet number were less affected. Further studies on the interaction between genotypes and environment for these traits would be of great use for cereal breeders.

References

Alessandroni, A., and Scalfati, E.M.C. 1973. Effects of environment on relationship between yield and the yield components: Seed weight per ear and ear number per plant. in *Triticum durum* Desf., pages 297 - 303 *in* Proceedings of the Symposium on Genetics of Durum Wheat, 14 - 18 May, Bari, Italy.

Asana, R.D. 1979. Effect of winter rainfall on non-irrigated wheat. Pages 907 - *in* Proceedings of the Fifth International Wheat Genetics Symposium. 23 - 28 Feb, New Delhi, India. Vol. 2.

Atale, S.D., and Joshi, M.G. 1979. Study of genotypes x environment interaction in triticale. Pages 1228 - , *in* Proceedings of the Fifth International Wheat Genetics Symposium. 23 - 28 Feb, New Delhi, India. Vol.2.

Davidov, S.E. 1974. The development of characters and properties in durum wheat hybrids under different cultivation conditions. Trudy Vsesoyuznogo Instituta Zernovogo Khozyaistva, Vol. 6, 186 -

Hadjichristodoulou, A. 1981. Aspects of barley breeding for dry mediterranean conditions. Pages 383 - 388 *in* Fourth International Barley Genetics Symposium 22 - 29 July, Edinburgh, U.K.

Lupton, F.G.H. 1982. Recent advances in cereal breeding, Netherlands Journal of Agricultural Science 30(1): 11 - 23.

Nachit, M.M. 1982. Effect of seedling growth vigour on yield of triticale. Rachis No. 1: 16.

Nachit, M.M., and Malik, M.A. 1983. Importance of tillering capacity for grain yield in triticale under rainfed conditions. Rachis No. 2: 5 - 7.

Nasr, H.G., and Haddad, N. 1977. Variation and covariation in segregating populations of three durum wheat crosses, Cereal Research Communications 5(3): 315 -

Sutton, B.G., and Dubbelde, E.A. 1980. Effects of water deficit on yield of wheat and triticale, Australian Journal of Experimental Agriculture and Animal Husbandry. 20(106) 594 - 598.

THE ECONOMIC CONTRIBUTION OF FORAGE AND FODDER FROM BARLEY CROPS IN WESTERN SYRIA

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Introduction

In dryland farming, few cropping decisions are made without considering the demand for feed by livestock, and few livestock decisions are made without considering the availability and prices of feeds (Thomson *et al.* 1982). This article uses data from a barley survey, conducted by ICARDA in 1981/82, in an economic model to demonstrate the importance of barley forage and fodder in relation to the value of grain in western Syria[1]. Forage and fodder as defined here include straw and stubble gathered and fed or grazed directly, the grazing of immature barley plants which are later allowed to mature, and the grazing of mature crops as an alternative to harvest.

Materials and Methods

An economic model of forage contributions to the value of mature crops (Nordblom 1983a), was used with the survey data to empirically estimate cost and benefit relationships in western Syria. Net harvest benefits (grain plus straw value, minus harvest costs) and direct grazing values of mature barley crops are estimated as linear functions of grain yield per hectare (Mazid and Hallajian 1983). The parameter estimates are given in Table 1 for the grain, straw, and direct grazing value functions.

The anticipated grain yield at which the direct grazing value of a crop is just equal to the net harvest benefit, is called the "grazing threshold." Below the threshold, direct grazing of the mature crop is more profitable to the farmer than harvesting. Above the threshold, harvesting the crop is more profitable. Thresholds will vary with the prices and costs facing a farmer (Nordblom 1983a).

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[1] The survey in western Syria included the Aleppo, Idleb, Hama, and Homs provinces.

For western Syria, the average 1981/82 grazing threshold was 321 kg/ha, estimated by regression analyses (Mazid and Hallajian 1983). A separate 1981/82 survey of sheep husbandry systems in Aleppo Province provided a similar estimate of 352 kg/ha (SD ± 67.2 kg/ha) for barley grazing thresholds (Thomson and Bahhady 1983).

Farmers' estimates of the frequencies of, and average grain yields for poor, normal, and good crop years are presented in Table 1. The estimated crop value functions were then used to derive average monetary values of the crop components for each class of years.

Results and Discussion

Grain yields in the poor seasons averaged only 208 kg/ha (Table 1) which is below the calculated grazing threshold of 321 kg/ha, indicating that the crop would be more profitably grazed than harvested. The direct grazing value is given to the forage and fodder component and grain value is set at zero since there is no harvest. In the normal and good seasons, grain is harvested and the forage and fodder component mainly includes the straw and stubbles.

Also, the crop component values in each class of years were multiplied by their respective frequencies of occurrence. The products were summed to yield the long-run weighted average value of forage and fodder and that of grain. The long-run contribution of the forage and fodder component worked out at about 38% of the total crop value (Table 1).

The above estimate does not include the economic value of green-stage barley grazing since sufficient data were not available. Our 1981/82 barley survey showed that about 10% of the barley farmers in western Syria followed this practice in all seasons, while others practiced it only occasionally. Theoretical models developed at ICARDA (Nordblom 1983b) give an economic rationale for green stage grazing, even when it reduces grain yields. Agronomic research is presently under way at ICARDA to define the parameters of gains and costs involved. Although green-

Table 1. Barley yield frequencies and the contributions of forage and fodder to total crop value in western Syria.

		Class of crop year		
	Poor	Normal	Good	Long-run
Frequency (percent of years)	24	53	23	100
Average grain yield "Y" (kg/ha, if harvested)	208	803	1563	862
Value of Crop Components[a]				
Forage and fodder (SL/ha)	242[b]	532[c]	996[c]	569
Grain (SL/ha)	0[d]	956	1860	934
Forage and fodder value, as percent of total crop value	100	36	35	38

a These values are computed from the following regression equations using the average grain yield figures above:

			n	$\bar{R}^2$	Significance level
Direct grazing value	=	0.14Y + 212.4	49	0.12	0.01
Straw and stubble value	=	0.61Y + 42.1	45	0.46	0.01
Grain value	=	1.19Y	56	0.99	0.01

where "Y" is grain yield (if harvested) in kg/ha, and values are in Syrian pounds per hectare (Mazid and Hallajian 1983).

b = Value of the mature crop for direct grazing.

c = Value of straw and stubble after harvest.

d = Assumes no grain is harvested since direct grazing value exceeds net harvest benefit (grain + straw - harvest costs).

stage grazing is a relatively small factor in western Syria, it could slightly increase the forage and fodder component of crop value.

There are two other reasons to suspect the contribution of forage and fodder to be greater than the calculated 38%. First, the bias caused by assuming the same prices for all three classes of years as for 1981/82. One would expect the prices for grain, straw, and grazing to be high in the poor and low in the good crop seasons. Adjusting for such price changes would increase our estimate of the long-run contribution of forage and fodder to total crop value.

Another bias in our calculations is that we did not subtract harvest costs when calculating revenues for the crop components in the normal and good seasons. However, correcting this bias increases our estimate from 38% to 39% only.

We do not yet have sufficient data to correct for all three downward biases mentioned above. We can only say that forage and fodder from barley account for at least 39% of the total economic value of this important crop in western Syria. Thus, at most, the harvested grain component contributes 61% to total crop value.

There are both quantitative and qualitative dimensions to the forage and fodder component (Nordblom 1983a). Straw quality, i.e. digestibility and palatability, should enter the list of selection criteria in breeding new barley cultivars for western Syria. We agree with the observations of Srivastava and Varughese (1979, p.145): "The adequacy of varieties should ... be reviewed in light of their ultimate use and farmers' requirements. If it is barley under low rainfall, will it be used for grazing or will it be a combination of grazing and grain production ? ... If we develop varieties without taking into account these requirements and farmers' circumstances, the varieties probably will not be widely accepted."

References

Mazid, A. and Hallajian, M. 1983. Crop-livestock interactions: information from a barley survey in Syria. FSP Research Report, ICARDA, Aleppo, Syria.

Nordblom, T.L. 1983a. Livestock-crop interactions: the decision to harvest or to graze mature grain crops. Discussion Paper No.10, ICARDA, Aleppo, Syria.

Nordblom, T.L. 1983b. Livestock-crop interactions: the case of green-stage barley grazing. Discussion Paper No.9, ICARDA, Aleppo, Syria.

Srivastava, J.P. and Varughese, G. 1979. Varietal adequacy for the different agroclimatic conditions of the West Asia and North Africa region. Pages 144 - 147 *in* The gap between: present farm yield and the potential. Proceedings, Fifth Regional Cereals Workshop, 5-9 May, 1979, Algiers, Algeria. Vol.2.

Thomson, E.F., Bahhady, F. and Nordblom, T.L. 1982. The role of livestock in the farming system. Farming Systems Program Project IV, ICARDA, Aleppo, Syria.

Thomson, E.F. and Bahhady, F. 1983. Aspects of sheep husbandry systems in Aleppo province of northwest Syria. FSP Research Report, ICARDA, Aleppo, Syria.

INCIDENCE OF SCALE INSECTS *PORPHYROPHORA TRITICI* BOD. AND *P. POLONICA* L. (HOMOPTERA: MARGARODIDAE) IN SYRIA

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Distribution

Porphyrophora tritici is found in Hassake, Raqqa, Aleppo, Hama, Homs, Damascus, and Suwayda provinces. *P. polonica* is found in Aleppo, Raqqa and Hassake provinces.

Host Plants and Type of Damage

Scale insects prefer barley, but sometimes attack wheat, rye, and grasses. *P. tritici* sucks the sap from the roots of plants, while *P. polonica* sucks the sap from the leaves, stems, and heads of plants (Fig. 1)

Damage is done by the nymphs, which cause rapid withering and usually death of the plants. Low infestations can reduce the weight of the grain and consequently the yield. Infestation is greatest in soils which are planted year after year with barley and wheat. In 1983, *P. tritici* infestations varied widely from less than 25% of plants infested with less than 0.5 nymphs/plant to more than 75% of plants infested with more than 3 nymphs/plant. Sometimes more than 12 nymphs/plant were found; at this level of infestation plants die.

Fig. 1. Scale insect (*Porphyrophora polonica* L.) feeding on a barley plant.

P. polonica infestations varied from less than 1 nymph/ plant (Aleppo, Hassake) to more than 50 nymphs/leaf (Raqqa). When the barley plants are destroyed, the nymphs move to other plants or attack wheat plants which are planted close by. However, wheat is not as susceptible as barley. Most *P. polonica* infestations in barley occurred at an early stage (4-5 leaves; 10-15 cm plant height), therefore, infested barley plants withered and died before flowering. The total barley area destroyed by this insect in Raqqa province was estimated as 30.000 - 40.000 ha. Damage did not reach major economic importance in the Aleppo and Hassake provinces (Fig. 2).

Life Cycle

Both species of scale insects have similar life cycles. The insect reproduces both sexually and parthenogenetically.

The eggs hatch in early winter (December or January), and the newly hatched nymphs feed on the plants until late May. The nymphs then burrow into the ground and secrete a white waxy material to cover themselves. This is called the chrysalis stage.

The percentages of damage (% plants killed) by *P. polonica* were estimated as follows:

	Areas	% plants killed
1.	Deir Haffer	0
2.	North of Lake Assad	40 - 60
3.	South of Lake Assad	20 - 40
4.	West of Raqqa	80 - 100
5.	North-east of Raqqa	40 - 60
6.	Kantari	80 - 100
7.	Ain Issa	0 - 20
8.	Tel Abied	0 - 20
9.	Kamishli	0

The winged males appear during late May and early June. The wingless females lay eggs in an underground chamber lined with wax threads; these eggs usually hatch next December and the cycle continues.

Factors Favouring the Infestations

1. Lack of rotation increases effects by scale insects; farmers plant barley after barley or barley after wheat thus favouring continuous propagation of the insects. A proper rotation would help break the life cycle of the insects.

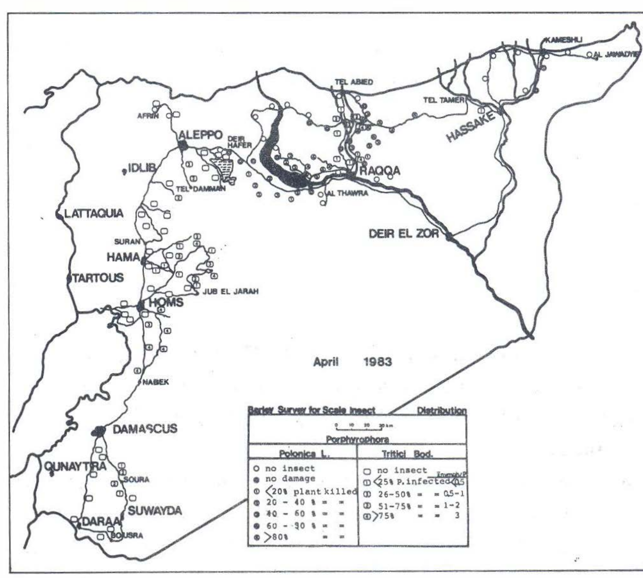

Fig. 2. Geographical distribution of scale insects (*Porphyrophora tritici* Bod. and *P. polonica* L.) in Syria.

2. Traditional cultural practices, such as leaving the stubble in the field. This in turn protects the eggs from sunshine and high temperatures during the summer, thus facilitating the survival of the populations. If the stubble was burned or plowed under, the carry over populations for the next season would be drastically reduced. Another possibility would be to destroy patches of infestation early in the season, so as to prevent their spread throughout the fields. Preliminary observations suggest that the chemical control of scale insects in cereals is not very efficient.

EFFECT OF SUNI BUG (*EURYGASTER INTEGRICEPS* PUT.) DAMAGE ON THE YIELDS OF HAMMARI AND GEZIRA–17 DURUM WHEATS

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Suni bug nymphs suck the sap of grains in the milky stage and up to the waxy-ripe stage. Damaged grains are shrunken, light in weight, whitish in colour, easily breakable at the point of puncture, and smelly.

A survey was conducted during the summer of 1983 to determine the relationship between percentage of seed infestation and yield losses. The evaluation was made for two mature wheat crops at Nada (Azaz-Aleppo), where heavy infestations of Suni bug had occurred during the season.

Fifty samples (0.45 m^2) of Hammari and 25 samples of Gezira-17 durum wheats were taken at random and threshed.

The percentages of damaged seeds and yield losses caused by Suni bug (Tables 1 and 2) were calculated using the number and weight of damaged grains in 1000 seeds randomly taken from each sample.

There was a significant positive relationship between Suni bug damage and losses in grain weight. The correlations between percentage of infested seeds and percentage reduction in weight were significant ($P < 0.01$) for both Hammari ($r = 0.98$) and Gezira-17 ($r = 0.93$).

Mean percentages of grain weight reduction were 16.1 and 10.4 for Hammari and Gezira-17, respectively, suggesting that Suni bug is an economically important pest of wheat in Syria.

Table 1. Relationship between percent seed infestation by Suni bug and seed weight reduction in Hammari durum wheat (1983).

No. of samples	$\bar{X}$ % seed infestation	$\bar{X}$ % yield losses
3	7.23	1.37
9	14.83	3.93
6	23.20	6.00
2	33.65	8.30
4	47.28	11.98
9	54.82	16.19
6	64.30	18.73
4	77.93	26.95
1	83.00	29.40
6	93.68	39.22

r (between % seed infestation and % yield losses) = 0.98**

Table 2. Relationship between percent seed infestation by Suni bug and seed weight reduction in Gezira-17 durum wheat (1983).

No. of samples	$\bar{X}$ % seed infestation	$\bar{X}$ % yield losses
3	17.43	3.90
5	23.42	3.78
9	35.39	6.31
3	44.70	7.80
1	56.70	10.60
3	64.20	13.70
1	81.90	26.90

r (between % seed infestation and % yield losses) = 0.93**

EFFECT OF FARM MECHANIZATION ON WHEAT PRODUCTION ON SMALL FARMS

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The size of yield of any crop is a result of a number of interacting crop production factors. For best results, these factors should be applied at the proper time and at the proper place. Tractor cultivation is particularly helpful, and there could be many ways in which the use of tractor might improve yield (Dalton 1976). Up to 40% more yield is possible on tractor farms than on bullock farms (Gile 1975).

A cross-sectional[1] type of study was carried out in the Sind province of Pakistan to study the effects of tractor use on the wheat yield. Data were collected from Bullock Farms, Tractor-Hiring Farms (custom farms) and Tractor-Owner Farms for the 1979/80 season in the following size groups:

BF_1 :	Bullock Farms 3-5 ha.	(20 farms).
BF_2 :	Bullock Farms 5-10 ha.	(20 farms).
THF:	Tractor-Hiring Farms 3-5 ha.	(20 farms).
TOF:	Tractor-Owner Farms 5-10 ha.	(20 farms).

Farm Survey Findings

Analysis of the survey data revealed that the average per hectare yield of wheat increased with the use of tractor (Table 1). The TOF produced the highest yields, about 24% more than small BF and about 10% more than THF. BF_1 and BF_2 were not significantly different in yield from each other but were lower than THF and TOF at the 5% level. The THF also produced significantly lower yields than the TOF. These findings are supported by earlier reports (Ali 1963; Gill 1962) that mechanical cultivation produced better seed-beds ensuring higher germination and more vigorous plants, and permitted optimum planting schedule.

To minimize the influence of fertilizers and sowing dates in the present study, data were separately analysed for farms using the same rate of fertilizer (i.e. 250 kg/ha) and optimum sowing dates:

Type of farm	Yield (kg/ha)
BF_1	2613
BF_2	2571
THF	3043
TOF	3222

Although the analysis of variance of these data indicated statistical significance at the 5% level, comparison of mean yields in farms sown at optimal dates, showed no significant differences either between BF_1 and BF_2 or between THF and TOF. However, THF and TOF yields were significantly higher than those of BF_1 and BF_2. The BF_1, BF_2, and THF produced 18.9, 20.2, and 5.6% less yield, respectively than the TOF.

Table 1. Average per hectare yields of wheat on the sample BF_1, BF_2, THF, and TOF.

Farm type and size	No. of farms	Yield[1] (kg/ha)	Differences[2] (+ / –)%
Bullock Farms 3 - 5 ha (BF_1)	20	2510a	–24.63
Bullock Farms 5 - 10 ha (BF_2)	20	2556ab	–24.25
Tractor-Hiring Farms 3 - 5 ha (THF)	20	3009c	–9.64
Tractor Owner Farms 5 - 10 ha (TOF)	20	3330d	

1) (i) Means with the same letter are not significantly different at the 5% level.
(ii) SE of differences between two means = $\sqrt{\dfrac{2 \times 192937.5}{20}}$
(iii) LSD at (5%) = 277.80
LSD at (1%) = 369.47

2) Differences (+/ –) measured from the TOF.

Conclusions

Tractor-Owner Farms were superior to all other types of farms and Tractor-Hiring Farms were superior to bullock farms, indicating that mechanization contributed to yield improvement.

1 The comparison of various types of bullock-operated farms with various types of tractor-operated farms at a given time.

References

Ali, S. 1963. M.Sc. Thesis, West Pakistan Agriculture University Lyallpur, Pakistan, 143 pp.

Dalton, G.E. 1976. British aid tractors in India, an ex-post evaluation. Ministry of Overseas Development, UK. 104 pp.

Giles, G.W. 1975. Agricultural Mechanization in Asia. 6: 15-25.

Gill, S. 1962. West Pakistan Journal of Agricultural Research. 42 pp.

LODGING RESISTANCE IN CEREALS WITH EMPHASIS ON BARLEY

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Monsoon winds and rains in SE Asia may cause considerable lodging damage to cereal crops. Fields of progressive farmers using nitrogen and other fertilizers are particularly prone to lodging. Grain losses from lodging typically of 15%but going as high as 60% have been reported in wheat by Shah and Jallel (1935).

Attempts have been made to identify major factors responsible for lodging in different crops. However, there is no unanimity on these factors in spite of the large number of research studies conducted over the last 100 years on this issue (Albrecht 1908, Alkim 1935, Bhide and Bhalerao 1925, Brady 1935, Davy 1798, Davidson and Le-Clerc 1923, Hamilton 1941, Holbert 1924, Howard and Howard 1912, Lange 1926, Malkani and Vaidya 1956, Mehta 1925, Moldenhawer 1914, Murdy 1960, Murphy *et al.* 1958, Tubbs 1930, Welton 1928, Zade 1920, Zanone and Fabretti 1954).

The problem of lodging has been under study since 1949 at the Indian Agricultural Research Institute (IARI), New Delhi. This work has revealed that lodging arises from a loss of balance between the root system and the above-ground plant parts. Malkani and Vaidya (1956) suggested two ratios as lodging indices in wheat crops, shoot: root and breaking strength: mother shoot weight, but Vaidya and Bhag Singh (1963) suggested another ratio, breaking strength: height.

The problem of lodging has been studied more extensively since 1967 at this institute. Wheat trials including 34 varieties (3 old Pusa varieties, 2 from the 700 series, 5 from the 800 series, 3 Punjab varieties, 7 recent semi-dwarf, 5 durum, 7 from other Indian States and abroad and 2 three-gene dwarf varieties) were grown for two years at three locations: Delhi, Pusa, and Indore. Results of this study (Table 1) indicate that two ratios, shoot x height: root and breaking strength: height x mother shoot can be taken as the most suitable indices for lodging resistance in wheat. The five component characters of these two ratios account for 78% of the total variation in lodging.

Table 1. Correlation of lodging with five ratio indices in wheat studies.

Ratio index	Correlation coefficient
Shoot: root	0.570 *
Shoot x height: root	0.829 *
Breaking strength: height	– 0.493 *
Breaking strength: mother shoot	0.024
Breaking strength: height x mother shoot	– 0.659 *

* Significant at the 0.05 level.

Lodging studies have also been conducted on barley at this institute. Table 2 shows the range of variability for five plant characters of the barley material used in these investigations. Results (Table 3) tend to confirm previous findings in wheat showing the importance of the five characters in lodging expression. However, lodging behavior is better explained by ratio indices with shoot x height: root and breaking strength: height x mother shoot being satisfactory lodging indices. Similar results have been reported in maize by Vaidya *et al.* (1963) and Vaidya and Bhag Singh (1972) for root and stem lodging, respectively. Thus, it appears that these indices are applicable to all crops. It is concluded that a cereal plant with good lodging resistance should have a well developed root system, a

Table 2. Ranges for five plant characters in barley studies.

Character	Range	
	Lowest	Highest
Shoot weight (g/10 plants)	368.0	1336.0
Root weight (g/10 plants)	5.8	29.2
Mother shoot weight (g/shoot)	8.1	21.2
Plant height (cm/main shoot)	65.0	110.0
Breaking strength (g/shoot)	345.0	1515.0

Table 3. Correlation of lodging with plant characters and ratio indices in barley studies.

Plant character or ratio index	Correlation coefficient	
Plant weight	0.169	*
Root weight	– 0.392	**
Mother shoot weight	0.114	
Plant height	0.253	**
Breaking strength	– 0.318	**
Shoot: root	0.531	**
Shoot x height: root	0.594	**
Breaking strength: height	– 0.507	**
Breaking strength: mother shoot	– 0.477	**
Breaking strength: height x mother shoot	– 0.613	**

*, ** Significant at the 0.05 and 0.01 levels, respectively.

dwarf habit and strong stems. Attempts have been made to combine these three desirable characteristics into one genotype. In wheat, it was possible to break up linkages between dwarfness and straw weakness and to develop strong-stemmed dwarf types (Vaidya 1971). In barley, lodging was found to be primarily due to weak-straw stem. Therefore, dwarf and strong-stemmed types are also desirable in this species.

A barley project on lodging resistance studies, is under way at the Indian Agricultural Research Institute, New Delhi, along with a Coordinated Barley Improvement Project with its headquarters at the Regional Station of the IARI, Karnal. The junior author, Dr. Mahabal Ram, who is the project coordinator is associated with the project on lodging resistance studies in barley. He has developed a number of hull-less barley varieties that can be readily accepted by the Indian people. Many of his Karan varieties were under test during rabi 1981/82 and rabi 1982/83 and very promising results were obtained for dwarfness and straw strength (Table 4).

Variety Karan 16, in particular, appears to have good lodging resistance despite moderately high values for shoot x height: root ratio and angle of inclination. In addition to its strong stems and root system and its dwarf habit this variety gives quite high yields in "diaraland" which is not usually suitable for wheat production. This is the type of variety Indian farmers need today.

Table 4. Lodging characteristics and grain yield for various barley varieties.

Variety	Shoot wt. (g)	Root wt. (g)	Mother shoot wt. (g)	Plant ht. (cm)	Straw str. (g)	SH/R*	B/HM*	Angle of inclination	Yield q/ha #
Karan 264	22.45	0.64	8.13	74.7	1133	27.1	1.89	15.0	27.17
Karan 4	18.12	0.62	8.14	74.7	1033	21.9	1.69	12.5	28.80
Karan 161	22.29	0.54	8.92	69.5	1130	30.9	1.90	15.0	27.60
Karan 231	26.01	0.62	10.35	79.7	1445	35.2	2.25	15.0	26.52
Karan 265	17.52	0.42	7.21	62.2	798	25.8	1.78	17.5	30.65
Karan 201	16.57	0.47	7.36	81.2	1005	30.8	1.69	10.0	24.67
Karan 3	24.28	0.61	9.87	72.0	1261	32.9	1.76	17.5	26.80
Karan 16	21.98	0.59	10.33	71.0	1505	22.9	2.05	12.5	30.65
Karan 163	25.37	0.37	10.06	75.7	1597	51.6	2.09	22.5	25.00
Jyoti (barley check)**									23.47
HD 2009 (wheat check)**									20.43
LSD (0.05)									3.60
S.308 ##	34.5	1.49	9.49	95.5	937	22.2	1.03	7.2	..
S.227 ##	43.2	2.26	12.38	89.7	1048	17.3	0.96	8.3	..

* SH/R = Shoot x height: root ratio and
B/HM = Breaking strength: height x mother shoot ratio.
** Included for yield purposes only.
# Grain yield is based on data from diaraland, Deoria.
Data from Vaidya *et al.* (1982).

References

Albrecht, K., 1908. Jb. Landw. Pf1-u-Tierz. 37: 617-72.

Atkins, I.M. 1935. A study of the relationship of some morphological characters to strength of straw and lodging in winter wheats. Pages 25 - 27 *In* Review of the Third Hard Red Winter Wheat Conference, Nebraska.

Bhide, R.K. and Bhalerao, G.G. 1925. Kolomba rice of north Konkan and its improvement by selection. Memoirs of the Department of Agriculture, India. (Bot. Ser.), 14: 199 - 245.

Brady, J. 1934. Some factors influencing lodging in cereals. Journal of Agriculture, Irish Free State, 35: 25 - 38.

Davidson, M. and Le-Clerc. 1923. Effect of inorganic nitrogen on wheat. Journal of Agricultural Research, 23: 56 - 68.

Davy, H. 1798. Elements of agricultural chemistry. Third edition, 53 - 55.

Hamilton, D.G. 1941. Certain root and culm characters and their relationship to lodging. Sci. Agric., 21: 646 - 676.

Holbert, J.R. 1924. Anchorage and extent of corn root system. Bull. J. agric. Res. 27: 71 - 78.

Howard, A. and Howard, G.L.C. 1912. On the inheritance of some characters in wheat. Memoirs of the Department of Agriculture, India (Bot.) 5: 1 - 46.

Lange, J. 1926. Investigations on the native wheat varieties from the district of Sehonan a.d. Kafzbech. Zeitschrift fur Pflanzenzuchtung, 11: 11 - 58.

Malkani, T.J. and Vaidya, S.M. 1956. Morphological characters of shoot and root in relation to lodging in three varieties of wheat. Indian Journal of Genetics 16: 121 - 133.

Mehta, M.M. 1925. Biochemical and histological studies on lignification. Part I. Biochemical Journal 19: 958 - 978.

Moldenhawer, K.V. 1914. Zeitsch. and W. Versuchs, Austria, 17: 886.

Murdy, W.H. 1960. The strengthening system in the stem of maize. Annals Missouri Botanical Gardens, 67(3): 205 - 226.

Murphy, H.C., Petr, F.C., and Frey, K.J. 1958. Lodging resistance studies in oats-comparing straw strength. Agronomy Journal 50: 609 - 611.

Shah, K.S.S.I. and Jallil, S.I. 1935. Loss caused by lodging in wheats. Bulletin of NW Frontier Province, Department of Agriculture, 13.

Tubbs, F.R. 1930. Physiological studies in plant nutrition. Effect of manurial deficiency on the mechanical strength of barley straw. Annals of Botany 44: 147-160.

Vaidya, S.M. 1971. Study of lodging resistance and its genetics in wheat. Ph.D. thesis, Indian Agricultural Research Institute.

Vaidya, S.M. and Bhag Singh. 1963. A new index of lodging resistance. Science and Culture. 29: 247 -

Vaidya, S M. and Bhag Singh. 1972. A new index for stem breakage in maize. Science and Culture 38(2): 83 - 84.

Vaidya, S.M. Paliwal, R.L., and Bhag Singh. 1963. A new lodging index for the use of maize breeders. Current Science 32: 128 - 129.

Vaidya, S.M., Joshi, A.B., and Murty, B.R. 1982. Two most suitable indices of lodging for wheat. Current Science 51(13): 667 - 668.

Welton, F.A. 1928. Lodging in oats and wheat. Botanical Gazette 85: 121 - 151.

Zade, A. 1920. Zuchtungant. Halmestigkeit. Fuhlings Landw. 449 - 457.

Zanone, L. and Fabretti, M.C. 1954. Variability of some histological characters of wheat stem. Ann. Sper. Agr. 8: 1227 - 1237.

Short Communications

Improved Durum and Bread Wheat Varieties Released for Cultivation in Syria

After several years of testing and evaluation at research plots and after four years of testing on farmers' fields throughout Syria by the collaborative research program between the Syrian Ministry of Agriculture and Agrarian Reform and ICARDA, two new wheat varieties were approved for release by the Syrian Variety Release Committee during their meeting on October 27, 1983. The durum wheat line Waha, renamed by the committee Sham–1, will be widely grown under rainfed conditions (zones A and B) while the bread wheat line 7C x Tob-Cno/Kal, named as Sham–2, will be cultivated in the irrigated and high rainfall areas of the country. Seeds of Sham–1 and 2 are under multiplication by the National Seed Organization for distribution to Syrian farmers.

Both varieties, along with several other promising lines and check varieties, were evaluated at farmers' fields in irrigated zones A and B of Syria for four years (from 1979/80 to 1982/83) under the ARC-ICARDA collaborative research program. They have consistently out-yielded the presently cultivated varieties.

Sham–1, whose pedigree is Plc'S'/Ruff'S'//Gta'S'/Rolt. CM17904-B-3M-1Y-1YOSK comes from a cross made in CIMMYT, Mexico and was identified by ICARDA as a promising line for the area through yield tests in Lebanon and Egypt. It was entered into the ICARDA durum observation nursery in 1976/77 where it exhibited good adaptability, plant characters and attractive kernels. In 1977/78, the line was named Waha and was included in the regional durum yield trial for wide scale testing. It was tested in this trial for four years and was consistently among the highest yielding entries at the regional level. It is recommended that seeds of Sham–1 be properly treated for bunt before planting.

It is hoped that Sham–1 will find wide acceptability by the farmers and will provide a much needed diversification of durum varieties in the country where 67% of the wheat grown is durum.

Sham–2 has also been tested in the farmers' fields in the irrigated and high rainfall areas of Syria under the collaborative program for the four years from 1979/80 to 1982/83 and its yield performance has been consistently good and better than the existing check variety Mexipak 65. Sham–2 is a wheat with very high baking strength and superior quality; its flour can be blended with Mexipak or similar weak flours to improve baking properties.

The pedigree of Sham–2 is 7C x Tob – Cno/Kal CM.8865-D-4M.1Y-1M-2Y-0M and it was received in Lebanon from CIMMYT, Mexico in 1974. It was identified by ICARDA as a promising line in Lebanon and promoted to its International Observation Nursery in 1977/78. Because of its adaptability, plant characters, disease resistance, grain quality, and yield potential, it was included in the regional wheat yield trial in 1978/79. For two years, this line was extensively tested for yield throughout the region where it out-performed Mexipak 65 and other lines. It was found to be a very promising line in Syria by the ARC-ICARDA collaborative research program and has been selected for intensive testing in farmers' fields since 1979/80.

It is believed that Sham–2 will be widely cultivated in Syria and will soon replace Mexipak 65.

Unprecedented Pullulation of Leaf Miner *(Agromyza megalopsis)* on Barley in Morocco

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An extraordinary pullulation of a leaf miner, identified as *Agromyza megalopsis*, was observed on barley in the spring of 1983 in Morocco. Infestation reached up to 100% of plants in some areas at Rommani and Sais in early April. Much of the foliage was destroyed and up to 30 larvae per leaf were observed. The neighboring wheat fields were not attacked. The pest was never previously reported as a serious problem on barley in the country. No explanation could be given for this pest causing so much damage for the first time this year.

Leaf miners on cereal crops have been reported from various countries of the world: USSR (Kurdjumov 1913), United Kingdom (Miles 1921; Spencer 1973), Germany (Geigenmüller 1966), and France (D'Aguilar *et al.* 1976). These reports suggest that leaf miner pullulations are often localized both in time and space and that barley is the crop that suffers most damage. Cereal crops can be attacked by several *Agromyza* species, the two most important ones being *A. megalopsis* and *A. nigrella.*

Were the pest to become a serious problem on barley in the country, chemical control, although efficient, would not be feasible due to the low productivity of the crop. Biological control methods will have to be found: we recorded two hymenopterous parasites of the pest, belonging to the families Braconidae and Chalcidoidea. The identification of the two parasites has not yet been completed.

References

D'Aguilar, J., Chambon, J.P. and Touber, F. 1976. Les Agromyza mineurs de feuilles de céréales (Dipteres Agromyzidae) dans la région parisienne. Annales de Zoologie: Écologie Animale. 8(4): 579-594.

Geigenmüller, M. 1966. Beobachtungen bei einem Massenauftreten der Minierfliege *Agromyza megalopsis* Heriny an Gerste. Anzeiger Für Schädlingskunde, Pflanzenschutz, Umweltschutz. 39(4): 57-60.

Kurdjumov, N.V. 1913. The more important insects injurious to the grain crops in middle and south Russia. (Abstr.) Review of Applied Entomology. 2: 172.

Miles, H.W. 1921. Observations on the insects of grasses and their relation to the cultivated crops. Annales of Applied Biology. 8: 170-181.

Spencer, K.A. 1973. Agromyzidae (Diptera) of economic importance. Junk. The Hague. 418 pp.

The Incidence of Suni Bug, *Eurygaster integriceps* Put. (Hemiptera: Pentatomidae) in Syria.

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A survey was conducted during the summer of 1983, to determine the geographical distribution and levels of infestation by Suni bug in Syria. More than 300 durum and bread wheat fields were visited and from each a sample of one kg of seeds was taken at random. From each of these samples, a subsample of 1000 seeds was examined for Suni bug damage. The percentage of infestation was then calculated.

The results indicated that:

1. The Suni bug is widely distributed in all the Syrian provinces (Table 1).

2. This pest is particularly important in north, north-east and north-west Syria (Aleppo and Idlib provinces).

3. Chemical control measures had to be taken in most of the fields in Aleppo and Idlib provinces.

Table 1. Percentages of infestation of durum (D) and bread wheat (BW) by Suni bug in Syria provinces (1983).

	Unsprayed sample no. & % range of infestation		X	Sprayed sample no. & % range of infestation		$\bar{X}$
Hassake	21 D	(0.3 - 16.0)	5.8			
	19 BW	(0.6 - 28.0)	9.6			
Raqqa	7 D	(0.2 - 13.0)	2.8			
	8 BW	(1.1 - 31.0)	11.0			
Aleppo	48 D	(0.1 - 81.0)	11.9	34 D	(0.1 - 41.0)	10.5
	17 BW	(0.6 - 95.0)	17.3	18 BW	(1.2 - 57.0)	15.6
Idlib	14 D	(0.6 - 17.0)	8.7	16 D	(0.6 - 14.0)	6.0
	9 BW	(0.0 - 14.0)	6.1	4 BW	(2.2 - 8.0)	4.5
Hama	20 D	(0.3 - 11.0)	2.6			
	22 BW	(0.2 - 12.0)	3.4			
Lattakia	17 D	(0.8 - 12.0)	4.2			
Tartous	9 D	(0.8 - 26.0)	6.8			
Homs	16 D	(0 3 - 24.0)	5.1			
	2 BW	(0.0 - 1.0)	0.5			
Daraa	9 D	(0.5 - 16.0)	3.8			
Suwayda	3 D	(0.6 - 9.0)	3.5			

4. The infestation levels varied widely from 0.1 to 81.0% seeds damaged in durum wheat and from 0.0 to 95.0% seeds damaged in bread wheat.

5. Chemical control in Idlib and Aleppo provinces did not seem to be very efficient as the percentages of infestation in sprayed fields were also relatively high (Table 1).

Fig. 1. Suni bug (*Eurygaster integriceps* Put.) feeding on a wheat spike.

High-Elevation Cereal Research

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One of the objectives of ICARDA is to improve agricultural productivity in the high-elevation areas of the region through developing bilateral projects with the national programs. This requires strengthening the research capabilities of the national programs by providing germplasm of greater genetic variability and also by providing training and assistance in developing production technology.

ICARDA has already developed a collaborative program on high altitude cereals with the Pakistan Agricultural Research Council in Baluchistan, Pakistan. This two-year old project has now identified a few high yielding disease resistant bread wheat lines which will be further tested on farmers' fields this year.

Research on production technology showed that good management increased yields from 4 to 7 t/ha under irrigated conditions and from 0.3 to 3 t/ha under rainfed conditions. Results also showed that efficient control of common bunt is possible by seed dressing with fungicides such as Vitavax and Benlate. Seed treatments were particularly effective with a local variety where increases from 323 to 866 kg/ha were recorded.

The two-years collaborative studies have been very rewarding in many ways. The research findings will now be demonstrated to the farmers in Baluchistan, under a collaborative ICARDA/FAO/PARC project.

A much bigger project covering other aspects of agricultural production as well has been developed for Baluchistan and, hopefully, will be implemented in the near future with the availability of outside funding.

Barley Evaluation and Documentation at ICARDA

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In a collaborative project between the Cereal Improvement Program and the Genetic Resources Unit (GRU) at ICARDA, a total of 5000 accessions were characterized and evaluated under dryland rainfed conditions for 20 qualitative and quantitative traits following the IBPGR descriptor list. Field and laboratory data have been documented in a computerized form by the GRU. Information on particular traits, such as days to flowering, resistance to lodging etc. can be easily retrieved and are available on computer printouts for use by cereal scientists.

A catalogue is being prepared and should be available by June-July 1984.

This project on the evaluation and documentation for barley is a contribution towards the production of a global data base for barley at ICARDA. It is being partly supported by IBPGR.

Weeds of Wheat in Azad Kashmir (PAKISTAN)

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Azad Kashmir is a mountainous area. A part of the Mirpur and Kotli districts is foothills (loosely called plains) and the Poonch and Muzaffarabad districts are hilly areas. Wheat is the second major crop of Azad Kashmir and the most important crop in Mirpur and Kotli. In lower areas it is grown as a food crop only, but at higher altitudes it is grown for both food and fodder. A weed survey was conducted in wheat fields during the 1982 post-rainy season in the area. The weeds commonly found are listed below:

Anagalis arvensis (Primulaceae): Commonly found in all the wheat growing areas.

Carthamus oxycantha (Compositae): Common in lower areas i.e. Kotli and Mirpur districts.

Chenopodium album (Chenopodiaceae): Very common in low areas, rare at high altitudes.

Convolvulus arvensis (Convolvulaceae): Recorded from Mirpur only.

Lamium amplexicaule (Labiatae): Commonly found in higher areas.

Lathyrus aphaca (Leguminosae) and *L. erectus:* Very common in Muzaffarabad area.

Phalaris minor (Gramineae): Recorded in Mirpur plains, very common in Bhimber tehsil.

Rananculus sp. (Rananculaceae) and *R. scleratus:* Common in all wheat growing areas.

Rumex dentatus (Polygonaceae): Recorded only near the Mangla Dam area in Mirpur district.

Scandix pectin-veneris (Umbellifereae): Common at higher altitudes.

Silene conoidea (Caryophyllaceae): Common in Muzaffarabad area.

Vicia sativa (Leguminosae): Very common throughout wheat-growing areas.

Triticales are Booming Down-under

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Professor Col Driscoll is Chairman of the Department of Agronomy, Waite Institute, South Australia and a very experienced Triticale Breeder. "Currency," which is resistant to the new stem rust race, is his latest release and appears to be the highest yielding triticale ever seen in Australia. Another line from his promising material has a very powerful resistance to cereal-cyst nematode, a single dominant gene on rye chromosome 6R. This is being back-crossed into Currency type material and transferred to bread wheat.

Australia has planted 137,000 ha with triticale this year and is expecting a harvest of 0.25 million metric tonnes for the feed milling industry. This will amount to 20-25% of all cereal grain milled for stock feed in Australia. Japan has expressed interest in taking one million tonnes over 5 years if Australia can produce it.

Effect of Sowing Date and Depth on Performance of Eight Barley Genotypes under Rainfed Conditions.

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Field experiments were conducted at Ramtha and Hisban locations in Jordan during the 1980/81 and 1981/82 growing seasons to study the effect of two sowing dates and two sowing depths on the performance of eight barley genotypes. The early sowing date was from the end of Nov to early Dec, while the late date was from the end of Jan to mid-Feb. The sowing depths tried were 2-4 and 8-10 cm. The experiment was laid in a split plot design with four replications.

The variables measured were 1000-grain weight and biological, grain, and straw yields on a plot basis. The total number of tillers, number of fertile tillers, biological yield, grain weight, number of grains, main stem height per plant, and number of grains per ear were also studied.

For all genotypes, early sowing gave a significant increase in all the characters studied in the first growing season.

Biological, grain, and straw yields were significantly increased at the sowing depth of 8-10 cm in all experiments. Yield components did not show any consistent response to sowing depth during either growing season.

Article and Book Reviews

Borojevic, S. **Principles and Methods of Plant Breeding**. Cirpanov, Novi Sad, 1981. 386 pp.; 22 chapters, with author journal and subject indexes. Price US$ 10.

This is a useful textbook for university students and teachers, and contains an up-to-date compendium of fundamental facts for practical breeders.

Gupta, P.K. and Priyadarshan, P.M. 1982. **Triticale: Present Status and Future Prospects.** Taxonomy and terminology, triticales at different ploidy levels, improvement and assessment of hexaploid triticales, tetraploid triticales, cytology of triticales, aneuploidy, problems, progress, and possibilities, summary, conclusions, and references. Cytogenetic Laboratory, Department of Agricultural Botany, Meerut University, Meerut, India. Advances in Genetics (21). Acamedic Press. ISBN: 0-12-017621-1.

Whitcombe, J.R. 1983. **A Guide to the Species of *Aegilops* L. Their taxonomy, morphology and distribution.** Wheat Program, IBPGR, Rome, Italy. 74 pp.

This Guide is recommended by the Wheat Advisory Committee of the IBPGR and is co-sponsored by CIMMYT and ICARDA. It fills an important gap for wheat germplasm work and ought to do much to enhance the collection and utilization of *Aegilops.*

Müntzing, A. 1979. **Triticale, Results and Problems.** Berlin, Hamburg: Paul Parey, 103 pp. Advances in Plant Breeding (10). ISBN: 3-489-76210-X.

This volume describes the main phases of the historical development of triticale. It gives information about recent progress and current problems of special importance, and also discusses the features of the present triticale situation and its background.

Contents: 1. Historical introduction, terminology. 2. Octoploid triticale. 3. Tetraploid and decaploid triticale. 4. Hexaploid triticale. 5. Cereal chemistry and baking technology. 6. Experimental and commercial work with triticale as food, feed and forage. 7. Diseases. 8. Present problems in relation to future possibilities. 9. Future trends in work with triticale. Summary, Bibliography, Subject Index.

Sharp, E.L. 1983. **Annual Report on Control of Barley Diseases for Lesser Developed Countries of the World.** (Recurrent selection, scald, net blotch-spot, leaf-rust, viruses, bacteria, agronomy, outreach, training, publications). AID Report No. 4, 42 pp. Montana State University, Plant Pathology Department, Bozeman, USA.

Rance, D. 1982. Pointers **to Profitable Winter Barley, a Survey of** Winter **Barley Growing in 460 fields in England in 1982.** Imperial Chemical Industries Plc, Agricultural Division, Fertilizer Sales Department, Technical Services Group, Billingham, Cleveland, UK. 31 pp.

This report describes the 1982 Winter Barley Survey which was done by farmers in cooperation with ICI on a total of 468 fields, covering 5,322 ha in England and Wales. The results highlight key factors of management and climate that combine to produce above average winter barley yields and gross margins.

Proceedings of the 17th Wheat Genetics Symposium of Japan. Kyoto, 1982.
The 17th Wheat Genetics Symposium of Japan was held at the Faculty of Agriculture, Kyoto University on Oct 9 and 10, 1982. Presentations on "Genetical analyses of dwarfism in common wheat" and "Progeny of a haploid common wheat with *Aegilops kotschyi* cytoplasm were made and followed by slide demonstrations on "Genetical utilization of the interspecific cross incompatibility" and on "A botanical expedition to Greece".

Oklahoma State University. 1983.

1982 Small Grains Performance Test, Wheat, Oats, and Barley. Research Report P-836 Mar 1983. Agriculture Experiment Station, Division of Agriculture, Oklahoma State University. 28 pp.

This report describes the results of the 1982 wheat, oat, and barley performance tests. It gives full details of the locations, the test procedure and gives interpretations of the results of the wheat, oat, and barley nurseries.

Pant, S.K., and Bisht, K.K.S. 1983. **Effect of Stripe Disease of Barley on Yield Components.** Indian Phytopathology 36(1) P 103-105. Vivekananda Parvatiya Krishi Anusandhan Shala, Almora 263 601, India.

Nielsen, N.E., and Schjørring, J.K. 1983. **Efficiency and Kinetics of Phosphorus Up-take from Soil by Various Barley Genotypes.** Plant and Soil 72(2-3): 225-230. Royal Veterinary and Agricultural University, Department of Soil Fertility, Plant Nutrition. Copenhagen, Denmark.

Welch, R.W., Njoroge, K. 1983. **Heritability and Selection for Grain Nitrogen Yield and its Components in F_2 Composite Populations of Spring Barley.** Z. Pflanzenzuchtg. 90(4): 305-315. Welsh Plant Breeding Station, Aberystwyth, Dyfed, UK.

Duczek, L.J., and Piening, L.J. 1982. **Effect of Seeding Depth, Seeding Date and Seed Size on Common Root Rot of Spring Barley.** Canadian Journal of Plant Sciences. 62 (4) 885-891. Agriculture Canada Research Station, Saskatoon, Saskatchewan S7N 0X2.

Zada, K., and Kaim, M. 1982. **Effect of Phosphorus and Late Sowing on Grain Yield Maturity and 100-Grain Weight of Barley.** Pakistan Journal of Agriculture Research. 3(4) 224-227. N.W.F.P. Agricultural University, Peshawar, Pakistan.

Rahman, M.A., and Goodman, P.J. 1983. **Effect of Seed Nitrogen on Response to Applied Nitrogen in Six Spring Barley (*Hordeum vulgare* L.) Cultivars in a Glasshouse.** Plant & Soil 73(2) 203-209. Welsh Plant Breeding Station, Plas Gogerddan, Aberystwyth, UK.

Habgood, R.M., 1983. **Genotypes-Environment Interactions for Predicting the Breeding Value of Bi-Parental Crosses in Spring Barley.** Euphytica 32(1): 273-279. Welsh Plant Breeding Station, Aberystwyth, UK.

Baker, R.J. and Briggs, K.G. 1983. **Relationships between Plant Density and Yield in Barley.** Crop Science. 23(3): 590-592. University of Saskatchewan, Crop Development Center, Saskatoon, Canada, S7N OWO.

Narula, P.N. and Srivastava, O.P. 1983. **Floral Sensitivity to Artificial Hybridization in Barley.** Indian Journal of Genetics and Plant Breeding. 43(1) 104-105. IARI Regional Station, Pusa, (Bihar), 848 125, India.

Canada Grain Council 1983. **Wheats of the World. (Production, utilization, trade, perspective).** 30 pp. C.G.C. Suite 500.177 Lombard Avenue, Winnipeg, Manitoba R3B OW5, Canada.

Dickinson, F.L. 1983. **Prairie Wheat. Three Centuries of Wheat Varieties in Western Canada.** Canada, Canada Grains Council, 55 pp. C.G.C., 400-177 Lombard Road, Winnipeg, Manitoba, R3B OW5, Canada.

Information Sources on the Flour Milling and the Bakery Products Industries. 1981. UNIDO Guides to Information Sources No. 39, United Nations, New York, 100 pp.

Michail, S. and Turkey, B., 1982. **Seed Pathology.** University of Mosul Press, Mosul, Iraq. 190pp.

A book on "Seed Pathology" written in Arabic by Dr Samir Michail of the Faculty of Agriculture, Alexandria University, Egypt, and Dr B. Turkey, Faculty of Agriculture and Forestry, Mosul, Iraq. It covers the subject up to 1980 in nine chapters: Historical review; Significance of seed transmission of pathogens; Seed anatomy in relation to seed transmission; Dynamics of seed transmission; Environment in relation to seed transmission; Relations between microorganisms in seed transmission; Effect of storage fungi on seeds; Control of seed-borne diseases; and Seed health testing methods.

ICARDA (1983)

International Nurseries Report. Cereals Nurseries 1980-81. Regional Yield Trials and Preliminary Observation Trials. Final (more detailed) Report (the preliminary report was distributed in Jan 1982). ICARDA, Aleppo, 228 pp.

ICARDA (1983)

Regional Yield Trials and Observation Nurseries 1981-82. Preliminary Report. Cereal Improvement Program, ICARDA, Aleppo, 69 pp.

Comitato Nazionale per l'Energia Nucleare. 1980. **Giornata di Studio sul Triticale. Atti.** (Proc. One-day Workshop on Triticale Research), Casaccia, 3 Oct 1979, 53 pp. Reprinted from Terra e Soli, Oct 1980, No 458, 667-720. (27 papers in Italian with summaries in English).

Tunisia Republic, Ministry of Agriculture. 1982.

Tunisia Cereal Breeding and Production Symposium, National Institute of Agronomy in Tunisia, El Menzah, Tunis, Tunisia, Apr 1982. 390 pp. (En, Fr).
The symposium was organized by: Oregon State University, United States Agency for International Development, National Institute of Agronomy (Tunisia), National Institute of Agronomic Research in Tunisia, Office of Cereals (Tunisia), and Superior School of Agronomy at Kef, Tunisia. The main objectives of the symposium were to review different aspects of research related to breeding and production of wheat and barley in Tunisia, to promote cooperation and support among the different national agencies working on various aspects of wheat and barley, and to strengthen areas of cooperation with other international and local organizations for the improvement of cereal production in the cereal growing areas particularly in western and eastern Tunisia. Another objective of the symposium was to encourage the selection and training of qualified research and extension personnel in short courses and at the graduate level.

Cereal News

IDRC GRANT - ARABIC DIMENSION. The International Development Research Centre (IDRC), Canada, has generously approved a grant of up to Canadian $84.600 to ICARDA for the project "ICARDA Information Services - Arabic Dimension." The overall objective of the project is to progressively build up the capability of ICARDA's Information services to publish in Arabic. The specific objectives of the project are: To publish the cereals newsletter (RACHIS) in Arabic; to index Arabic documents; to increase and facilitate the handling of Arabic literature in the library; and to provide the basis for more information services in Arabic.

Dr A.H. Kamel, formerly the senior pathologist of the Cereal Improvement Program at ICARDA, has now moved to ICARDA, Tunisia, to the position of regional representative of ICARDA in North Africa. His main task will be to coordinate the ICARDA research projects with the North African national programs, and to link these with similar research projects conducted in other parts of Africa. He will also be supervising the Farming Systems Project in Tunisia until a senior agronomist is appointed.

Dr Rients Niks, durum wheat breeder in ICARDA's Cereal Improvement Program, is leaving in January 1984 to join the Institute of Plant Breeding, Agricultural University, Wageningen, The Netherlands where he obtained his Ph.D.

Since October 1981, Dr Niks, as a post doctoral durum wheat breeder, has been working on all aspects of durum wheat improvement in cooperation with Dr J.P. Srivastava and Dr M. Nachit, with special interest in improving the data administration of the breeding material.

Dr. Guillermo Ortiz-Ferrara joined the Cereal Improvement Program of ICARDA in early August 1983 to replace Dr. W. Nelson who went back to CIMMYT, Mexico. Dr. Ortiz-Ferrara is a wheat breeder and he is jointly appointed from CIMMYT and ICARDA. He is also CIMMYT's regional representative for the Middle East countries. Memo has worked for CIMMYT since 1971. Since then, he has worked in the durum, triticale, and bread wheat programs. He completed his Ph.D. in January 1981 at Oregon State University where he conducted research on the evaluation of different methods of selection and the effect of visual selection for winter yielding of spring wheat cultivars.

Dr. Omar Mamluk, previously a pathologist in the Pasture and Forage Improvement Program of ICARDA, has now moved to the Cereal Improvement Program as a senior pathologist to replace Dr. A.H. Kamel who, in his turn has moved to ICARDA, Tunisia. Dr. Mamluk obtained his Ph.D in Phytomedicine in 1971 from Bonn University. He then worked for four years on a joint project between the American University of Beirut and the University of Bonn, in the Near and Middle East.
Prior to joining ICARDA in Feb 1981, Dr. Mamluk, was an associate professor at the University of Jordan, where he worked for five years in lecturing and research.

Dr. D.K. Mulitze, spent the month of November with the Cereal Improvement Program of ICARDA as a consultant on the international nurseries and analysis of plant breeding data. He discussed with the cereal breeders the needs and concerns for a data base management system, especially for the yield trials and international nurseries. Special attention was given to the study of genotype - environment interactions and correlated responses to selection. Dr. Mulitze also discussed with the Computer Service Unit the on-going development of CRISP (Crop Research Integrated Statistical Package) and CERINT (Cereals International Nurseries).

He has recently completed his doctorate in quantitative genetics at the Department of Crop Science and Plant Ecology, University of Saskatchewan, Saskatoon, Canada.

Dr. Melaku Worede (Director) and Ir. Jan Engles (Project Coordinator) from PGRC/E (Plant Germplasm Research Centre-Ethiopia) visited ICARDA Headquarters in Aleppo, in the first week of June, 1983. During the visit, discussions were held with the managers and scientists of ICARDA on various aspects of future co-operation between the two institutions in the field of germplasm collection, evaluation, and staff training.

Dr J.P. Srivastava, Cereal Program Leader of ICARDA, attended a meeting of the Wheat Committee of the IBPGR (International Board for Plant Genetic Resources), of which he is a member, on 5-6 December, 1983.

Dr M. Mekni, barley breeder from the Cereal Improvement Program of ICARDA, attended the Australian Barley Technical Symposium in Perth, western Australia, which was held during October 17-20, 1983. He met with a large number of barley breeders who are working in a similar environment. The meeting dealt with selection for procedures for low rainfall environments. The Australians were particularly concerned with selection for quality characteristics, given the major importance of malting barley in Australia. The Symposium was sponsored by the Swan Brewery Company, western Australia's oldest brewery.

Upon an invitation from the Tunisian Ministry of Agriculture **Dr H. Ketata,** ICARDA Cereal Training Officer and formerly Professor at INAT, participated in December 1983 in a scientific jury for the evaluation of the research work of one of his former M.Sc. students, Mr A. Sellami. The thesis topic was "the effects of genotype and environment on agronomic and quality traits in wheat." Part of the work will be submitted for publication in RACHIS 4.

Dr. Moncef Ben Salem, the head of the Grain Quality Laboratory, INRAT, Tunisia, visited ICARDA from October 23 to November 2, 1983. During his visit he had meetings with Drs. Ketata, Srivastava, and Williams, and spent a large part of his time in the cereal quality laboratory with Dr. P. Williams, conducting *'khobz'* baking tests, and macaroni making trials. In a reciprocal arrangement, Dr. Williams may visit Tunisia to become acquainted with the macaroni making processes used there.

Before his departure, Dr. Ben Salem discussed the possibility of cooperation between his laboratory in Tunisia and the ICARDA cereal quality laboratory, and made recommendations for the purchase of certain quality analysis equipment.

Dr. Ketata is currently analyzing some data for Dr. Ben Salem.

Prof. Desmond Hayes visited ICARDA during 13-18, November, 1983. He is a consultant for FAO. The purpose of the visit was to discuss the SIDA/SAREC/FAO proposal for collaborative research on breeding techniques for improving drought, salinity, and disease resistance in barley. This project is to be aimed at Egypt, Pakistan, Ethiopia, and India.

Other visitors included: **Peter kyeba** (Cereal research and research station management) from Kenya, **Mohamed Iqbal** (Cereal breeding and agronomy) from Pakistan, and **Taoufik Zarkouna** (Cereal research and research station management) from Tunisia.

Dr Skorda Elpis has retired from Institut de Cereales, Thessalonika, Greece, where she was responsible for the Cereal Breeding Program. **Drs. Stratilakis Stylianos** (bread wheat and triticale breeder), **Tsipropoulos Taxiarchis** (durum wheat breeder), and **Theoulakis Nikolaos** (barley breeder), are now working in the Cereal Breeding Program.

In a letter dated 26 Sep 1983 and addressed to the Cereal Improvement Program of ICARDA, **Dr Ngamchuen Ratanadilek** from the Department of Agronomy, College of Agriculture, Kasetsart University, Bangkok, Thailand, expressed his deep gratitude for the breeding material he received from ICARDA and which provided the highest yielding lines in the regional yield trials conducted in the 1982/83 season. The lines were selected at Suwan farm from the ICARDA RWYT 1981/82.

Dr Ngamchuen added that the line SW9 = Tob 66-Cno "S" x P 162/SK9 L771-2L-3AP-OAP is one of the best lines of the ICARDA material tested.

Chicken Feeding Trial

ICARDA and the University of Aleppo have initiated a poultry feeding trial using triticale to replace maize in the diets of growing chickens. The project involves Dr Nachit, from the Cereal Improvement Program, Mr F. Bahady, from the Farming Systems Program, and Dr F. El-Yassin from Aleppo University.

Jordan Cereal Project

The Minister of Agriculture, Jordan, has approved the formation of a committee from the University of Jordan, the Ministry, and ICARDA, for the preparation of a new cooperative cereal project. Drs. Srivastava, Nygaard, and Winslow travelled to Jordan for meetings with representatives of those who will be involved in the project, as well as the Jordan Cooperative Organization, and USAID.

The current cooperative project was reviewed, and proposals for the new project were made. It was proposed that the new project should start in a limited geographical area which has good yield potential, where the results of improved technologies may be expected to show some early benefits. The introduction of the improved practices will be step-wise, since it is felt that the adoption of the practices will be greater in this manner.

In a meeting with Mr. Ken Laurent, a regional representative of USAID, the possibility of that body funding the future project was discussed. USAID already has plans for a much larger agricultural project in Jordan, and the cooperative cereal project would be complementary to the work being done. In the mean time, the Ford Foundation has donated a further $US 25,000 for the support of the current cooperative project through to the end of 1984.

Managing the Mountains for More Food

The Cereal Improvement Program of ICARDA has launched experiments in five high-elevation areas: three in Quetta, Pakistan and two in Morocco. Germplasm nurseries are also provided to Iran and Afghanistan. The major research activity is at Quetta, where a collaborative project has been running for two years with the Arid Zone Research Institute (AZRI) of Pakistan and the Provincial Agricultural Research Institute, Sariab. The project receives support from ICARDA and the government of Pakistan, but further support to strengthen it is being sought from a donor agency. The agroclimatic and socioeconomic conditions as well as production practices at Quetta bear similarities with other high-elevation areas in countries served by ICARDA.

The major thrust of research at Quetta is on wheat and barley, the two most important cereal crops in mountainous areas, but some attention is also being paid to triticale, which has shown promise in blends with wheat flour and as animal feed.

ICARDA has a handsome collection of wheat and barley accessions in its germplasm bank. The research approach is to cross the mountain landraces with the available high-yielding accessions of wheat and barley, and then to test the progenies at high-elevation sites. In bread wheat, a cultivar named Zargoon, identified by the national program in Baluchistan, Pakistan, has been doing very well; two others, Paiyupao of Chinese origin and Bezostaya of Russian origin, have also shown promise. These cultivars are being further tested and improved through multilocation trials. The experimental plot yields from these cultivars have ranged between 5000 kg/ha and 7000 kg/ha against 750 kg/ha from local landraces.

Appropriate agronomic practices are being developed for improving the productivity of wheat and barley. Significant response of wheat to fertilizer nitrogen has been recorded.

Wild Hordeum Species

The following Hordeum species have been received by ICARDA from the Swedish University of Agricultural Sciences, Department of Crop Genetics and Breeding, S-268 00 Svalöv, Sweden.

Annuals الحوليات	الرقم **Nr**	عدد الكروموسومات الجسمية **2n**	**Origin** المصدر
Hordeum euclaston	H 1132	14	Argentina, prov. Buenos Aires
Hordeum pusillum	H 722	14	USA, Texas
Hordeum depressum	H 2008	28	USA, California
Hordeum marinum	H 539	14	Spain, Lagrosan
Hordeum murinum	H 803	14	Turkey, Bolu
Hordeum murinum	H 797	42	Turkey, Ankara
Perennials المعمرة			
Hordeum secalinum	H 249	28	Holland, Wageningen
Hordeum brachyantherum	H 1972	28	USA, California
Hordeum jubatum	H 2013	28	Mexico, Mexico City
Hordeum roshevitzii	H 179	28	USSR (exact location is unknown)
Hordeum bogdani	H 287	14	Pakistan, Tirich Mir
Hordeum flexuosum	H 1110	14	Argentina, prov. Buenos Aires
Hordeum muticum	H 1784	14	Argentina, prov. Tucuman
Hordeum stenostachys	H 1708	14	Argentina, prov. Cordoba
Hordeum santacrucense	H 1259	14	Argentina, prov. Santa Cruz
Hordeum parodii	H 1311	42	Argentina, prov. Santa Cruz
Hordeum halophilum	H 1204	14	Argentina, prov. Neuquen
Hordeum comosum	H 1333	14	Argentina, prov. Santa Cruz
Hordeum lechleri	H 1324	42	Argentina, prov. Santa Cruz
Hordeum procerum	H 1166	42	Argentina, prov. Rio Negro

Collaborative Cereal Improvement Program between the Agricultural Research Institute, Cyprus and ICARDA

The collaboration between Cyprus and ICARDA started in 1979 with a two-year project to breed and evaluate short maturity spring barley, wheat, and triticale varieties suitable for dry areas and mild winters. In view of the usefulness of this collaboration the project was further extended for three years in 1981.

Collaboration consists of reciprocal testing of barley, durum wheat and triticale breeding material from ICARDA and the national program. Cyprus provides a suitable environment for screening lines that perform well in warmer winter conditions than those experienced at Tel Hadya. Such lines have been found suitable for large areas of North Africa that have mild winters. In Cyprus the work is conducted entirely by national scientists with the aid of a small grant from ICARDA.

ICARDA-CIMMYT Cooperation

The Technical Advisory Committee (TAC) of the CGIAR met during October in Washington to examine the report of the ICARDA Quinquennial Review Team, and the new collaborative agreement between ICARDA and CIMMYT.

The new agreement on the division of responsibility for durum wheat and barley research between ICARDA and CIMMYT was endorsed. For barley, ICARDA will expand its frontiers towards its global mandate. ICARDA will fund and employ a jointly-appointed barley breeder who will be stationed at CIMMYT, Mexico to cover the needs of Latin America. He will be integrated in the CIMMYT Cereal Program and will be under its day-to-day supervision. Support services and staff will be financed by CIMMYT. Nurseries will be distributed in the Andean region under the CIMMYT/ICARDA label.

For durum wheat, CIMMYT will maintain its global responsibility, but ICARDA has a special interest in developing and testing breeding strategies in North Africa and West Asia. Thus the breeding strategy in the ICARDA region is a joint responsibility of CIMMYT and ICARDA. CIMMYT will fund and employ a jointly-appointed durum wheat breeder who will be stationed at ICARDA, Aleppo, and who will be fully integrated in the Cereal Improvement Program for the implementation of the joint program. Support services and staff will be financed by ICARDA.

The development of the ICARDA regional program in the durum research will continue to be aimed at production technologies for the benefit of the region. Special emphasis will be laid on stress tolerance and breeding for resistance to pests, diseases etc. as well as on grain quality.

Nurseries in the ICARDA region will be distributed from ICARDA under the ICARDA/CIMMYT label. For irrigated and high-rainfall areas, CIMMYT headquarters, Mexico will send durum material direct to the national programs.

Training will be allocated such that ICARDA will concentrate more on technologies for dryland agriculture, while CIMMYT will target its training for the region more towards the needs of the irrigated and higher rainfall conditions.

The bread wheat breeding for the ICARDA region is a joint endeavour between ICARDA and CIMMYT, and it has been performing well since 1980. A jointly-appointed bread wheat breeder has been posted by CIMMYT at ICARDA, Aleppo. This joint program concentrates on developing varieties suitable for the rainfed areas of the region, and germplasm is distributed to ICARDA/CIMMYT nurseries.

Training, Conferences, and Meetings

TRAINING

The 1983 Cereal Training Residential Course conducted at Tel Hadya from January to July was attended by 18 research technicians or assistants from 11 countries, namely Afghanistan, Al Jamahyria Al Lybia, Djibouti, Egypt, North Yemen (YAR), Pakistan, Somalia, South Yemen (PDRY), Sudan, Syria and Tunisia. See RACHIS No. 2: 28 - 29.

Courses focussed on barley improvement, durum wheat improvement, bread wheat improvement and cereal agronomy with emphasis on practical aspects and methods in cereal breeding, pathology, agronomy and field plot techniques. Trainees worked closely with scientists in their respective fields of interest. Evaluation of the training by the participants has indicated the general satisfaction of the trainees and the usefulness of the training in meeting the needs of their national programs. Short-term training was also an important component in the 1982-1983 Cereal Training. Two short-term trainees from Tunisia, Brahim Khalfat and Mohamed Mosbahi, spent one month each, respectively in the use of Oyjord seeder and in plant pathology.

RECENT CONFERENCES AND MEETINGS

June 17-26, 1983

20th International Seed Testing Congress, Ottawa, Canada. The International Seed Testing Association held its 20th International Seed Testing Congress in Ottawa at the invitation of Agriculture Canada. Approximately 260 delegates attended from 50 countries.

The congress consisted of a 3-day seed symposium followed by the ordinary meeting of the association. Papers presented during the symposium were arranged under the following subject headings: Developments in germination physiology; Recent advances in tree seed research; New techniques for the detection of seed-borne micro-organisms; Electronics in the management and the operation of the seed laboratory; Laboratory techniques for cultivar identification; Miscellaneous papers.

Aug 17-24, 1983

Fourth International Congress of Plant Pathology. Melbourne, Australia. The congress was chaired by Professor Allen Kerr, President of the Australian Plant Pathology Society, and was attended by over 1200 participants from more than 60 countries. The congress was organized by the Chairman of the Seed Pathology Committee of ISPP (International Society for Plant Pathology), Dr. James 8. Sinclair, assisted by Dr. S.J. Navaratnam.

Half of the congress time was devoted to general symposia and the other half to 14 more specialized scientific sections. Topics such as biological control of plant diseases and weeds, the effects of new cropping practices on plant diseases and teaching plant pathology were dealt with in the symposia.

The highlight of the Australian Congress for plant pathologists working on seed-borne diseases was the section on seed pathology. Twenty four research papers were presented in the following eight sessions: Detection of seed-borne viruses; Epidemiology of seed-borne pathogens; Detection of seed-borne fungi; Control of seed-borne pathogens; Certification and quarantine; Teaching and training in seed pathology; Detection of seed-borne bacteria; Deterioration of seeds in storage.

A special symposium on "Progress and Problems in Seed Pathology" included the following topics: Seed pathology-an expanding discipline; Economic impact and assessment of losses due to seed-borne organisms; Seed pathology and seed production; and Seed pathology and food production.

Sept 3-6, 1983

The Second Annual Meeting of ICARDA Joint Research Program with the Agricultural Research Center, Syria. The meeting was called to renew the pledge for progress in the agricultural sector of Syria, the host country, and to make a critical review of what has been done in the past, correct the deficiencies in ICARDA's efforts and determine the future course of action.

The participation of senior government officers, policy makers and scientists in the meeting among whom were His Excellency the Minister of Agriculture and Agrarian Reform, Mr. Amash Jdeih, was an indication of the host country's enthusiasm and interest in the collaborative research. Senior representatives from the Arab Center for Studies of Arid Zones and Dry Lands (ACSAD), the Damascus, Aleppo, and Lattaquieh Universities, the Syndicate of Arab Agricultural Engineers, and ICARDA's Director General, Dr. M.A. Nour as well as a great number of ICARDA's senior scientists, were also present.

The meeting was organized by ICARDA, and the main objectives of it were to strengthen the base for, and accelerate the process of agricultural research in Syria and other Arab countries as well as those served by ICARDA in other parts of the world.

Oct 4-9, 1982

First International Training Course on Seed Bacteriology, Angers, France. The training course organized by the ISTA (Int. Seed Testing Ass.) Plant Disease Committee was held at the Institute of Phytobacteriology of INRA, Angers, France. Twenty one participants from 11 countries attended this course.

Lectures were presented on different methods of detection, statistical interpretation, tolerance levels and serological problems in bacteriology. The lectures were followed by demonstrations and practicals for the detection and identification of *Corynebacterium michiganense, Pseudomonas phaseolicola, Xanthomonas campestris, X. phaseoli,* and *X. phaseoli* subsp. *fuscans.*

Oct 13-14, 1983.

The Annual Coordination Meeting, Tunisia. At the annual coordination meeting for the ICARDA program based in Tunisia, the results of the project, and the plans of work for the forthcoming season were discussed.

The work on barley has been particularly successful. Two varieties tested in the on-farm trials in the past seasons may be released soon. The Tunisian national program is now in a position to take the major responsibility for barley breeding activities, and the emphasis of the ICARDA cereal input is now being diverted to pathology.

Oct 17-19, 1983

The **Second** Technical **Consultation on Agricultural** Research Cooperation in the Near East **and North Africa**. Nicosia, Cyprus. The meeting was co-sponsored by FAO, ICARDA, and ISNAR (International Service for National Agricultural Research). The main purpose of the meeting was the establishment of an Association of Agricultural Research Institutions in the Near East and North Africa.

Nov 17-19, 1983

Workshop on **Breeding Methodologies in Durum Wheat and Triticale**, Viterbo, Italy. The workshop was held at the University of Tuscia, Viterbo, and was attended by Dr. J.P. Srivastava, Cereal Program Leader of ICARDA, who presented a paper entitled "Breeding strategies for durum wheat in rainfed areas."

Nov 28 - Dec 3, 1983

The Sixth International Wheat Genetics Symposium, Kyoto, Japan. The symposium was attended by Drs. J.P. Srivastava, M. Nachit, and M. Tahir, from the Cereal Improvement Program of ICARDA, who presented papers to the symposium. "Parallel selection: an approach to increase grain yield and stability" (Dr. Srivastava). "Evaluation of genetic resources of durum wheat for environmental stress tolerance." (Jana, S., Srivastava, J.P., and Gotam, S.). "Triticale yield potential in North Africa and West Asia" (Dr. Nachit). "Cereal breeding for semi-arid high elevation areas of ICARDA's region" (Drs. Tahir and Nachit).

In addition to the ICARDA personnel attending this symposium, ICARDA is also sponsoring Dr. Kaser Edes Masoud, from Aleppo University, Dr. Hadjichristodoulou, from Cyprus, and Dr. Duweri from the University of Jordan.

FORTHCOMING CONFERENCES AND MEETINGS

Jan 1984

International Symposium on Post-Harvest Technology of Agricultural Products, Taipei, Taiwan, ROC.

Jointly sponsored by: CCSSC (China Commission for Scientific and Scholarly Cooperation with USA), Academia Sinica, Taiwan, ROC

NAS (National Academy of Science), USA

CAPD (Council for Agricultural Planning and Development) 37 National Road, Taipei, Taiwan, ROC

FIRDI (Food Industry Research and Development Institute), Taiwan, ROC

FFTC (Food and Fertilizer Technology Center for the Asian and Pacific Region) 5th Floor, 14 Wenchow Street, Taipei, Taiwan, ROC

The symposium will study the problem of post-harvest losses of food particularly in tropical and sub-tropical areas. It is estimated on a world scale that 10% of durable crops such as grain, and 20% of perishable crops, are lost after harvest. Such losses are particularly high in countries with high humidity and high temperatures, as in most of South-east Asia. The symposium will discuss the problems in the handling and storage of:

- Dry grains
- Fruit and vegetables
- Animal products

Contact: CAPD or FFTC

Mar 19-21, 1984

16th Stadler Genetics Symposium, Columbia, Missouri, USA.

July 8-13, 1984

Sixth International Conference and Exhibition on Mechanization of Field Experiments, Dublin, Ireland.

July 9-16, 1984

The 18th International Workshop on Seed Pathology of ISTA will be held at Puyallup, Washington, USA. The current plans call for two and one-half days for working groups to work together on their problems, and two and one-half days of combined activity. A tour of the seed industry in western Washington is planned.

The number of participants will be limited and preference will be given to those persons actively involved in working group tests.

At the suggestion of Dr. Gabrielson, an international teaching course will be held for plant pathologists in the seed industry who are directly involved with seed health. This course will follow the workshop so as to use the expertise and material gathered at Puyallup. Instructors for the course will be drawn from the chairman and members of the working groups.

Contact: Dr. R.L. Gabrielson, Washington State University, W. Washington Research & Extension Center, Puyallup, WA 98371, USA.

Sept 4-7, 1984

The Sixth European and Mediterranean Cereal Rusts Conference, organised by the European and Mediterranean Cereal Rusts Foundation, will take place from 4 to 7 September 1984 at Grignon (30 km west of Paris), France.

Contact: Dr P. Auriau, Laboratoire du Ble, Station d'Amelioration des Plantes, C.R.A., Route de Sainte-Cyr, 7800 Versailles, France.

The Foundation also publishes the **Cereals Rust Bulletin,** and seeks publishable material, information and news relating to cereal rusts.

Contact: Dr N.H. Chamberlain, Nickerson RPB, Joseph Nickerson Research Center, Rothwell, Lincoln LN7 6DT, England.

Oct 1-6, 1984

Sixth Congress of the Mediterranean Phytopathological Union, Cairo, Egypt, organized by the Egyptian Phytopathological Society and the Egyptian Academy of Scientific Research and Technology under the auspices of the Egyptian Ministry of Agriculture.

Tentative list of topics

1. Prevention and control of virus, virus-like and mycoplasma diseases.
2. Soil-borne plant pathogens.
3. Biological control of bacterial and fungal plant pathogens.
4. Non-infectious diseases, mainly as related to nutritional imbalance and pollutants.
5. Selected diseases of plants in the Mediterranean area:
   a. Powdery mildew
   b. Cereal diseases
   c. Cotton diseases
   d. Leguminous crop diseases
   e. Sugar crop diseases

Evening or round table discussion groups may be organized on subjects as those proposed below:

a. Post-harvest diseases
b. Nematode problems

All communications under the above mentioned topics should be related to problems in the Mediterranean region.

Presentation of papers

Papers will be refereed for acceptance by an international committee. Either poster or oral presentation of papers is allowed. All papers will be published in the form of extended summaries (about 1000 words, i.e. 2-3 pages including tables and illustration). Presentation in English is recommended. The registration fees are US$ 80 for active members and US$ 40 for accompanying members.

Contact. Prof. Moustafa Fahim, P.O. Box 198, Orman, Giza, Egypt.

Oct 15-20, 1984

The Arab Biologists Society has the pleasure to announce its third conference to be held between the 15th and 20th of October, 1984.
This conference is one of the Arab Biologists' activities aiming to develop cooperation between biologists of the Arab world.

General topics:

1. Plant and animal resources
2. Plant and animal diseases
3. Microbes and viruses
4. Medical science
5. Biochemistry and molecular biology
6. Cell science and anatomy
7. Environment and pollution science
8. Classification of living organisms

Arabic will be the main language used, however, some research papers may be presented in English.

Contact: the Executive Secretary of the conference, The Arab Biological Society, P.O.Box 13322, Jordan University, Amman, Jordan.

Oct 22-26, 1984

International Symposium on Genetic Manipulation in Crops, Peking, China.
The Third International Symposium on Haploidy and, at the same time, the First International Symposium on Somatic Cell Genetics in Crops will be sponsored by the Chinese Association of Science and Technology, the Genetics Society of China, the Institute of Genetics of the Academia Sinica and IRRI.

Contact: Dr. Shao Ququan, Institute of Genetics, Academia Sinica, Beijing, China.

NEW PUBLICATION

Galliard, T. and Schofield, J.D. (Editors). **Journal of Cereal Science**, Academic Press, The Lord Rank Research Centre, Lincoln Road, High Wycombe, Bucks, HP12 3QR, UK. Vol. 1, 1983. £38 (UK), $95 (Overseas).

This new international quarterly publication aims to cover cereal science research as it relates to the functional and/or nutritional quality of cereal grains and their products. Among the topics included in the journal's scope will be composition, structure, physical properties, chemistry and biochemistry of cereal grains; polysaccharides, proteins or oils derived from grains, cereal-based foods and beverages whether baked, fermented or extruded; and animal feedstuffs and industrial products.

CONTRIBUTORS' STYLE GUIDE

Policy

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

Editing

Articles will be edited to preserve uniform style but substantial editing will be referred to the author for his approval; occasionally, papers may be returned for revision.

Disclaimers

The views expressed and the results presented in the newsletter are those of the author(s) and not the responsibility of ICARDA .

Similarly, the use of trade names does not constitute endorsement of or discrimination against any product by ICARDA.

Language

The Newsletter will be published in English but ICARDA will endeavour to translate articles submitted in Arabic and French.

Manuscript

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

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

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

Examples of common expressions and abbreviations

3g, 18 mm, 300 m^2, 4 Mar 1983; 27% ; 50 five-day old plants; 1.6 million; 23 u g; 5^oC; 1980/81 season; 1981-82; Fig., No.; FAO, USA. *Fertilizers:* 1 kg N or P_2O_5 or K_2O/ha.

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

versus = vs, least significant difference = LSD, standard error = SE±, coefficient(s) of variation = CV(s).

Probability: Use asterisks to denote probability * = $P < 0.05$; ** = $P < 0.01$; ***= $P < 0.001$.

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

References

Journal articles: Slinkard, A.E. 1981. Eston lentil. Canadian Journal of Plant Science 61: 733-734.

Books: Webb, C. and Hawtin, G. (eds.). 1981. Lentils. ICARDA/CAB, CAB, Slough, England, 216 pp.

Articles from books: Solh, M. and Erskine, W. 1981. Genetic resources. Pages 53-67 *in* Lentils (Webb, C. and Hawtin, G., eds.). ICARDA/CAB, CAB, Slough, England.

Papers in Proceedings: Hariri, G. 1979. Insect pests of chickpea and lentils in the countries of the Eastern Mediterranean: a review. Pages 120-123 *in* Food legume improvement and development: Proceedings of Workshop, University of Aleppo (Hawtin, G. and Chancellor, G.J., eds.), ICARDA/ Aleppo University, May 1979, Aleppo, Syria. ICARDA/IDRC, Ottawa, Ont., Canada.

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