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9. ABSTRACT

Participants in the Third Regional Wheat Workshop included scientists from the region, representatives of international development agencies, and international authorities on wheat production. Topics covered in the Workshop were chosen on the basis of current scientific interest as well as on their importance to the region: Durum Wheat, Weed Control, Crop Rotation Based on Annual Forage Legumes, and Seed Production. To increase the production of wheat, emphasis is given to increased yield per hectare rather than to cultivating new land. In achieving increased yields, new varieties and techniques must be adopted, hence the great importance of seed processing, storage, and distribution, as well as of fertilizer and weed control. Also essential is the use of leguminous plants as a replacement of fallow. Scheduled papers on these subjects are reproduced here in the language in which they were presented, with a summary in the alternative language. (French and English were the two languages used.) Field trips also were made and they are summarized here. The field trips, as well as subcommittees formed at the conference, covered the same general subjects as described above. All discussion and non-scheduled contributions are reproduced in English. Opening and closing remarks also are included, as are the pertinent tables.

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- Weed Control
- Crop Rotation with Annual Forage Legumes
- Seed

Tunis, Tunisia
APRIL 28–MAY 2, 1975

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1

INTRODUCTION

The Third Regional Wheat Workshop, held in Tunisia April 20 to May 2, 1975, was sponsored by FAO, Rockefeller Foundation, CIMMYT, Ford Foundation and the Cereal Board of Tunisia, and was hosted by the Ministry of Agriculture of Tunisia. Participants included national scientists of the region, representatives of international development agencies, and international authorities on wheat production.

Major presentation topics were chosen on the basis of current scientific interest as well as their importance in the region: Durum Wheat, Weed Control, Crop Rotation Based on Annual Forage Legumes, and Seed Production. Field trips were taken also.

Presentations and discussions were in English or French, with immediate translation provided. Scheduled contributions are reproduced in the language in which they were presented, with a summary in the alternate language. All discussion and non-scheduled contributions are reproduced in English. Discussion is placed at the end of the presentation and precedes appended tables; however, in the Rotation section, all discussion is combined following the final presentation. In these proceedings the discussions and some of the presentations have been edited to achieve some consistency of style, with every effort to retain the original thought and philosophy. Quotes or reproduction of presentations should be cleared with the author.

Editor's Note:

These proceedings have been prepared from manuscripts received in different formats and languages. We have reduced the size and reproduced many of the original documents (text, graphs, figures, and tables). We hope that this smaller size —and any losses in legibility or errors in translation-- will be outweighed by increased accuracy, savings in cost, and faster delivery to the reader.

2

CONFERENCE OPENING

Z. Ben Mustapha & W.J. LeMelle

The conference was opened by Mr. Zaccarhia Ben Mustapha. He introduced Mr. Will LeMelle, who welcomed delegates and guests as follows in summary form:

The Minister of Agriculture was thanked for honoring the conference by his presence at this inaugural session. The organizing committee was commended, and the more than 100 conferees were welcomed.

Although valuable technical information will be exchanged at this workshop, the more fundamental purpose concerns the menacing shortage of world food stuffs. Increase of wheat production is essential in coping with this crucial problem. The progress in cereal research and production in this region during the past several years is cause for optimism.

In behalf of the Ford Foundation and the conference organizing committee, the Government of Tunisia was thanked for its generous and capable assistance, without which this Third Regional Wheat Workshop could not have been achieved.

OPENING ADDRESS OF MR. HASSEN BELKHOJA

Growing wheat has been a Tunisian tradition since ancient times. Wheat has been, and still is, Tunisia's most important food commodity and like other Mediterranean countries, the goal is to increase production as the needs increase. The price rise which accompanied the recent international wheat shortage has caused many countries to spend precious resources for the purchase of wheat. As discussed in the recent Rome conference on world food, the trend in many countries is decreasing production, increasing prices and decreasing per capita consumption. The difficulties are greatest in countries with the highest rate of population increase. Economic development is sacrificed if a country spends most of its resources to secure food.

The primary objective in Tunisia is to become self sufficient in wheat. Cereal production is dependent on rainfall and according to the ministry of agriculture the annual deficit varies between 2 and 4 million quintals per year. This year, 1974-75, rainfall has been favourable and the deficit is expected to be 2 million quintals. In a year of unfavourable rainfall the deficit can be as high as 4 to 5 million quintals.

No new land is available for wheat; therefore, in order to increase production, yield per hectare must be increased by adopting new varieties and techniques. Fertilizer and weed control are important in this respect.

Tunisia supports and follows closely all that is being done in wheat research, accepts the projects of foreign organizations, and is interested in training of Tunisian personnel. To be useful, new technology must be adapted to Tunisian conditions and in addition the grain of new varieties must possess suitable technical qualities.

Once varieties are known to be adapted, seed must be multiplied, processed, stored and distributed. Tunisia has two organizations specializing in seed (COSEM and CCSPS), a seed quality control laboratory, a project which will create a national seed committee, a catalogue of varieties and a system of control and certification.

Weeds are a big problem in this climate. Traditionally weeds were pulled by workers but salaries have increased and now hand weeding is a costly method. Herbicides provide an alternate method and 500,000 hectares are suitable for their use. However, due to lack of staff and equipment, as well as fragmentation and small units only 100,000 hectares have been treated annually.

Also the use of nitrogen fertilizer is inadequate and this is general in all developing countries. It is important to increase fertilizer production and use.

Also important is the use of leguminous plants as a replacement of fallow. They add nitrogen to the soil, improve soil texture, assist with weed control and furnish valuable forage for livestock. Much effort is needed on research and production.

The government of Tunisia helps the producer financially as well as technically. Fertilizers, pesticides and agricultural machinery are sold at reduced prices. There is a subsidy of 50% on some

herbicides. The price of cereals is fixed at a point which assures a stable income for the farmer as well as an acceptable price for the customer. Taxes on farm income are arranged to encourage the increase of production and modernization by the small producer.

A grain reserve sufficient for about three months is held for internal consumption. This is sufficient for the present but the plan is to eventually increase this to a six months supply. In order to reach the minimu goal of self sufficiency in wheat, much effort is needed in the next few years. This includes research, extension, staff training and production factors.

All that is said at this conference will be considered by the Government of Tunisia. You are following a humane aim because increased food production means a decrease of unhappiness and an increase of dignity. We encourage you and hope you have a pleasant stay in Tunisia. On your success depends the life of thousands of people.

Original: French

3

IMPORTANCE OF DURUM WHEAT IN THE WORLD FOOD SUPPLY

G.T. Scarascia Mugnuzza

In essence, this contribution consisted of a series of tables and figures with comments by the author. The presentation is represented here by: notes on the content of the tables and figures, a list of breeding objectives, discussion, and reproduction of the tables as an appendix.

Comments on the tables and figures

Table 1. "Total Durum wheat area, production and yield per hectare by region and country". Major durum producing countries are in descending order, Soviet Union, Turkey, United States of America, Canda, Italy, and Morocco, all with more than 1 million hectares. Yields vary widely from year to year. For the same order of countries, the reported yields per hectare in 1969-70 were: 1.11, 1.18, 2.14, 1.77, 1.76 and .89 tons/ha. With the exception of USA where yields are usually lower than 2.14 t/ha and of Morocco where they are usually higher than .89 tons/ha., these levels reflect normal average yields.

Figure 1. "Durum wheat: Production, area, yield per ha by region, Av.1968/69-1971/72" graphically represents the highlights of Table 1. In Canada, USA and Western Europe, yield levels were near 1.75 tons/ha in this period. Other regions were near the traditional one ton per hectare level. North Africa was somewhat lower.

Figure 2. "Production, area and yield of durum wheat in Italy" shows the fluctuations during the 8 year period from 1967 to 1974. Production peaked in 1971, dropped sharply in 1973 and continued the upward trend in 1974.

Table 2. "Durum wheat: Area, production and yield per ha in North Africa and Middle East countries (1974)" gives these figures for 13 countries as well as the wheat requirement for 8 countries. The high yield in Egypt of 3.21 m tons/ha is produced under irrigation. Lebanon and Afghanistan follow with 1.80 m tons/ha.

Table 3. "World production of durum wheat relative to the global wheat production (except centrally planned countries)" presents total wheat and durum wheat production in 1962 and in the 5 year period from 1969 to 1973. Durum wheat ranged from 9.5% to 8.5% of total wheat production with the lowest values the last 3 years, especially in 1972.

Table 4. "Durum trade, percent of all wheat trade" gives total wheat exports and the percent of durum averaged for the period from 1961-62 to 1965-66 and each year from 1966-67 to 1971-72. In contrast to durum production, durum trade increased from 3.2% in the 1961-62 to 1966-67 average to 7.5% in 1971-72. This represents an increase of 1,648,000 to 3,284,000 metric tons in the amount of durum wheat in world trade.

Table 5. "International trade in durum wheat - destination of supply" covers the same years as Table 4. During this period, major buyers of durum wheat in the world have been the countries of Europe (41.7%), Africa (21.3%), Asia (17.2%) and USSR (14.1%).

Table 6. "International trade in durum wheat - destinations and major exporting countries (1970-71 and 1971-72)". Major suppliers of durum, in descending order, were Canada, USA and Argentina. Canadian and US durum was shipped mostly to Europe, Asia and Africa, while most of the Argentine durum went to the E.E.C. The USSR bought very little durum in 1970-71 but made a large purchase from Canada in 1971-72.

Figure 3. "International trade in durum wheat: Destination, source and percent of total exports" graphically represents the information in Table 6.

Table 7. "Availability and stocks of durum wheat in Argentina, Canada and USA (1970-71 and 1971-72)" lists opening stocks, production, imports, domestic disappearance, exports and closing stocks.

Table 8. "Durum supply in Italy and EEC" covers the 6 year period from 1969 to 1974 for Italy but only 1974 for E.E.C. In this year, area seeded, production and internal consumption in Italy was 87.84 and 83 percent respectively of that of the entire E.E.C., indicating the extreme importance of Italy in the world of durum wheat.

Figure 4. "Average annual prices for wheats imported in Italy (1970 to 1974)" illustrates the dramatic rise in price from 1973 to 1974. The price of durum was lower than bread wheat before this price rise but considerably higher afterwards.

Figure 5. "Prices of imported durum and bread wheat: CIF Rotterdam - 1973" shows the extreme increase of durum price during July, August and September of 1973. In units of account, the price rise of bread wheat during this period was only one half this amount.

Figure 6. "E.E.C. price of bread and durum wheat in units of account, 1967-68 to Oct. 1973" shows a fixed price advantage for durum wheat of approximately 18% until 1973-74 when the price of durum was allowed to rise a great deal faster than the price of bread wheat. On October 1, 1974, the last date listed, the durum price was approximately 50% higher than the bread wheat price.

Figure 7. "Total consumption of durum and pasta in three regions, 1967 to 1970" illustrates higher consumption of both products in the E.E.C. than in Western Europe and North America combined (Western Europe here means all Europe minus E.E.C. and centr. planned countries). In Western Europe pasta consumption is one third of durum wheat consumption but in North America pasta consumption accounts for most of the durum consumed.

Figure 8. "Consumption per capita of durum wheat and pasta, average 1967 to 1970" breaks down the three regions of figure 7 into individual countries. Consumption in Italy and Greece is extremely high, 30 kg of pasta per person; less than one kg in the United Kingdom, Norway and Sweden; and mostly 3 to 6 kg in the other countries.

Table 9. "Mode of use of durums (%)" presents a break down of durum use into pastas, couscous, bread and other foods for 18 countries. World use is 28% pastas, 16% couscous and 24% bread. The remaining 32% corresponds to the consumption in the USSR and China.

Table 10. "Range of protein and wet gluten content in flour or semolina of some wheats selected and grown in Italy, U.S.A. and Canada" gives figures for both durum and bread wheats and includes data on percent ash. The durum wheats had slightly higher protein, slightly lower wet gluten and higher ash than the bread wheats.

Figure 9. "Amino acid concentration/dry weight (mg/100 gm)" plots these concentrations for durum wheat, hard wheat and soft wheat. For every amino acid the concentration in soft wheat is the lowest. Values for durums and hard wheat are similar but in most cases the durum value is slightly higher.

Figure 10. "Carbohydrate/dry weight and mineral element concentration/dry weight" also presents values for durum wheat, hard wheat and soft wheat. Carbohydrates are: reducing sugar, non-reducing sugar, starch, pentosans, crude fiber, hemecellulose, cellulose and lignin. Values are similar among the three wheat types except for starch which is lowest in durum, intermediate in hard wheat and highest in soft wheat. Minerals are: Na, K, Mg, Ca, P, Fe, Cu and Mn. These values vary more than the organic constituents. The durum is relatively high in Na and K and low in calcium.

Figure 11. "Nutrient fatty acid/dry weight and vitamin/dry weight" also gives values for the 3 wheat classes. Fatty acids are: palmitic, stearic, oleic, linoleic, linolenic and fat. Durum values are highest for each material; values for hard and soft wheat are similar. Vitamins are: thiamine, riboflavin, niacin total, niacin free, vitam B6, peridoxine, piridoxal, piridoxamine and tocopherol. Again, durum values tend to be highest.

Breeding objectives

The presentation was closed with the following two lists:

Main objectives of durum wheat breeding up to 1975.
* earliness
* lodging resistance (and semidwarfness)
* disease resistance (rusts, mildew)
* spikelet fertility

Tasks for future breeding work.
* earliness; drought tolerance and water use
* cold tolerance (plant habit and photosensitivity)
* lodging resistance
* disease and insect resistance (rusts; mildew; septoria; take-all; insects; nematode)
* leaf duration; net assimilation rate
* fertilizer utilization
* intervarietal competition
* nutritional value (protein and essential amino-acids content)
* technological characters (color; milling yield; pasta quality)
* weathering inhibition; coleoptile length

DISCUSSION

Question: Is the pasta making quality of durum wheats imported from Argentina, Canada and U.S.A., different from those produced in Italy?

Answer: The Argentinian durums have very good gluten strength but their colour is less desirable. The canadian durums are very carefully selected in order to achieve the quality level required by the importers, particularly Europe and Italy. The U.S. durums are on the way toward reaching good quality standards.

Table 1 - TOTAL DURUM WHEAT AREA, PRODUCTION AND YIELD PER Ha BY REGION AND COUNTRY

REGION AND COUNTRY	ESTIMATED DURUM WHEAT AREA (1000 ha)					PRODUCTION (1000 metric tons)					YIELD/Ha (metric tons)				
	Av.years 1964/65 1968/69	1968/69	1969/70	1970/71	1971/72 prov.	Av.years 1964/65 1968/69	1968/69	1969/70	1970/71	1971/72 prov.	Av.years 1964/65 1968/69	1968/69	1969/70	1970/71	1971/72 prov.
EUROPE															
EEC:															
Italy	1,339	1,469	1,526	1,587	1,596	1,958	2,130	2,684	2,675	3,284	1.46	1.45	1.76	1.69	2.06
France	64	106	126	162	172	161	303	341	454	478	2.39	2.86	2.70	2.80	2.77
Subtot. EEC	1,403	1,575	1,652	1,749	1,768	2,119	2,433	3,025	3,129	3,762	1.51	1.54	1.83	1.79	2.13
OTHER EUROPEAN COUNTRIES:															
Austria	5	6	6	7	7	10	12	12	15	17	2.5	1.90	2.03	2.19	2.27
Greece	255	238	202	208	200	386	362	362	343	350	1.51	1.52	1.79	1.65	1.75
Portugal	70	65	80	90	94	68	75	65	75	81	0.98	1.15	0.81	0.83	0.86
Spain	205	207	173	240	241	263	254	197	225	286	1.06	1.23	1.14	0.94	1.19
Subtot.other Eur.Count	535	516	461	545	542	727	703	636	658	734	1.36	1.36	1.38	1.21	1.35
Total	1,938	2,091	2,113	2,294	2,310	2,846	3,136	3,661	3,787	4,496	1.47	1.50	1.73	1.65	1.95
NORTH AMERICA															
Canada	602	959	1,276	1,240	996	787	1,236	2,259	2,202	1,647	1.34	1.29	1.77	1.78	1.65
U.S.A.	1,094	1,445	1,348	817	1,113	1,996	2,708	2,887	1,375	2,390	1.83	1.87	2.14	1.68	2.15
Total	1,696	2,404	2,624	2,057	2,109	2,783	3,944	5,146	3,577	4,037	1.64	1.64	1.96	1.74	1.91
CENT. & S. AMERICA															
Mexico	-	-	125	-	-	-	-	100	-	-	-	-	0.80	-	-
Argentina	341	389	420	317	336	529	475	760	652	550	1.54	1.22	1.81	2.06	1.64
Chile	-	-	125	-	-	-	-	100	-	-	-	-	0.80	-	-
Total	-	-	670	-	-	-	-	960	-	-	-	-	1.43	-	-
NEAR EAST ASIA															
Turkey	1,901	1,904	2,635	2,666	2,690	2,349	2,265	3,100	3,100	4,107	1.24	1.19	1.18	1.16	1.53
Cyprus	-	-	43	-	-	-	-	40	-	-	-	-	0.93	-	-
Syria	1,175	891	1,210	1,340	1,205	905	600	1,004	520	840	0.76	0.67	0.82	0.46	0.70
Lebanon	-	-	20	-	-	-	-	31	-	-	-	-	1.55	-	-
Israel	-	-	60	-	-	-	-	60	-	-	-	-	1.00	-	-
Jordan	-	-	147	-	-	-	-	150	-	-	-	-	1.02	-	-
Iraq	-	-	1,220	-	-	-	-	400	-	-	-	-	0.33	-	-
Saudi Arabia	-	-	90	-	-	-	-		-	-	-	-	-	-	-
Yemen	-	-	10	-	-	-	-		-	-	-	-	-	-	-
Iran	-	-	1,600	-	-	-	-		-	-	-	-	-	-	-
Afghanistan	-	-	630	-	-	-	-		-	-	-	-	-	-	-
Total	-	-	7,575	-	-	-	(4,000)	>5,000	(4,500)	(5,200)	-	-	(0.82)	-	-
NORTH AFRICA															
Morocco	1,304	1,502	1,332	1,380	1,375	1,028	1,775	1,192	1,492	1,595	0.77	1.18	0.89	1.08	1.16
Algeria	1,620	1,627	1,497	1,540	-	944	1,000	855	911	-	0.58	0.61	0.57	0.59	-
Tunisia	700	700	600	750	700	324	310	220	300	400	0.41	0.44	0.37	0.40	0.57
Libya	-	-	83	-	-	-	-	-	-	-	-	-	-	-	-
Total	(3,712)	(3,829)	3,512	(3,670)	-	(2,296)	(3,085)	(2,267)	(2,703)	(2,700)	-	-	(0.67)	-	-
USSR	-	-	6,000	-	-	-	-	7,600	-	-	-	-	1.27	-	-
WORLD	-	-	22,595	-	-	-	-	25,134	-	-	-	-	1.11	-	-

: not available

No data available for India and Ethiopia, where the area grown with T. turgidum is estimated around 2.2 million hectars and 1 million ha, respectively.

( ): Estimated

TABLE 2 - Durum Wheat: Area, Production and Yield per Ha in N. Africa and M. East Countries.

(1974)

COUNTRY	AREA (000 ha)	PRODUCTION (000 m.tons)	YIELD (m.tons/ha)	REQUIREMENT (000 m.tons)
SYRIA				
MOROCCO				
ALGERIA	1,300	800	0.61	1,000
TUNISIA				
LYBIA *	180	62	0.35	unknown
EGYPT *	560	1,800	3.21	80
LEBANON	17	20	1.80	50
JORDAN	190	140	0.74	300
CYPRUS	40	45	1.12	4
TURKEY	2,200	2,400	1.09	2-2,500
SAUDI ARABIA	30	40	1.33	unknown
IRAQ	240	270	1.12	270
AFGH.	467	840	1.80	1,000
SUDAN *	?	300		
ETHIOPIA	982	657	0.67	unknown
PAKISTAN *	6,300	7,500	1.19	"
IRAN				

* Data referred to total wheat (bread and durum).

TABLE 3 - World production of durum wheat relative to the global wheat production (except centr. planned Countries).

(Million m tons)

	1962	1969	1970	1971	1972	1973
Wheat Production	152.6	185.9	168.1	197.4	201.0	205.2
Durum Production	14.5	17.5	16.0	17.6	17.1	18.2
% durum	9.5	9.4	9.5	8.9	8.5	9.2

TAB. 4 - Durum trade % of all wheat trade.

DURUM	Av. 1961-62 1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72
Total exports (000 m tons)	1,651	2,507	1,803	2,228	1,895	2,803	3,284
% all wheat trade	3.2	4.6	3.6	5.6	4.3	5.9	7.5

Table 5 - INTERNATIONAL TRADE IN DURUM WHEAT - DESTINATION OF SUPPLY (1000 metric tons)

REGIONS	AV.1961/62 1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72 TOTAL	%
EEC	1,002.0	1,205	1,032	1,571	1,270	1,383	1,004	
Other West Countr.	158.0	463	171	191	201	197	324	
East Countries	48.6	104	70	23	-	50	40	
Total EUROPE	1,208,6	1,772	1,273	1,784	1,472	1,630	1,369	41.7
Near East	10.4	34	13	4	41	228	197	
Far East	99.0	108	25	29	50	230	369	
Total ASIA	109.4	142	38	33	91	458	566	17.2
USSR	263.0	127	28	15	26	52	467	14.1
NORTH & CENTR. AMERICA	3.0	9	17	45	24	46	58	1.8
SOUTH AMERICA	12.4	24	35	39	52	105	127	3.9
AFRICA	39.8	429	409	311	231	514	698	21.3
UNSPECIFIED	11.8	2	2	T	-	-	-	
WORLD	1,648	2,504	1,802	2,228	1,895	2,803	3,284	

T = Less than 500 metric tons

Table 6 - INTERNATIONAL TRADE IN DURUM WHEAT: DESTINATIONS AND MAJOR EXPORTING COUNTRIES-(1,000 metric tons)

DESTINATION \ SOURCE	1970/71 ARGENT.	CANADA	USA	OTH.	TOTAL	1971/72 ARGENT.	CANADA	USA	OTH.	TOTAL
EEC	479	374	514	16	1,383	313	478	213	-	1,004
Other West Countr.	16	116	64	T	197	-	48	275	2	325
East Countries	-	50	-	-	50	-	40	-	-	40
Total EUROPE	495	540	578	17	1,630	313	566	488	2	1,369
Near East	49	106	74	-	228	14	-	182	-	197
Far East	-	178	51	-	230	-	312	57	-	369
Total ASIA	49	284	125	-	458	14	312	239	-	566
USSR	-	52	-	-	52	-	467	-	-	467
NORTH & C. AMERICA	-	16	29	-	46	-	13	45	-	58
SOUTH AMERICA	18	T	86	-	105	-	T	127	-	127
AFRICA	42	276	196	-	514	41	314	331	12	698
UNSPECIFIED	-	-	-	-	-	-	-	-	-	-
WORLD	604	1,168	1,014	17	2,803	368	1,671	1,231	14	3,284

T = less than 500 metric tons

Table 7 - AVAILABILITY AND STOCKS OF D. WHEAT IN ARGENTINA, CANADA and U.S.A.-(1000 metric tons)

COUNTRY / STOCKS of DURUM WHEAT	ARGENTINA		CANADA		U.S.A.		TOTAL THREE EXPORTERS	
	1970/71	1971/72	1970/71	1971/72	1970/71	1971/72	1970/71	1971/72
OPENING STOCKS	100	138	1,935	2,356	2,113	1,462	4,148	3,956
PRODUCTION	652	550	2,202	1,524	1,375	2,390	4,229	4,464
IMPORTS	-	-	-	-	-	-	-	-
DOMESTIC DISAPPEAR.	92	(98)	427	(400)	968	786	1,487	(1,284)
EXPORTS	522	(400)	1,354	(1,734)	1,058	(1,231)	2,934	(3,365)
CLOSING STOCKS	138	(190)	2,356	(1,746)	1,462	(1,835)	3,956	(3,771)

(Estimated)

TABLE 8 Durum supply in Italy and EEC (000 metric tons)

DURUM	I T A L Y						EEC
	1969	1970	1971	1972	1973	1974	1974
Area (000 ha)	1,525	1,587	1,595	1,588	1,525	1,570	1,800
Yield (mt/ha	1.75	1.68	2.06	1.94	1.71	1.92	2.03
Production (000 t)	2,684	2,673	3,284	3,073	2,620	3,020	3,600
Opening stocks	80	260	250	450	190	300	300
Imports	718	770	490	520	800	500	1,200
Total supply	3,482	3,703	4,024	4,043	3,610	3,820	5,100
Internal consumption*	3,084	3,303	3,424	3,681	3,213	3,340	4,000
Exports	150	150	160	180	100	180	500
Closing stocks	250	250	450	190	300	300	600

* including consumption in farm

TABLE 9 Mode of use of Durums (%)

COUNTRY	PASTAS	COUSCOUS	BREAD	OTHERS
ITALY	55	-	45	
FRANCE	60	-	40	
UNITED KINGDOM	79	-	21	
BENELUX	100	-	-	
GERMANY, Fed.Rep.	65	-	35	
OTH. W. EUR.	32	-	68	
N. AMERICA	76	-	24	
ALGERIA	30	40	10	20
EGYPT	100 (?)	-	-	-
LEBANON	40	-	20	40
JORDAN	2	1	95	2
CYPRUS	10	-	90	-
TURKEY	10	30(Bulgur)	60	-
SAUDI ARABIA	-	80	10	10
IRAQ	40	10(")	50	-
AFGHANISTAN	20	8	60	12
ETHIOPIA	35	-	5	60
PAKISTAN	-	-	3	97
WORLD	28	16	24	?

Remaining 32% corresponds to the USSR and China consumption for: Pastas? bread? others?

TABLE 10 - Range of protein and wet gluten content in flour or semolina of some wheats selected and grown in Italy(I), USA (A), Canada (C) in the last years.

		Protein %	Wet Gluten%	Ash %
	I	10.5 - 14.5	25.2 - 38.0	0.65 - 0.95
Durum w.	A	11.2 - 13.6	30.4 - 36.6	0.58 - 0.80
	C	11.3 - 13.1	34.6 - 42.1	0.56 - 0.60
	I	9.0 - 13.1	-	0.43 - 0.66
Bread w.	A	-	-	0.42 - 0.56
	C	10.6 - 14.0	35.0 - 42.0	0.45 - 0.53

Fig 1 - Durum Wheat : Production, area, yield per ha by Region - Av 1968/69 - 1971/72 (or data 1969/70)*

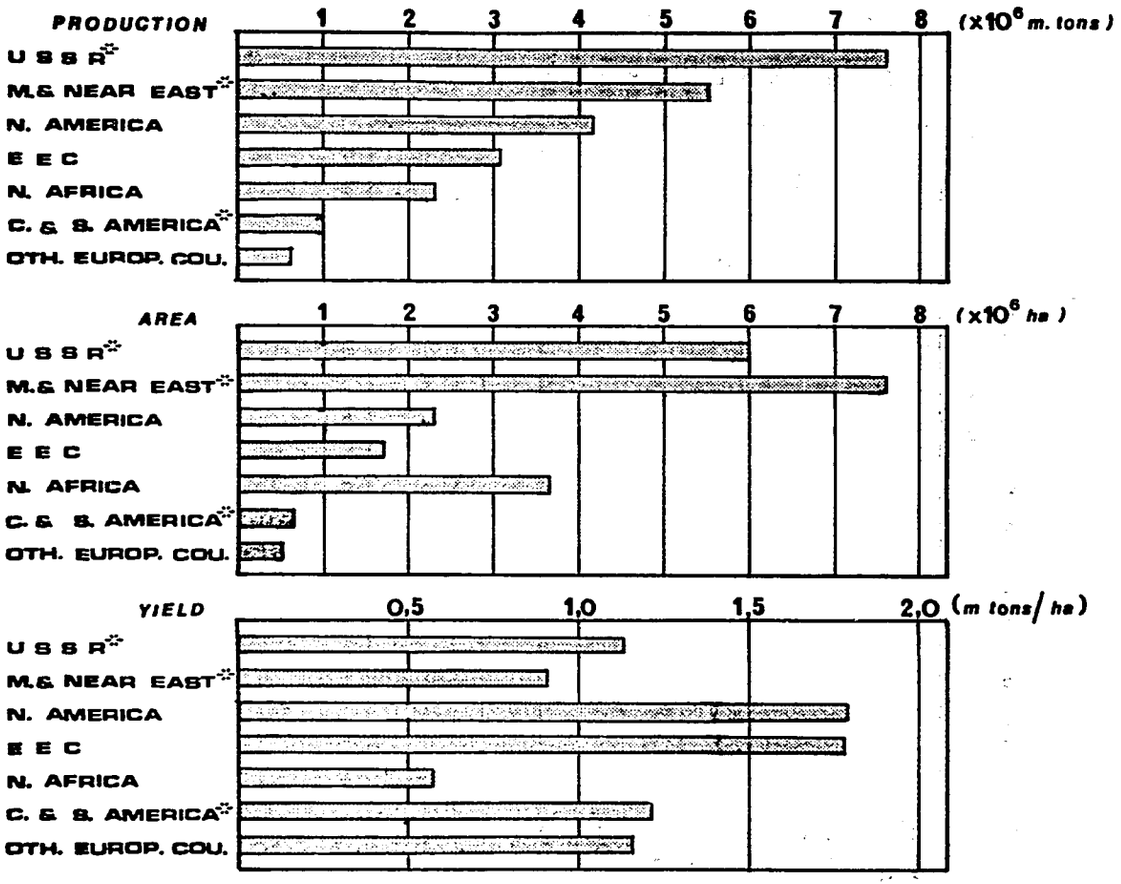


Fig. 2 - Production, Area and Yield of Durum wheat in ITALY

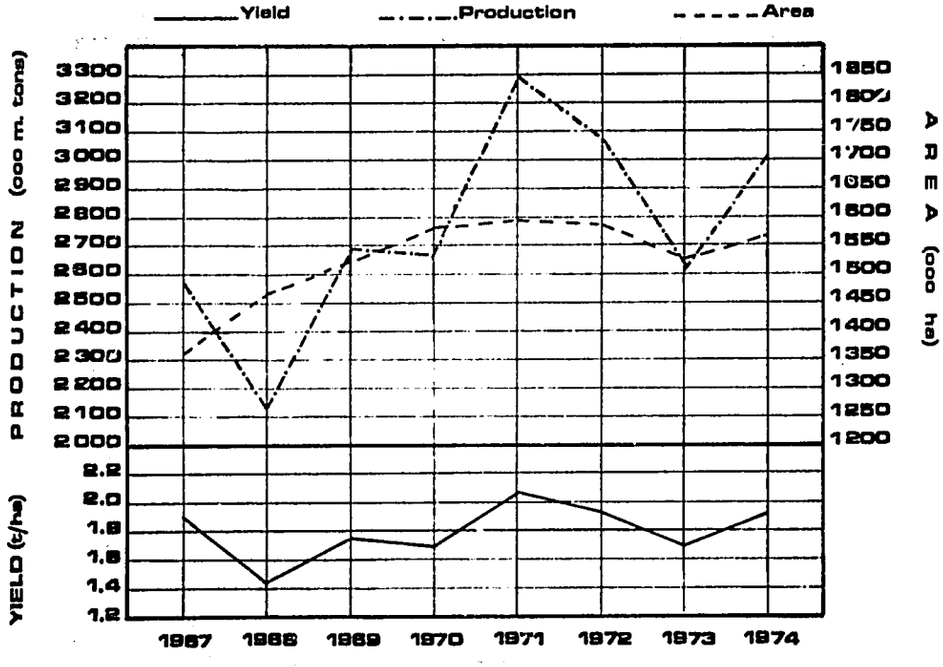


Fig. 3 - International Trade in Durum Wheat : destination, source and % of total exports

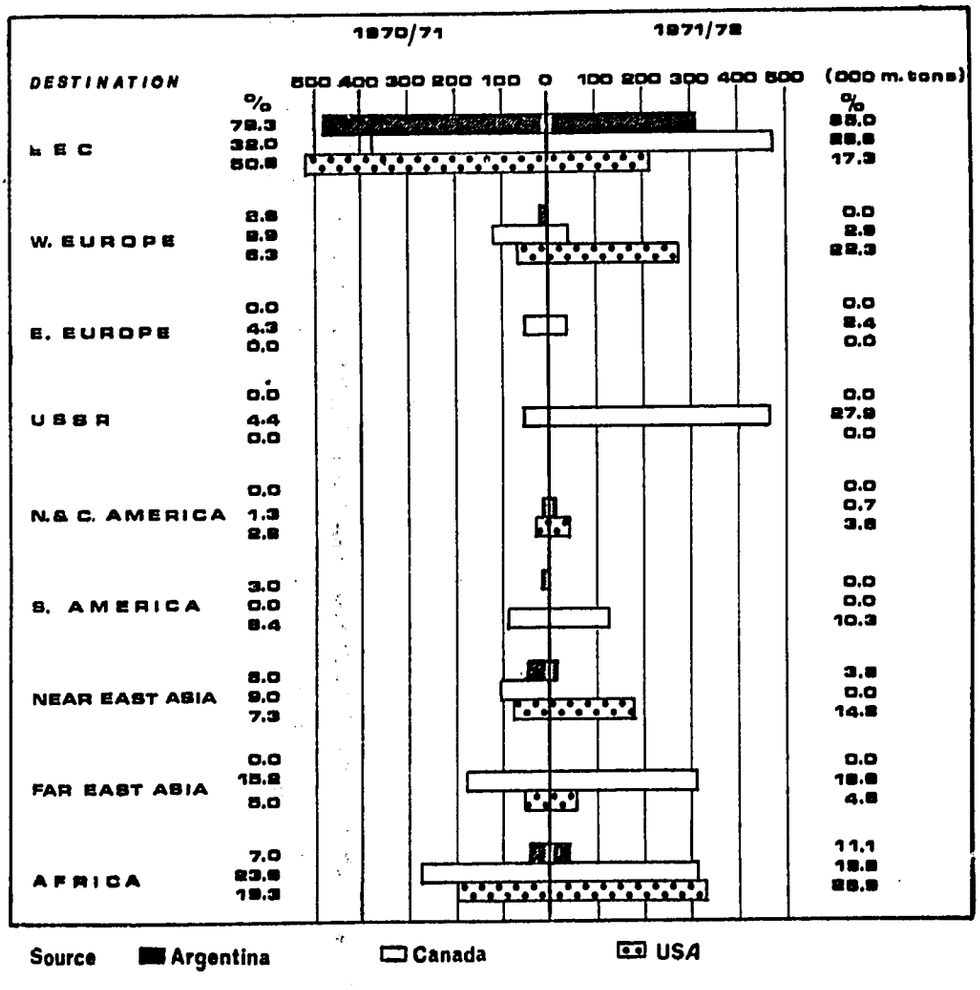


Fig 4

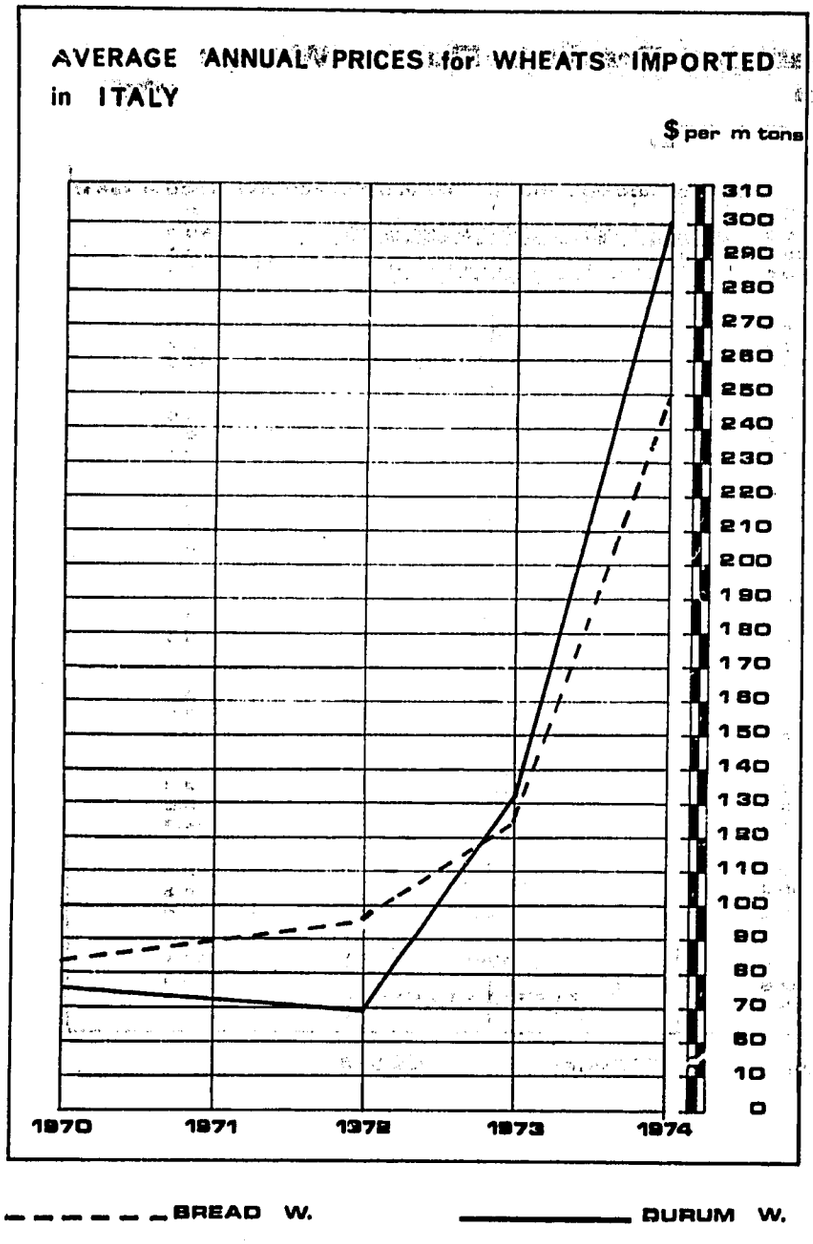
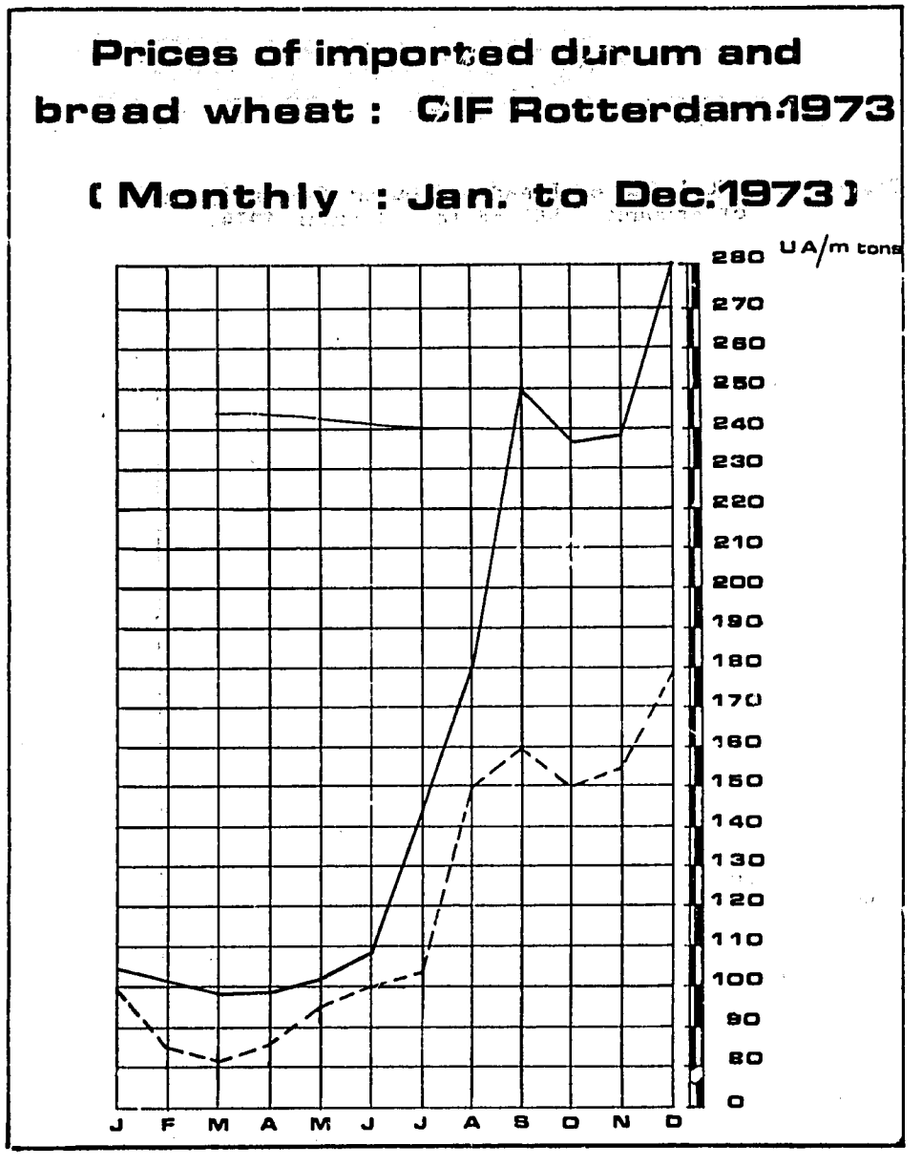

AVERAGE ANNUAL PRICES for WHEATS IMPORTED
in ITALY
$ per m tons
310
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
10
0
1970
1971
1972
1973
1974
BREAD W.
DURUM W.

Fig. 5



—— Durum wheat ---- Bread wheat

Figure 6. EEC Price of Bread and Durum Wheats in Units of Account, 1967-68 to 1 October 1974.

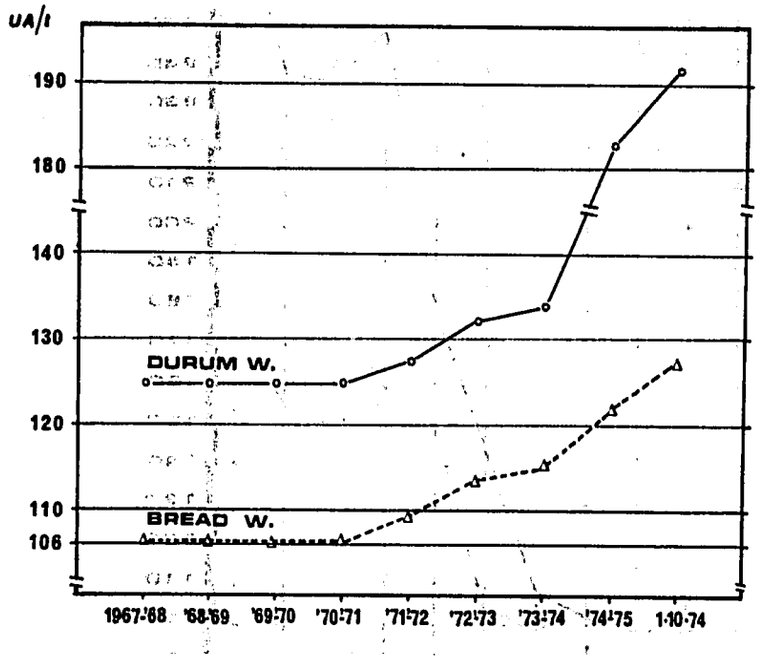
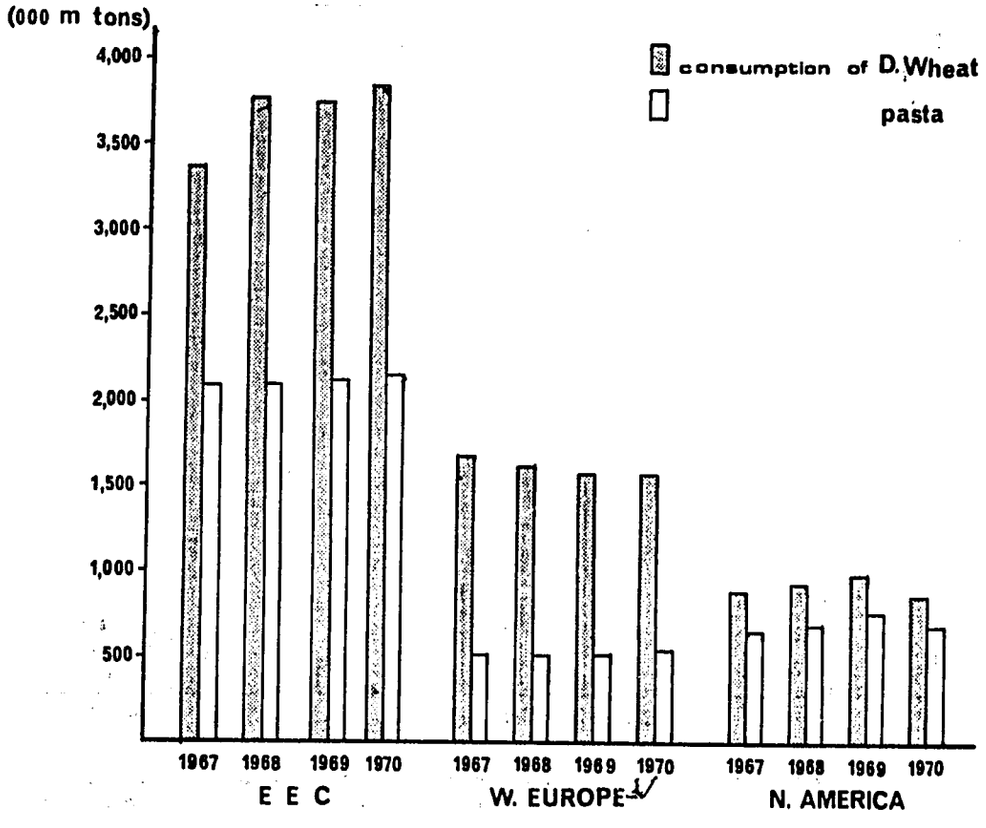


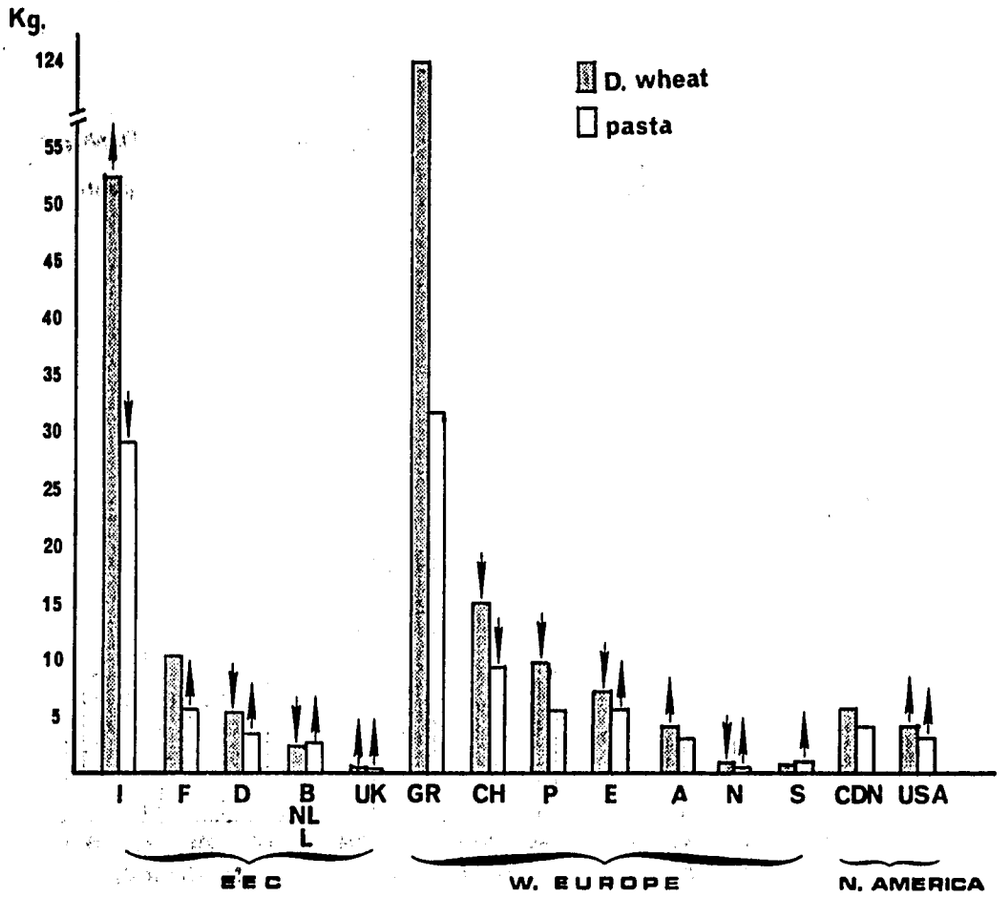
Fig 7 - Total consumption of D. Wheat and pasta in three Regions



1/ All Europe minus EEC and Central Planned Countries

Fig. 8 - Consumption per caput of D. Wheat and pasta (Kg.)

- Av. years 1967 – 1970 -



I = Italy
F = France
D = W. Germany
B = Belgium
NL = Netherlands
L = Luxemburg
UK = Great Britain
GR = Greece
CH = Switzerland
P = Portugal
E = Spain
A = Austria
N = Norway
S = Sweden

Fig. 9 - Amino acid concentration / dry weight (mg/100g)

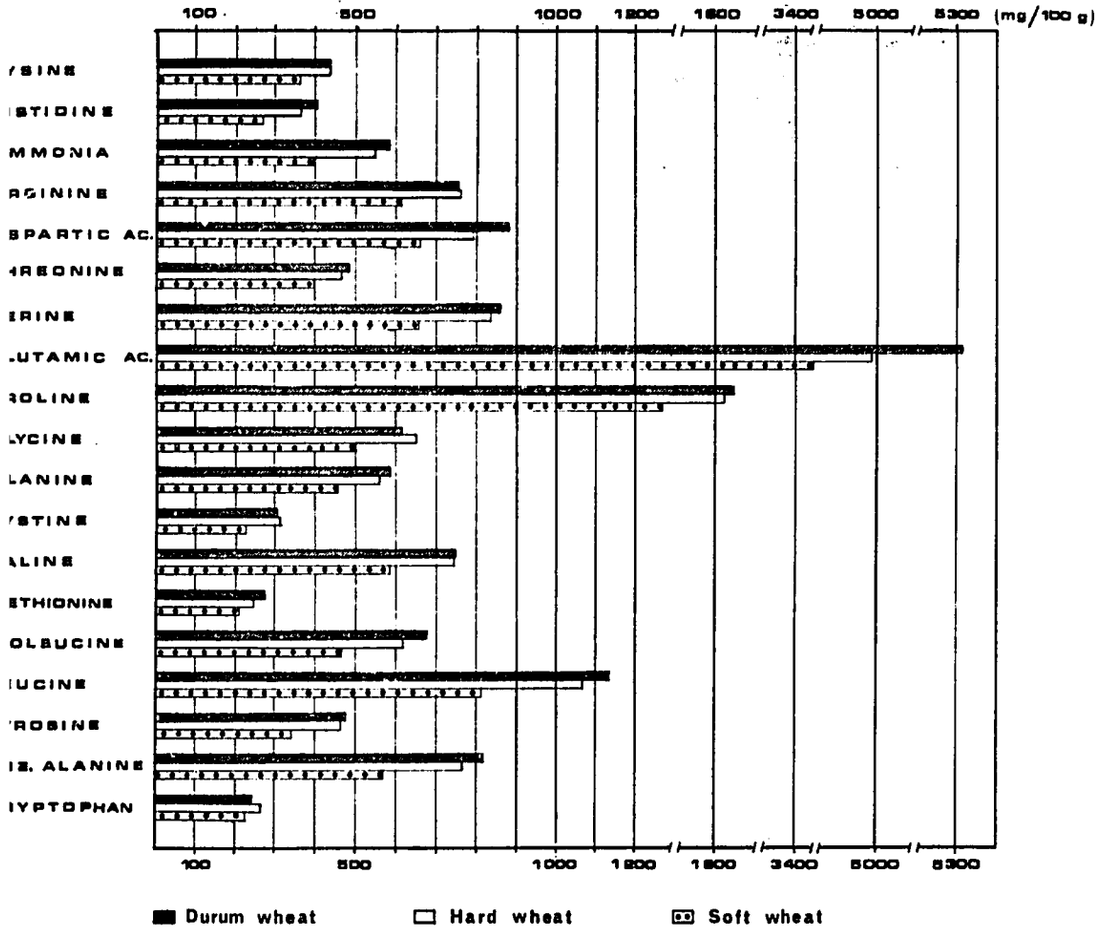
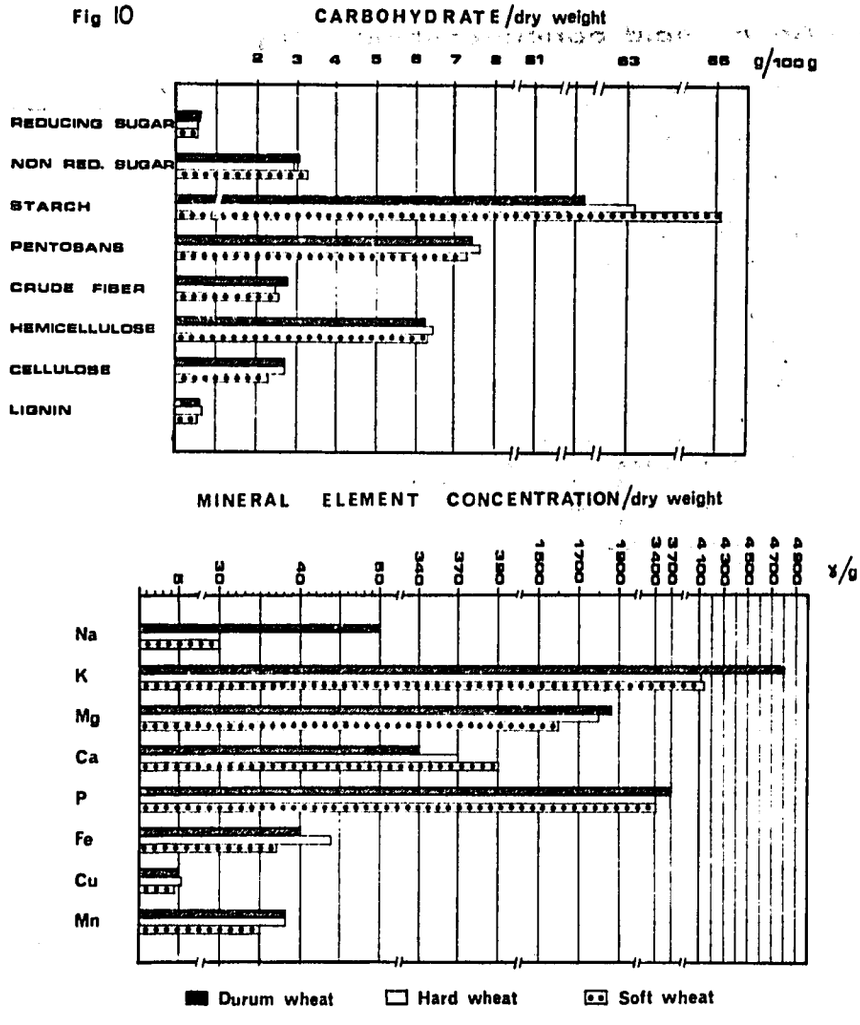
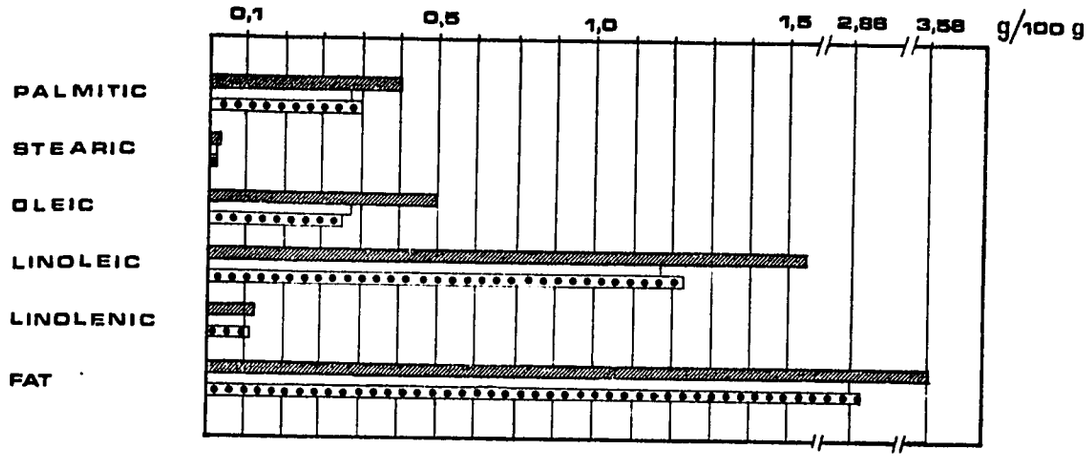


Fig 10

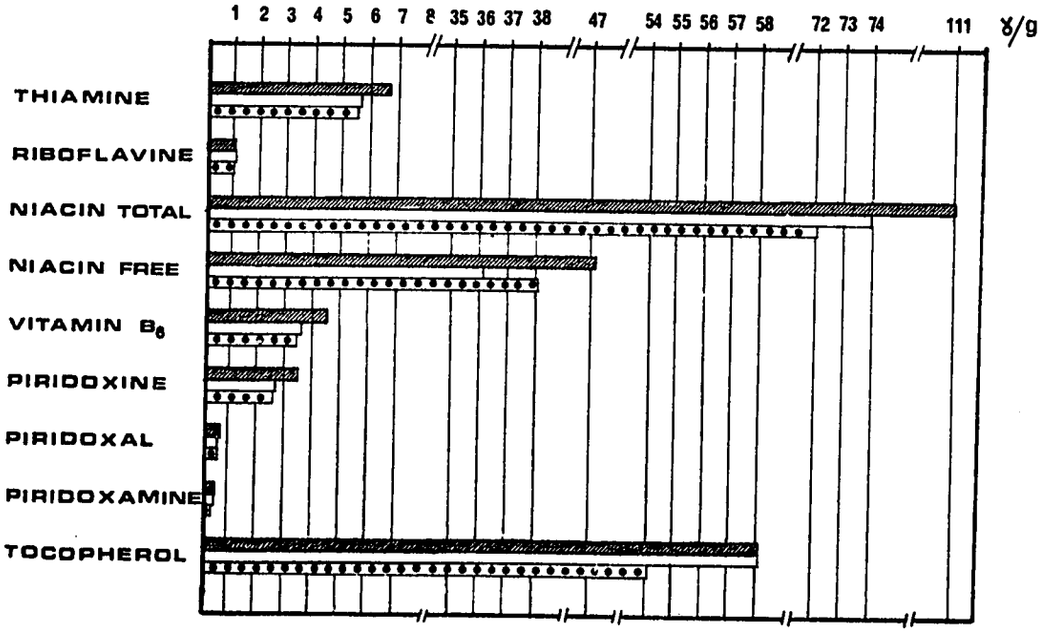

CARBOHYDRATE/dry weight
2 3 4 5 6 7 8 61 63 66 g/100g
REDUCING SUGAR
NON RED. SUGAR
STARCH
PENTOSANS
CRUDE FIBER
HEMICELLULOSE
CELLULOSE
LIGNIN
MINERAL ELEMENT CONCENTRATION/dry weight
8 30 40 60 340 370 350 1500 1700 1800 3400 3700 4100 4300 4500 4700 4800 γ/g
Na
K
Mg
Ca
P
Fe
Cu
Mn
Durum wheat
Hard wheat
Soft wheat

·Fig. 11

NUTRIENT FATTY ACID/dry weight



VITAMIN / dry weight



Durum wheat; Hard wheat Soft wheat

L'IMPORTANCE DE BLE DUR DANS L'ALIMENTATION MONDIALE

G.T. Scarascia Mugnozza

RESUME:

Des renseignements sont présentés aux tableaux et dans les illustrations. Les données se divisent en trois catégories: (1) Blé dur; superficie, production, et rendements à travers le monde; (2) le commerce en blé dur; prix, consommation, et utilisation y compris comparaisons avec tout autre catégorie de blé; (3) comparaison des caractéristiques qualitatives et de la composition chimique du blé dur, blé tendre, et blé de biscuiterie.

Les objectifs des programmes phytogenetiques pour le blé dur que nous avons retenus dans le passé sont présentés aussi bien que ceux projetés pour l'avenir.

Original: Anglais

4

CIMMYT'S INTERNATIONAL ROLE IN IMPROVING DURUM WHEAT

G. Kingma, M. Quiñones &
R.G. Anderson

Durum or macaroni wheats occupy a significant portion of the total wheat acreage of the world. Statistics on production are extremely difficult to obtain since durum wheat is lumped with bread wheats in reporting. However, estimates as high as 30 million metric tons for world production are recorded for certain years. The major producing countries are the U.S.A., Argentina, Canada, Italy, Algeria, Morocco, Ethiopia, Turkey, Syria, USSR and India. Many other countries also grow significant proportions of their wheat acreage to durums. The main product use includes pasta products macaroni, spaghetti, etc.) couscous and a number of flat breads.

CIMMYT's interest in durum wheat improvement began in the 1950's when the availability of Norin-10 dwarfing genes of the winter and spring wheats offered an opportunity for the development of superior agronomic types. During this period crosses were effected between the earlier released Mexican tall varieties Tehuacan and Barrigon-Yaqui with the early dwarf wheats. The older varieties had considerable drought tolerance and large seed. These crosses resulted in such dwarf durum releases as Oviachic 65 and Chapala 67 in Mexico and Quilafen in the Chilean program.

Further improvement was required in these varieties. In general they were too late and some sterility was still present, inherited from the early dwarf bread wheat parents. They did, however, have real merits in their dwarfness, straw strength, fertilizer response and tillering. Unfortunately, many of the varieties available as parent material had been developed in the more temperate regions and day length sensitivity was common. Varieties, therefore, had to be rendered daylength insensitive through crossing to day length insensitive materials if varieties were to be produced suitable for growth in the semi tropic and near semi tropic countries for which CIMMYT has its main obligation.

In the second cycle of material the variety Jori 69 was released in Mexico. This variety gave a marked increase in yield, was earlier in maturity, had greater yield stability through its improved fertility and was less sensitive to date of sowing than the older varieties. Because of these results durum breeding was intensified in 1968 with the object of providing high yielding, day

length insensitive varieties which would replace traditional tall varieties in the durum producing countries. This, it was considered would be more readily accepted in these countries than the high yielding bread varieties which because of yield advantage were eroding the durum acreages. Jori 69 then was the first variety which offered close yield competition with the high yielding bread wheats.

In the 1969-70 crop season a group of 38 advanced dwarf durum lines were distributed to 16 countries to determine the range of adaptation. In northwest Mexico these lines gave yield test results ranging from 6-7 tons/ha. Favourable response to the new durums was encountered in several other durum producing countries. In the same year, the first International Durum Yield Nursery (IDYN) which included several of these lines was prepared. Results from 32 locations primarily representing Middle Eastern and African countries demonstrated the superiority of these materials over the tall and/or daylength sensitive varieties of the U.S.A., Italy and India. The highest yielding lines were Anhinga, Jori 69, Crane, Brant and Gerardo VZ466 (the latter a short Italian variety). Since that year the IDYN has been continued, the Elite Durum Yield Trial (EDYT), the International Durum Screening Nursery (IDSN) as well as F2, and crossing blocks have been distributed. From these nurseries a further number of dwarf varieties have been released.

Cocorit 71 was released in Mexico. It will also be released as Dicle 1 in 1975 and certain other sisters are under advanced trials in Turkey. In the same country, the line LD 357E-Tc^2 x A1"S" 27354-1M-1Y-1M-0Y is expected to be released as Gediz 1. Amal 72 and Maghrebi 72 two dwarf varieties of the parentage Brant "S", D 24102-4r-4m-0y and G11"S"/Br 180-Lk x G2-61-130, D 26842-21Y-3m-0y respectively, have been released in Tunisia. It is reported that a durum variety derived from the dwarfs has been grown in Argentina which has been received well in trials as an export variety. In Mexico, the variety Stork is to be released in the current year. Algeria imported 15,000 tons of Jori 69, in 1973 and the variety is grown widely. In 1971 Iraq imported 10,000 tons of Jori 69 seed from Mexico for their national program. Egypt has been testing Jori 69 and Cocorit 71 and plans to release one or both for growing in Middle Egypt.

International Durum Screening Nurseries

This nursery, like those of the other CIMMYT crops, is probably the most important nursery distributed by CIMMYT for assisting national programs in the introduction of new germplasm with wide adaptability and high yielding ability. It also serves to screen for resistance to such major diseases as the three rusts, *Septoria tritici*, powdery mildew and scab. Varieties are screened for suitability to both rainfed and irrigated conditions and it is from these nurseries that varieties are selected for entry into CIMMYT's international yield trials.

Materials are selected under a range of conditions in Mexico. Locations at Obregon, Toluca and El Batan vary in elevation, moisture conditions and the disease to which they are subject. They provide screening for the three rusts, scab and to a lesser degree Septoria tritici. Those which as finished lines continue to have resistance to Mexican virulence patterns of diseases and demonstrate high yield potential in Mexico are placed in the IDSN. These advnaced lines also receive additional testing in the Regional Disease and Insect Screening Nursery (RDISN) distributed from ALAD-FAO-CIMMYT in Beirut and the Latin American Disease and Insect Screening Nursery (LADISN) distributed from CIMMYT.

Data from these screening nurseries are provided by the cooperating National Programs for such characteristics as yield, stripe, stem and leaf rust and Septoria, mildew and scab reaction as well as seed quality and other traits. Data are now available for the crop seasons from 1968-69 to 1972-73. The number of reports received have been disappointing but for the most part about one-half the number distributed have been returned. The number of lines and number of nurseries distributed have advanced over the 5 year period as well as the number of outstanding entries in relation to the check varieties which include bread wheats as well as Jori and Cocorit durum checks.

Disease Resistance (See appended table)

The Rusts - All three species of rust found on bread wheats can attack durum wheat with equal severity. As is common to bread wheat, durum wheats may be fully resistant to stem rust in Mexico but be fully susceptible in Chile, Tunisia, Turkey, Kenya or Ethiopia. The screening nurseries are very useful, therefore, in detecting which of the varieties have broad spectrum resistance over wide areas and these resistances can be entered into the durum crossing blocks of National Programs and in CIMMYT's crossing block to increase the general level of resistance in the germplasm.

In the 2nd IDSN 26 varieties were resistant to stem rust representing eight crosses. In the 3rd eight crosses. In the fourth again 8 crosses showed resistance and in the fifth seven crosses.

In leaf rust in the second IDSN 26 entries from 10 crosses were resistant; in the 3rd seven crosses; in the 5th eight crosses.

In stripe rust in the 2nd IDSN 25 entries from 18 crosses were resistant; in the 3rd 6 crosses; in the fifth 19 crosses.

These results were based on reactions taken in Ethiopia, Iran, Turkey, Italy and Chile. In some cases lines were resistant to two or three of the rust species.

Septoria tritici - In general the taller varieties have higher Septoria resistance than the dwarf varieties but in a few cases which include some of the Cocorit sibs, varieties derived from Ganso and some derived from Jori parentage show reasonable tolerance. Thus far, with advanced lines, the best sources of resistance have been the original tall Mexican durums, the North American varieties and such varieties as Buck Balcarce and Tacur 125. The resistance derived from North African, Italian and Argentinian sources are being incorporated but are only now coming into the advanced line status. It is hoped that these will give adequate levels of tolerance for the Septoria affected areas of the world.

Erysiphe graminis - powdery mildew - It is evident from a review of screening nursery materials that the North American varieties are a major source of mildew resistance. Such lines as Anhinga, Gaviota, LD 357_E-Tc^2, Maghrebi, D21563-AA, Flamingo and some crosses of Ganso-Crane and Pinguino, have varying levels of resistance. Similarly, Cocorit and Stork possess some resistance. The best of these are equal to or superior to Siete Cerros (bread wheat) which is well known for good tolerance. Powdery mildew is most important in European countries from which most of the data on resistance were derived.

Fusarium - In general resistance to scab is not yet well developed in the dwarf varieties. In Mexico in 1973 Fusarium nivale was extremely heavy in the Toluca nursery where it almost eliminated all durums. Rabi - Fg, Gta - Fg, Gerardo VZ469-Plc"S", Pg"S" x Chap'21563, Bo"S"-Ganso "S" and Gs"S"-AA"S" x Pg"S"/Fg"S"-Cit"S" were less heavily attacked. The variety Cinnamon in triticales and Yecora 70 and Inia 66 used as checks in the nursery were generally more resistant than the durums. Fusarium roseum was recorded in France and in Romania there were attacks of unidentified Fusaria reported. Conditions for scab development are most severe in coastal Mediterranean areas and in Argentina.

Superior grain type

Grain type, test weight, percentage of yellow berry, protein content and so forth have been reported from several locations. Certain lines appear superior. For example, Anhinga and many of its derivatives show good test weight; high kernel weights were reported for Ganso and several derived lines; Jori 69 and its sister D 21563 also showed good kernel weight; Flamingo lines showed good seed type; Td-T.sph-Grulla x Mariza Sadovo/Anhinga showed 100 percent yellow berry in Lebanon; Jori "S"-Crane"S" also gave high yield but rather poor seed type; Gaviota-Flamingo crosses gave good seed type and kernel weight; Stork entries show good kernel weight; test weight of Rabi-Flamingo derivation showed good test weight; line 21563-Anhinga combines the good kernel weight of Jori with high test weight of Anhinga; and Rabi x 21563-AA showed good grain types in general.

Eleven varieties of the 5th IDSN were rated at 14 percent or above in protein in Greece. Among these lines Jori, Albatros and D 21563 appeared frequently as a parent. Leeds and related U.S.A. germplasm also occur repeatedly as parents.

Leeds and Hercules showed better carotenoid pigmentation than the dwarf varieties but recently developed material are now entering screening nurseries which have twice the pigmentation of previous dwarf lines. This analyses of the durum screening nursery over the five year period indicates marked improvement in yield, adaptation, disease resistance and seed quality.

Under good conditions of fertility and irrigation in Mexico yields have approached 8 tons/ha on an experimental basis. Much yet must be done in improvement but steady progress is being made.

New Developments

In its base program in Mexico, CIMMYT is continuing to assemble and incorporate in crosses, materials collected from all durum producing areas and from collections made earlier. Through international collaboration these are being assessed for their important characteristics and incorporated in some 5000 crosses per year. This will, undoubtedly, increase the adaptation through a widening of the germplasm. Change in virulence of the various pathogens continues to plague the breeder but with the regional and worldwide testing system the best sources of resistance to current virulence patterns is continually sorted.

In the beginning of the program partially sterile genes in the durums derived from the Norin 10 dwarfing source was a major problem. Although this still is a hindrance in the segregating generations, the dwarf varieties released have been selected for much better fertility. In 1960, Tehuacan 60 in yield tests in Mexico gave about 4.2 tons/ha. Oviachic 65 and Chapala 67 in 1965 and 1967 gave about 7.0 tons/ha. In 1969, Jori raised the yield level to 7.7 tons/ha. Cocorit advanced the yield plateau again in 1971 to 8.3 tons/ha and in 1974 Stork gave 8.6 tons/ha. These figures are higher than would be expected in farm fields because of plot/border effect but their relative levels give an indication of the steady progression of yield increments. The best are now equal to the best bread wheats. New sources of high fertility are being incorporated from triticale and bread wheats as well as superior durum fertility types.

In certain countries the dwarf durums as a class are somewhat late in maturity to fit well into the cropping season. Attempts are being made to shorten the cycle for these areas. In Mediterranean countries there is a special need for varieties which have a relatively long period from seeding to flowering and a short maturation period in order to avoid the hot winds which character-

istically blow from the deserts at that time. To select for these conditions a new departure has been made. Crosses are effected in Mexico and F1 seed is sent directly to Algeria, Tunisia, Turkey, Lebanon and Ethiopia in order to cross directly with the locally grown types for further selection. In 1974, F1's of some 3200 crosses were distributed. Similarly F1 seed from Tunisia has been distributed to Algeria and CIMMYT for recrossing. F2 populations are also supplied for selection under these particular conditions. F1 seed exchange is now proposed also with the Indian program where some of the earliest maturing varieties are being grown. Similarly plans are laid for exchange with Argentina.

In such cooperating countries as Turkey and Algeria some degree of winter hardiness is desirable in the durum areas. In the past three years CIMMYT has collected available winter type durums which are being incorporated in crosses with spring types in its Toluca Nursery. Winter types are sown in November and spring types in January to effect crosses in May. More than 250 durum winter types will be used in crosses in 1975 and seed will be distributed to the concerned countries.

In the quality field, CIMMYT now has the equipment to carry out extensive quality testing of semolina. Pigmentation, cooking quality, extrusion suitability, protein quality and so forth are now being added to the selection pressure available. These will complement the visual quality assessment of seed size, test weight and grain appearance previously practiced.

CIMMYT hopes during the next two years to extend its disease testing through the establishment of two regional nurseries one in the Eastern and one in the Western Hemisphere for selecting the most highly resistance materials for stem and stripe rust resistance respectively. These centres, it is felt will add appreciably to the list of potential parents for resistance. The eastern hemisphere centre will also be a summer nursery for advancing generations more rapidly. In the appendix table are listed some of the parents presently being employed in breeding for resistance to the principal durum diseases. In addition crosses for disease resistance, particularly to Septoria are being made to bread wheat and triticale varieties in an attempt to bring in resistance from these sources.

The authors would like to take this opportunity to express their appreciation to the scientists of the National Programs for their close collaboration in the furtherance of this world wide durum improvement program. With this collaboration, which we are sure will increase, the future of durum wheat looks very bright indeed.

DISCUSSION

Question: What are the hopes of CIMMYT in making crosses between the durums and other species?

Answer: Our main approach is to incorporate disease resistance, particularly to Septoria, from bread wheat to durum wheats. Secondly, crosses with triticale are being made to see whether additional lines with a single rye chromosome can be transferred for disease resistance or other characters such as winter hardiness. In using these lines in breeding programs, selection includes the character which will ensure the presence of that chromosome.

Question: How long will a variety remain resistant and why does a variety change from resistant to susceptible?

Answer: Sometimes a variety will be resistant one year, susceptible the next and resistant the next. This is the case when the pathogen does not live over in the area and the epidemic is reintroduced each year. Change in resistance depends on what virulence moves in and is established each year.

The length of time a variety will maintain resistance is very variable. In some cases such as stripe rust in Western Europe a variety may become susceptible the very year of release. In another case, Sonalika, released in 1967, is still fully resistant to all three rusts.

Question: What is CIMMYT's philosophy of danger of varietal monoculture?

Answer: Farmers will always sort out a preferred variety if they are given several to choose from. The widely adapted variety, tested for good performance over many locations worldwide, encounters many diseases and many environments. It will be expected to have buffering action to the environmental changes from year to year at any one location. This is particularly valuable in rainfed locations where there are wide fluctuations in environment.

Comment: In the last 15 to 20 years, varietal improvement has been quite rapid. Many new lines have been tested in many countries, but few were released due to difficulty of multiplication and distribution. Usually the one with broad adaptation has been selected for release.

In view of the genetic variation within pathogen populations which result in breakdown of disease resistance, is it better to have one variety with broad adaptation or a series of varieties with more specific adaptation?

Comment: Both systems are of value and are combined in the multi-line approach, a variety with broad general adaptation composed of phenotypically similar lines into which a great many different genetic sources of disease resistance have been incorporated.

Selected durum varieties used in the breeding program as sources of disease resistance. Data taken from RDISM 1971-72, 1972-73 and 3rd RCB 1972-73

Variety or cross	Genealogy	Origin	South Asia	West Asia	East Africa	North Africa
			Stem rust reaction			
Hercules		Canada	MR	R	S	R
Durum var. 24		Unknown	MR	R	MR	R
Tehuacan 60		Mexico	MR	MR	S	MR
Jori 69		Mexico	MR	R	MS	S
Cocorit 71		Mexico	MR	MR	S	MR
Anhinga "S"	22234-52M-3Y-1M-0Y	Mexico	MR	MR	S	MR
Flamingo "S"	27582-9M-8Y-1M-0Y	Mexico	R	R	MS	R
Flamingo "S"	27582-8M-13Y-2M-0Y	Mexico	MR	R	S	R
D.dwarf 5.15 x Cr"S"	33312-7Y-2M-1Y-0M	Mexico	MR	MR	S	MR
Maghrebi		Tunisia	R	R	MS	R
Wells		USA	R	R	MS	R
Leeds		USA	R	R	MR	R
Ward		USA	R	R	MR	R
			Stripe rust reaction			
Zenati-Boutellis		Algeria	R	R	MR	R
Senator Capelli		Italy	-	MR	R	R
Tehuacan 60		Mexico	-	MR	R	R
Jori 69		Mexico	-	R	R	MR
Cocorit 71		Mexico	MS	MS	MR	R
Flamingo "S"	27582-8M-13Y-2M-0Y	Mexico	-	S	MR	R
Flamingo "S"	27582-18M-12Y-5M-500Y	Mexico	R	R	R	R
Flamingo "S"	27582-9M-8Y-1M-0Y	Mexico	R	R	R	R
Cr"S"-Gs"S"	28980-28Y-13M-500	Mexico	R	MS	R	R
Crane "S"	23055-56M-1Y-1M-0Y	Mexico	R	R	MR	R
Gaviota "S"	31725-3M-8Y-1M-0Y	Mexico	MR	R	MR	R
Maghrebi		Tunisia	R	R	R	R
			Septoria tritici reaction			
INRAT 69		Tunisia	-	MR	MR	R
T.turgidum		Unknown	-	R	MS	R
Durum var. 24		Unknown	-	R	MR	R
Gerardo 512		Italy	-	R	MS	R
Gerardo 466		Italy	-	R	S	R
61-130 x Lds		USA	-	MS	MS	-
Leeds		USA	-	-	-	R
Boobi "S"	21263-5Y-1Y-2Y-3M-2Y-102M	Mexico	-	R	MS	R
Cr"S"-Gs"S"	28980-28Y-13M-500Y	Mexico	-	R	MS	R
Gaviota	31725-40M-3Y-13Y-0M	Mexico	-	R	S	R
Pelicano	25609-2M-1Y-1M	Mexico	-	R	S	R
Anhinga	22234-52M-3Y-1M-0Y	Mexico	-	R	S	S
Flamingo	27582-8M-13Y-2M-0Y	Mexico	-	R	S	MS
			Powdery mildew reaction			
Tehuacan 60		Mexico	-	R	-	R
Chapala 67		Mexico	-	R	-	R
Pelicano "S"	25609-2M-1Y-1M	Mexico	-	R	-	MR
Jaafari		USSR	-	R	-	-
Durum var. 24		Unknown	-	R	-	R
INRAT 69		Tunisia	-	R	-	R
Maghrebi		Tunisia	-	R	-	R
Senator capelli		Italy	-	R	-	R
Capelli		Italy	-	MR	-	R
Gerardo 466		Italy	-	R	-	MR
Hercules		Canada	-	R	-	R
Wells		USA	-	R	-	R
Leeds		USA	-	R	-	R
61-130 x Lds		USA	-	R	-	MR
			Fusarium reaction			
			France		**Poland**	
T. turgidum		Unknown	R		-	
Maghrebi		Tunisia	S		MS	
Lakota		USA	S		R	
Cr"S"-Plc"S"	31724-33M-0Y-0M	Mexico	MS		-	

ROLE INTERNATIONAL DU CIMMYT DANS L'AMELIORATION DU BLE DUR

G. Kingma, M. Quiñones
R.G. Anderson

RESUME:

On cultive le blé dur sur une surface considérable notamment en Afrique du Nord et de l'Est, au Moyen Orient, en Amerique du Nord, en Argentine et en URSS; sa production mondiale est estimée à 30 millions de tonnes métriques annuellement.

L'intérêt du CIMMYT pour les blés durs commença en les 1950 quand les premiers types nains furent obtenus par croisement. Cette activité fut intensifiée fin 1960's et, depuis 1969, diverses nurseries ont été distribuées internationallement. Un certain nombre de variétés ont été successivement divulguées depuis 1965 dans plusieurs pays et l'intérêt pour cette culture n'a pas cessé de monter en raison de ses possibilités potentielles comme ses rendements, par exemple, qui ont augmenté jusqu'à être pleinement compétitifs avec les blés tendres. De nombreux pays ont importé des semences provenant du Mexique.

Les maladies principales des blés durs sont les rouilles, Septoria, oïdium et fusariose qui sont importantes dans certaines régions. Des sources de résistance ont continuellement été identifiées dans les programmes nationaux collaborateurs; ce qui a nettement augmenté l'efficacité des efforts d'amélioration locaux et du CIMMYT.

Les problèmes de fertilité ont été outrepassés grâce à des croisements effectués avec des variétés hautement fertiles de blé dur, de triticale et de blé commun.

Actuellement la qualité du grain est utilisée comme critère pour sélectionner les différents matériels du CIMMYT afin d'obtenir des variétés avec meilleure proteine, bonne teneur en carotenoides, bonne qualité pastière et caractèristiques physiques satisfaisantes.

Un nouveau programme d'échange de semences F1 pour l'utilisation de celles-ci dans les différents programmes nationaux et le CIMMYT va permettre l'augmentation de l'adaptation des sélections varietales aux conditions spécifiques de culture. Ceci inclu l'introduction de matériel d'hiver, plus

précoce et présentant une meilleure résistance aux maladies et aux insectes. Dans ses plans d'assistance future le CIMMYT projète d'introduire des tests régionaux de résistance aux maladies concernant les rouilles noire et jaune afin de supporter par la suite ces tests régionaux qui seront conduits.

Avec la collaboration étroite et continue des programmes nationaux, l'avenir de l'amélioration des blés durs parait être en très bonne voie.

Original: Anglais

5

RECENT DEVELOPMENTS IN DURUM WHEAT RESEARCH IN ITALY

A. Bozzini

This presentation is represented by the author's summary, highlights of the material presented, discussion which followed the presentation and the author's tables.

Summary by the author

An attempt is made to give some information on the history and development of durum wheat research in Italy, with particular emphasis on breeding and physiological studies and agronomical aspects of its cultivation. In relation to the main problems related to morphological and physiological ideo-type of durum wheat, different attempts for finding the correct germplasm to be used for fulfilling the goal are illustrated by a description of the subsequent varieties released in the last 30 years. Quality problems are afterwards taken into consideration, some of which are still to be resolved, particularly if breeding techniques are taken into consideration.

Finally, nitrogen uptake, metabolism and protein accumulation researches are dealt with, particularly in relation to the response to nitrogen fertilization of some key enzymes, like nitrate reductase and proteases.

Highlights of the material presented

1. Grifoni and Capeiti were good varieties improved from locals.

2. Yield is related to nitrate reductase level from heading to maturation.

3. There is a direct correlation between protease activity during ripening and the protein level in the kernels.

4. Nitrate reductase in roots is important for nitrogen intake in the vegetative stage.

5. For transport of nitrogen to the grain, the upper plant parts are important, especially the leaf sheaths and blades.

6. From jointing to maturity yield is related to nitrate reductase activity and from flowering to maturity the correlation is high.

7. The flag leaf is the best tissue for determination of nitrate reductase activity. Leaf area and position must be taken into consideration.

Notes on the tables and figures

Table 1. Is a summary of 6 yield trials in 1973-74, conducted in Italy by various cooperators. The top yielding varieties were Valsacco, Creso, Valselva, Valnova and Velgerardo. In these tests Creso combined excellent hectoliter weight with high yield. Also percentage yellow berry in Creso tended to be lower than in the Val-varieties, especially under conditions resulting in low yellow berry levels. Trinakria was the least affected by yellow berry; however, it was the lowest yielder in these tests.

Table 2. Is a summary of many trials carried out by the agricultural products laboratory (Laboratorio Applicazioni in Agricultura). Average values of all varieties in the trials for yield, hectoliter weight and percent yellow berry are compared with average values of Creso and Capeiti.

Table 3. Presents yield results of 6 durum wheat trials conducted at Ente Sviluppo in 1973-74. The variety Creso consistently produced a high yield.

Table 4. Presents yield results of 15 selections and four varieties, including Creso, at 2 levels of nitrogen at 4 locations in Central Italy in 1973-74.

Table 5. Compares yield and hectoliter weight performance of 12 bread and 4 durum wheats in 3 trials conducted at Ente Maremma 1973-74. The yield of Creso was better than the average of the bread wheats, and in two trials the hectoliter weight was better than any of the bread wheats.

Figure 1. Illustrates the relationship between nitrate reductase activity and protease in 10 varieties. A significant correlation exists if the two varieties with lowest protein and protease levels are omitted.

Figure 2. Illustrates the change in total nitrogen content, soluble protein, protease level and nitrate reductase activity as the growing season progresses.

Values given are the average of 10 varieties. Total nitrogen declined steadily from mid May to mid June. Nitrate reductase activity held steady from May 20th to June 6th, but dropped rapidly from June 6th to June 14th. During this latter period the protease level rose rapidly while soluble protein declined.

Figure 3. Illustrates a dramatic increase of percent and total grain protein as application of nitrogen fertilizer was increased from 0 to 400 kgs/ha. Also there is a corresponding increase of nitrate reductase activity sampled at heading stage or throughout the season and expressed as seasonal average.

Figure 4. Illustrates the close relationship between nitrate reductase activity at heading stage and both grain yield and grain plus straw yield. The influence of nitrogen application rate on these values is also shown.

DISCUSSION

Question: Do these differences in nitrate reductase activity result in increased grain yield or just in increased protein content of the grain.

Answer: Nitrate reductase activity is related to N uptake and translocation; therefore it influences both yield and grain protein content.

Question: (1) Is the relationship between the nitrate reductase activity and the yield linear? (2) What is the potential use of this technique in increasing production? (3) What is the relationship with the other nutrient elements and their effect on yield?

Answer: (1) Based on our experiments on durum wheat, nitrate reductase activity and grain yield follow a linear regression from 0 up to 200 kg N/ha. Measured by total yield (grain plus straw) the relationship holds from 0 to 400 kg N/ha.
(2) The impact of this technique on our production falls in two categories: as a selection tool and as a way of assessing the nutritional status of the crop at a given moment. (3) The other nutrients are important in relation to availability, soil structure, plant canopy, etc. and the usual relationships with nitrogen metabolism apply.

Question: Is the level of nitrate reductase activity also dependent on nitrogen supply or is it purely genetical.

Answer: Nitrate reductase is an induced enzyme, therefore from the very beginning it depends on nitrate availability in the soil. Genetic factors are however, responsible for the general level of nitrate reductase activity.

Question: At what critical stages of plant development can high levels of nitrate reductase be used to predict high yield and high protein level in the grain.

Answer: According to our results, nitrate reductase activity of flag leaves from heading to the soft dough has the highest correlation coefficient with yield and protein content.

Question: Which are the easy and fast screening techniques for durum pasta making quality?

Answer: At present such techniques are not available. However, it seems that pasta quality (and gluten quality) may be closely related to the number and position of (SH-HS) groups. If this is demonstrated an easy technique may be available.

Comment by Dr. Scaracia: I wish to stress the importance of gluten quality and of rheological properties of the dough (tenacity, viscosity, elasticity) and, consequently, the need of identifying a parameter connected with these properties which is easy to detect in a small sample. There is evidence that disulphide bonds of the protein, which gives rise to the gluten, play an important role in the cohesiveness of the dough. Since disulphide bonds and thiolic groups are roughly proportional these groups should be a good parameter of the gluten quality and therefore pasta quality.

Question: What are your hopes of interspecific crosses and would you make a brief resume of what was done in this field in Italy?

Answer: Interspecific crosses have been a very useful tool for transfering interesting characteristics into durum wheat such as the work done in Italy. Mr. Maliani started using interspecific crosses about 20 years ago, followed by many other workers. Characters that have been transferred from hexaploid to durum wheat are mainly: spike and spikelet fertility, winter habit, winter survival, disease resistance, lodging resistance.

TABLE 1. GRAIN YIELD AND QUALITY DATA: MEANS, MAXIMUM AND MINIMUM OF 6 LOCATIONS. FROM THE "ITALIAN REGIONAL DURUM WHEAT VARIETIES TRIALS, 1974, ORGANIZED BY ISTITUTO SPERIMENTALE PER LA CEREALICOLTURA

	Grain yield moisture content 14% Q/Ha			Test weight Kg/hl			1000 Kernel Weight			Protein on dry matter basis %			Protein on dry matter basis Kg/Ha			Lysine on dry matter basis %			Lysine on dry matter basis Kg/ha			Lysine % of protein		
	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.	m.	max.	min.
Valsacco	45,5	60,1	36,8	78,9	80,9	75,2	45,5	53,5	39,8	10.72	11.30	8.90	416	509	300	0.30	0.34	0.28	11.8	15.1	8.9	2.84	3.29	2.53
Creso	45,5	54.7	36.6	84.3	86.1	80.8	53.0	60.8	48.2	11.00	12.76	8.55	431	504	268	0.29	0.35	0.27	11.5	14.0	8.5	2.71	3.19	2.30
Valselva	45.1	52.3	40.4	81.4	83.5	78.5	50.9	59.8	44.5	11.06	13.27	9.33	426	490	326	0.31	0.34	0.27	11.9	14.2	9.5	2.81	3.34	2.34
Valnova	44.0	53.2	38.7	81.5	82.9	78.1	52.8	61.2	46.5	11.59	12.57	9.75	438	522	324	0.28	0.32	0.24	10.5	12.0	8.1	2.40	2.73	2.11
Valgerardo	42.0	47.4	37.8	81.9	83.5	78.0	49.9	58.3	46.7	10.57	11.97	8.31	382	469	270	0.30	0.32	0.27	10.5	11.7	8.9	2.79	3.28	2.24
Tito	38.8	54.4	30.2	78.9	82.5	74.3	36.9	45.0	32.1	11.16	12.82	9.33	376	496	233	0.31	0.36	0.24	10.4	13.3	7.6	2.81	3.28	2.30
Appulo XX	37.2	40.9	32.7	82.7	84.8	80.0	43.8	53.3	40.8	12.03	14.76	10.15	395	466	328	0.30	0.35	0.26	9.6	10.9	7.2	2.49	3.09	2.02
Belvedere	37.1	45.3	28.3	81.2	83.4	77.0	42.1	48.0	38.9	11.55	15.36	9.12	360	402	278	0.34	0.36	0.30	10.9	13.4	8.0	3.01	3.36	2.13
Valgiorgio	36.9	46.3	29.2	79.9	81.6	75.8	47.3	60.1	41.5	11.46	12.76	9.12	362	442	263	0.31	0.33	0.28	9.7	11.8	7.1	2.70	3.10	2.38
Valfiora	36.5	46.4	30.2	81.7	82.9	79.8	54.2	64.9	47.2	12.11	13.33	9.75	380	473	269	0.33	0.37	0.29	10.4	14.1	8.4	2.75	2.99	2.50
Valnera	35.3	41.2	30.5	81.2	82.6	78.3	54.0	60.3	46.1	11.19	13.37	8.88	361	406	245	0.29	0.34	0.22	9.1	11.6	6.0	2.51	2.07	2.21
Raineri	35.2	48.3	33.0	80.8	83.2	76.3	40.6	49.9	35.7	12.52	14.89	10.15	376	440	265	0.33	0.35	0.30	10.0	14.6	6.8	2.67	3.35	2.05
Mariotella	35.1	38.4	27.0	82.7	84.4	78.9	45.8	54.3	38.8	12.21	14.01	10.15	371	462	235	0.33	0.38	0.28	10.0	11.6	7.3	2.72	3.11	2.38
Pepe 64	34.9	40.6	23.8	83.4	85.0	80.5	45.9	55.0	40.7	12.58	14.01	9.55	381	460	196	0.30	0.34	0.24	8.9	11.8	6.2	2.40	3.14	1.89
Sincupe 9	34.1	41.3	28.3	83.1	84.8	80.9	41.2	48.7	36.9	11.40	14.01	8.88	334	440	228	0.31	0.33	0.28	9.2	11.7	7.3	2.81	3.21	2.16
Pepe 0130	34.0	37.2	27.7	83.0	84.5	79.4	49.0	57.6	41.8	12.09	13.72	9.75	355	435	231	0.31	0.37	0.26	9.1	10.8	7.0	2.62	3.42	2.18
B.52	33.2	40.2	27.0	82.9	84.4	80.2	42.5	50.4	37.8	11.15	13.59	7.96	319	410	195	0.32	0.37	0.26	9.2	12.5	6.4	2.92	3.46	2.45
Capeiti 8	31.9	37.6	23.1	83.1	85.9	79.2	43.8	55.6	36.1	11.58	14.01	9.96	319	434	199	0.30	0.33	0.24	8.1	10.3	4.9	2.57	3.22	2.27
Himera	30.7	37.8	22.8	83.6	84.8	82.1	45.5	56.0	38.8	13.85	15.91	10.35	369	512	203	0.36	0.40	0.32	9.3	12.8	7.6	2.62	3.81	2.23
L.51	29.9	36.0	26.6	82.0	83.5	79.5	39.8	47.1	34.7	11.07	13.24	7.96	286	352	182	0.32	0.36	0.28	8.2	9.7	6.5	3.02	3.67	2.63
Carpomoro	29.7	42.0	18.5	82.7	84.2	79.9	37.0	47.2	32.7	13.48	15.51	11.21	342	421	226	0.34	0.39	0.27	8.5	10.4	5.0	2.48	2.71	2.20
Granato	29.2	39.4	25.2	83.5	84.8	81.7	48.8	59.5	45.1	13.85	16.52	11.16	348	426	252	0.34	0.37	0.31	8.5	10.7	6.7	2.46	2.85	1.99
Cappelli	28.1	33.0	20.4	82.9	83.8	80.7	50.9	61.2	44.0	12.40	14.67	9.86	299	362	246	0.33	0.44	0.23	8.1	12.7	5.0	2.69	3.52	1.92
Eliodoro X	27.6	31.5	24.9	82.7	84.5	80.3	42.1	56.5	33.5	12.58	14.33	10.96	362	328	256	0.31	0.34	0.27	7.4	8.2	6.4	2.50	2.68	2.30
Trinakria	26.6	35.5	13.4	80.7	83.3	77.3	50.7	58.1	43.2	15.37	17.50	10.66	359	516	123	0.37	0.41	0.33	8.6	12.5	3.8	2.46	3.05	2.12
Mean	35.4			82.0			46.1			12.05			366			0.32			9.6			2.67		

X Mean of 4 locations: Roma, Catania, Palermo, Cagliari

XX underlined means have been obtained from all locations except Catania.

Table 2. Summary of tests made by the agricultural products laboratory (Laboratorio Applicazioni in Agricoltura)

Location and year	No. of lines tested	Yield Qx/ha.			Hectoliter weight			Yellow berry, %		
		Ave.	Creso	Capeiti	Ave.	Creso	Capeiti	Ave.	Creso	Capeiti
Casaccia 63-60	35	35.33	57.70	44.52	81.65	85.80	82.00	38	34	17
Casaccia 69-70	43 x 2	46.03	50.72	46.08	82.63	85.40	84.70	40	15	36
Casaccia 70-71	72 x 2	53.80	67.05	53.20	81.14	84.30	80.08	9	22	10
Casaccia 71-72	71 x 2	47.28	50.55	38.25	80.82	83.16	81.35	14	5	10
Casaccia 71-72 (FAO)	12	38.75	44.50	37.66	78.49	82.58	80.48	4	1	2
Casaccia 71-72 (CNR)	14	38.76	53.91	43.03	70.15	82.65	80.07	4	2	4
Casaccia 71-72	52	53.97	60.11	42.12	79.32	82.23	80.28	14	2	4
Casaccia 71-72	52	37.33	56.10	--	76.90	81.40	--	6	3	--
Casaccia 71-72	27	44.66	50.14	--	77.12	78.80	--	18	13	--
Casaccia 71-72	14	46.08	49.05	--	75.29	79.01	--	39	34	--
Casaccia 71-72 Rockefeller	26	47.25	47.13	40.82	80.08	82.61	82.31	18	5	15
Casaccia 71-72	41	44.31	46.54	43.17	77.19	80.13	79.01	35	20	36
Casaccia 71-72	49	50.14	54.38	41.05	74.70	79.95	77.75	25	17	27
Casaccia 71-72	49	50.24	48.13	45.59	75.77	80.73	78.35	24	5	26
Casaccia 71-72	46	56.67	63.00	35.12	75.59	80.45	77.38	10	10	10
Casaccia 71-72	46	47.84	57.66	37.92	77.43	80.88	79.16	20	6	7
Casaccia 71-72	46	37.94	55.17	36.97	76.87	81.35	78.65	14	21	16
Casaccia 72-73	71 x 2	57.50	57.47	56.98	80.48	83.81	84.17	7	2	5
Casaccia 72-73 (CNR)	16	49.91	51.27	50.27	82.74	82.73	83.00	8	9	11
Casaccia 72-73 (FAO)	12	49.88	51.09	52.24	82.42	83.33	84.41	12	14	10
Casaccia 72-73 epoca semina	5	43.47	41.94	47.56	81.66	82.71	84.43	10	3	45
Casaccia 72-73 epoca semina	27	48.03	51.43	57.99	80.86	02.40	84.18	2	1	2
Casaccia 72-73 epoca semina	42	47.61	51.94	48.13	82.24	81.93	83.11	2	1	2
Casaccia 72-73 epoca semina	42	44.09	50.44	49.38	82.27	82.48	83.66	3	3	7
Casaccia 72-73 epoca semina	38	46.16	47.36	--	82.01	61.26	--	1	1	--
Casaccia 72-73 epoca semina	38	43.50	48.53	46.25	81.60	82.46	83.12	2	2	7
Casaccia 72-73 epoca semina	56	41.97	46.15	44.44	80.10	81.40	83.50	1	1	1
Casaccia 72-73 epoca semina	56	41.25	45.23	--	79.02	81.40	--	2	1	--
Casaccia 72-73 epoca semina	61	44.27	47.37	41.15	80.81	82.53	83.31	2	3	4
Casaccia 72-73 epoca semina	61	40.77	43.45	37.89	81.71	83.13	84.10	7	5	13
Ancona 69-70	43 x 2	46.97	53.57	50.50	80.29	84.30	81.00	2	1	1
Ancona 70-71	72 x 2	38.11	45.12	25.35	79.89	83.20	76.70	1	1	1
Ancona 71-72	73 x 2	46.27	61.20	41.05	78.05	83.73	78.91	1	3	1
Ancona 72-73	69 x 2	54.51	66.04	57.37	75.22	79.85	78.00	4	5	3
Tarquinia 70-71	73 x 2	23.35	22.68	27.22	81.42	82.10	84.95	1	0	1
Tarquinia 71-72	76 x 2	35.90	37.82	35.16	76.25	78.60	79.50	8	1	5
Tarquinia 72-73	71 x 2	41.23	39.15	45.12	75.78	76.46	79.47	4	0	2
Maccarese 69-70	10 x 2	42.75	54.91	35.57	80.16	84.03	81.02	9	21	15
Maccarese 70-71	14 x 2	38.11	61.94	36.03	82.79	85.11	82.45	1	1	2
Maccarese 70-71	15 x 2	57.45	77.25	--	81.30	85.62	--	14	17	--
Maccarese 71-72	22 x 2	42.62	61.12	33.70	77.09	82.48	79.53	6	1	1
Maccarese 71-72	11 x 2	34.16	58.46	--	76.75	82.71	--	8	5	--
Maccarese 72-73	20 x 2	49.44	50.37	--	83.60	85.57	--	19	12	--
Maccarese 72-73	16 x 2	62.58	66.55	--	81.80	83.85	--	28	36	--
Terni 69-70.	10 x 2	45.20	53.20	44.50	80.53	84.12	80.81	1	1	1
Terni 70-71	20 x 2	30.20	44.00	28.00	71.72	79.75	73.40	1	5	1
Terni 71-72	20 x 2	38.98	47.10	--	77.09	80.25	--	7	4	--
Terni 72-73	19 x 2	45.49	46.04	--	78.18	81.17	--	15	4	--
Avezzano 71-72	2 x 2	52.21	55.51	--	80.34	80.57	--	27	38	--
Avezzano 72-73	16 x 2	64.32	77.85	--	76.49	83.73	--	1	1	--

Table 3. Yield results of trials conducted by Ente Sviluppo in Tuscany and Lazio (1973-74).

Variety	Tarquinia (Vitterbo)		P. Mirteto (Rieti)		Barbaruta (Grosseto)		Riotorto (Livorno)		Buonconvento (Siena)		Average	
	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank	Yield Qx/ha.	Rank
1) Appulo	35.71	10	--	--	37.40	24	34.39	18	31.60	7	34.77	25
2) Creso	37.85	1	43.90	1	69.93	1	48.42	1	37.20	1	47.49	1
3) FC 120	31.71	20	--	--	--	--	35.97	15	30.40	11	32.69	32
4) FD 1156	29.28	27	--	--	--	--	35.07	15	34.70	4	33.01	29
5) FD 1514	34.57	12	--	--	62.29	5	43.66	6	--	--	46.84	2
6) FD 1543	39.71	23	--	--	62.44	5	41.63	8	--	--	44.92	5
7) FE 137	28.14	31	35.20	6	48.72	13	--	--	--	--	37.35	17
8) FE 164	33.71	17	32.60	11	--	--	--	--	--	--	33.15	29
9) FE 484	26.14	38	--	--	58.07	8	--	--	--	--	42.10	8
10) FE 1705	17.14	47	37.20	4	--	--	--	--	--	--	27.17	45
11) FE 1706	36.42	6	--	--	--	--	38.03	10	--	--	37.72	17
12) FE 1708	21.14	46	29.80	15	46.30	17	--	--	--	--	32.41	32
13) FE 3017	26.42	38	--	--	64.40	3	--	--	--	--	45.41	4
14) FE 3023	32.57	19	35.80	6	45.70	18	--	--	--	--	38.02	16
15) FE 3066	28.85	31	--	--	65.16	2	45.36	3	--	--	46.46	3
16) FE 3068	38.28	1	--	--	--	--	42.08	7	29.80	13	36.72	20
17) FE 3091	36.42	6	--	9	42.08	20	--	--	--	--	37.70	17
18) FE 3097	29.28	27	34.60	11	--	--	--	--	--	--	30.99	36
19) FE 3297	27.71	37	32.70	10	--	--	--	--	--	--	30.70	36
20) FE 3302	34.57	12	33.70	--	48.87	13	--	--	--	--	41.72	9
21) Gerardo 522	29.71	27	--	--	--	--	--	--	--	--	29.71	42
22) Gerardo 523	28.28	31	--	--	--	--	--	--	--	--	28.23	43
23) Gerardo 613	34.00	12	--	--	--	--	--	--	--	--	34.00	23
24) Gerardo 619	26.85	38	--	--	--	--	--	--	--	--	26.85	46
25) Gerardo 620	28.14	31	--	--	57.77	9	40.84	9	31.50	7	39.56	13
26) Gerardo 629	35.71	10	--	--	--	--	--	--	--	--	35.71	22
27) Gerardo 634	26.14	38	--	--	--	--	--	--	--	--	26.14	47
28) Gerardo 635	33.28	17	--	--	--	--	--	--	--	--	33.28	29
29) Gerardo 644	28.57	31	--	--	--	--	--	--	--	--	28.57	43
30) Gerardo 645	26.43	33	--	--	--	--	--	--	--	--	26.43	47
31) Hymera	36.85	6	--	--	--	--	34.28	18	--	--	35.56	22
32) Linea 6259	30.00	23	--	--	--	--	--	--	--	--	30.00	40
33) Linea 6587	31.85	20	37.40	4	59.88	7	48.87	1	--	--	44.50	6
34) Linea 7418	34.18	12	35.30	6	41.62	21	32.69	20	34.00	4	35.55	22
35) Linea 7614	37.85	1	--	--	--	--	27.26	23	--	--	32.50	32
36) Linea 7635	38.14	1	--	--	--	--	31.11	21	--	--	34.62	25
37) Montanari	34.71	12	30.40	14	41.93	21	37.23	12	36.50	3	36.17	20
38) Patrizio	26.85	38	--	--	31.24	23	35.41	15	34.80	4	32.82	32
39) Pepo 64	23.42	31	25.60	18	43.29	19	39.14	10	37.60	1	34.81	23
40) Raineri	28.14	38	21.70	19	39.21	13	37.67	12	31.50	7	31.24	36
41) Tenero locale	31.14	20	28.60	16	55.05	10	44.91	5	--	--	40.07	11
42) Tito	29.71	27	42.30	2	48.72	13	45.25	3	31.00	7	39.39	13
43) Trinaoria	30.42	23	--	--	--	--	31.45	21	--	--	30.93	36
44) Val Gerardo 451	--	--	39.30	3	--	--	--	--	--	--	30.30	13
45) Val Gerardo 512	38.28	1	36.60	17	64.40	3	--	--	--	--	43.09	7
46) Valnera	25.71	45	--	--	--	--	--	--	--	--	25.71	49
47) Valnova	30.28	23	--	--	--	--	--	--	--	--	30.28	40
48) Valsacco	--	--	--	--	51.73	12	37.89	12	30.20	11	39.91	11
49) Valseva	38.28	1	31.30	13	54.15	11	--	--	--	--	41.14	9
Average	31.09	--	33.35	--	51.83	--	38.68	--	33.14	--	35.58	--

Table 4. Yield in quintals per hectare of Creso and other lines at 4 locations of central Italy, 1973-74.

	Casaccia		Narni		Maccarese		Avezzano	
Linea	100kgN	150kgN	100kgN	150kgN	100kgN	150kgN	100kgN	150kgN
FE 1091	52.8	56.2	59.9	63.9	56.4	61.4	78.8	78.8
FE 1097	59.7	52.8	61.9	60.9	57.5	60.6	94.0	90.9
FD 1514	69.5	63.6	63.3	63.6	73.1	64.5	89.9	87.9
FD 1543	64.4	64.3	62.3	63.9	56.4	55.6	95.0	96.3
FE 3066	75.8	68.5	59.3	59.6	67.3	50.9	94.0	96.0
FE 3068	68.6	72.5	56.8	57.3	51.4	54.2	95.3	94.0
FE 3017	68.8	62.3	68.6	65.3	60.6	56.2	99.4	97.7
FE 3023	64.0	62.1	72.6	68.6	70.3	71.7	102.1	97.3
FE 3297	59.1	52.3	59.3	50.3	38.1	42.5	79.8	68.6
FE 3302	45.8	52.8	60.6	56.9	54.2	50.3	82.5	83.8
FE 164	57.7	42.0	62.3	56.9	57.0	54.5	85.5	71.0
FE 137	61.2	59.7	62.6	61.6	56.7	51.2	94.0	75.4
FE 484	65.9	63.6	68.6	67.9	54.8	48.4	98.4	82.5
FE 1705	71.5	67.2	60.3	64.3	58.4	52.8	89.6	81.5
FE 1706	53.7	52.4	61.6	65.9	56.7	55.6	90.6	75.4
Test	43.1(1)	38.9(1)	54.6(2)	57.3(2)	33.9(1)	33.6(1)	85.2(3)	81.8(3)
Creso	72.6	69.2	67.3	70.9	64.8	64.2	102.8	100.4
Tito	78.5	59.6	66.3	62.6	63.1	55.6	97.7	86.9
Mida	-	-	67.3	67.6	65.1	66.0	95.3	83.8

(1) Capeiti, (2) Irnerio, (3) (Produttore).

Table 5. Comparison of bread and durum wheats at 3 locations (Ente Maremma, 1973-74), (coastal area).

	Barbaruta (Grosseto		Marsiliana (Grosseto)		Casotto Pescatori (Grosseto)	
Variety	Yield Qx/ha.	Hecto. l. wt.	Yield Qx/ha.	Hecto. l. wt.	Yield Qx/ha.	Hecto. l. wt.
Orso	58.67	82.15	47.39	89.10	57.50	82.15
Costante	67.12	81.70	57.91	81.70	51.25	79.90
Generoso	49.47	81.70	47.91	82.60	53.00	85.30
Marzotto	49.62	80.35	44.16	82.80	47.50	78.60
Granarolo	56.41	79.45	60.31	82.15	54.50	75.90
M.E.C:	61.39	31.85	48.64	85.55	52.00	85.90
Strampelli	56.71	81.25	57.29	82.15	55.00	78.60
Irnerio	57.31	81.70	58.33	81.70	50.00	76.80
Gagliardo	57.31	80.35	52.03	79.45	56.00	76.80
Palata	56.86	81.70	53.75	81.70	61.00	80.95
Fontarronco	57.62	80.35	53.64	83.30	48.75	80.35
Resistente	-	-	50.31	84.40	-	-
Creso	64.40	86.20	49.89	85.75	59.50	82.60
Appulo	48.42	81.70	-	-	-	-
Tito	-	-	-	-	34.25	74.55
Raineri	-	-			41.50	79.45

Figure 1. Correlation between nitrate reductase activity and protease (mg protein digested per hr. per gram fresh weight). The radius of the circles indicates the protein content of the grain.

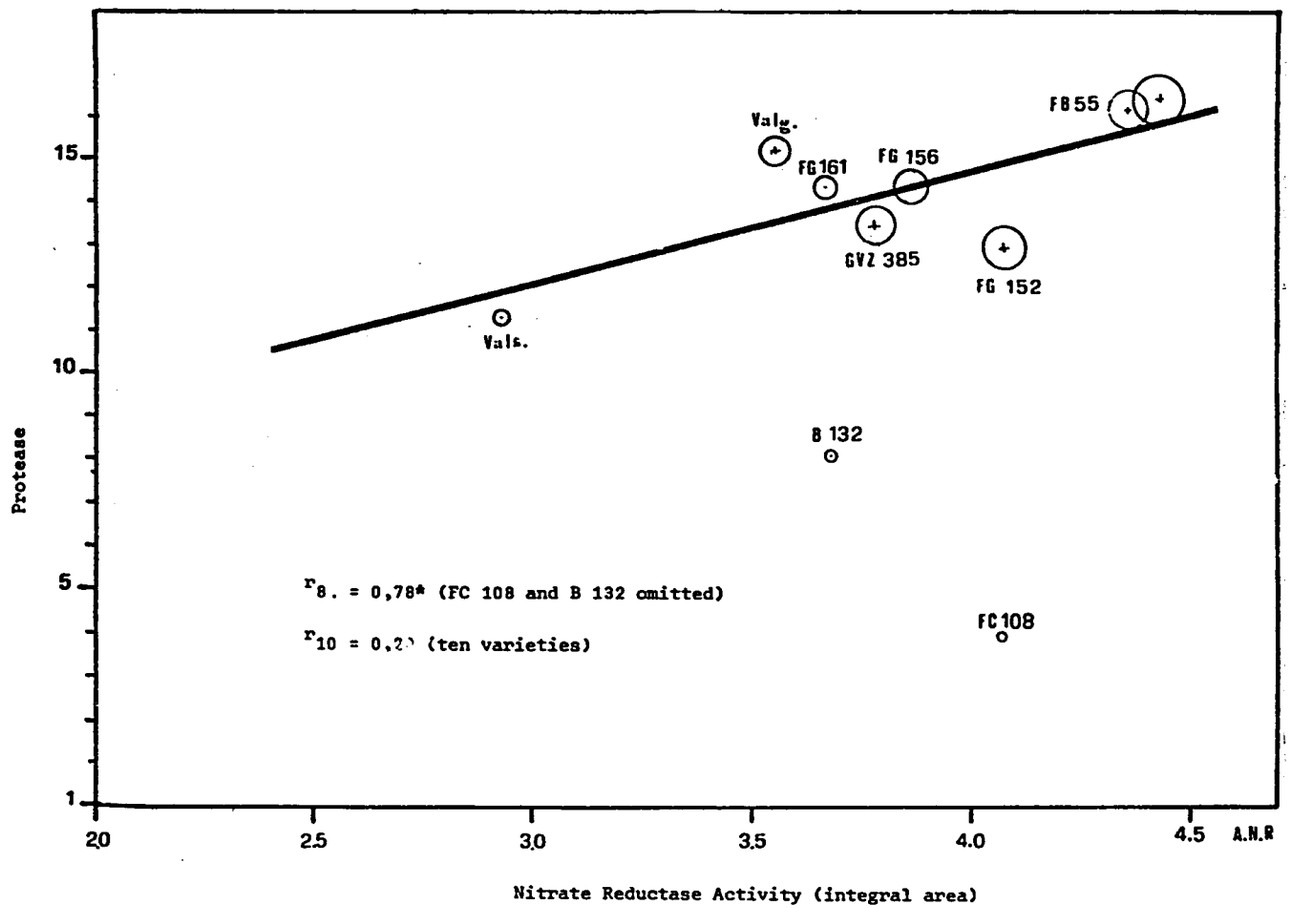


Figure 2. Change in total N content, soluble protein, protease and Nitrate Reductase Activity with sampling date, each value is the average of 10 varieties.

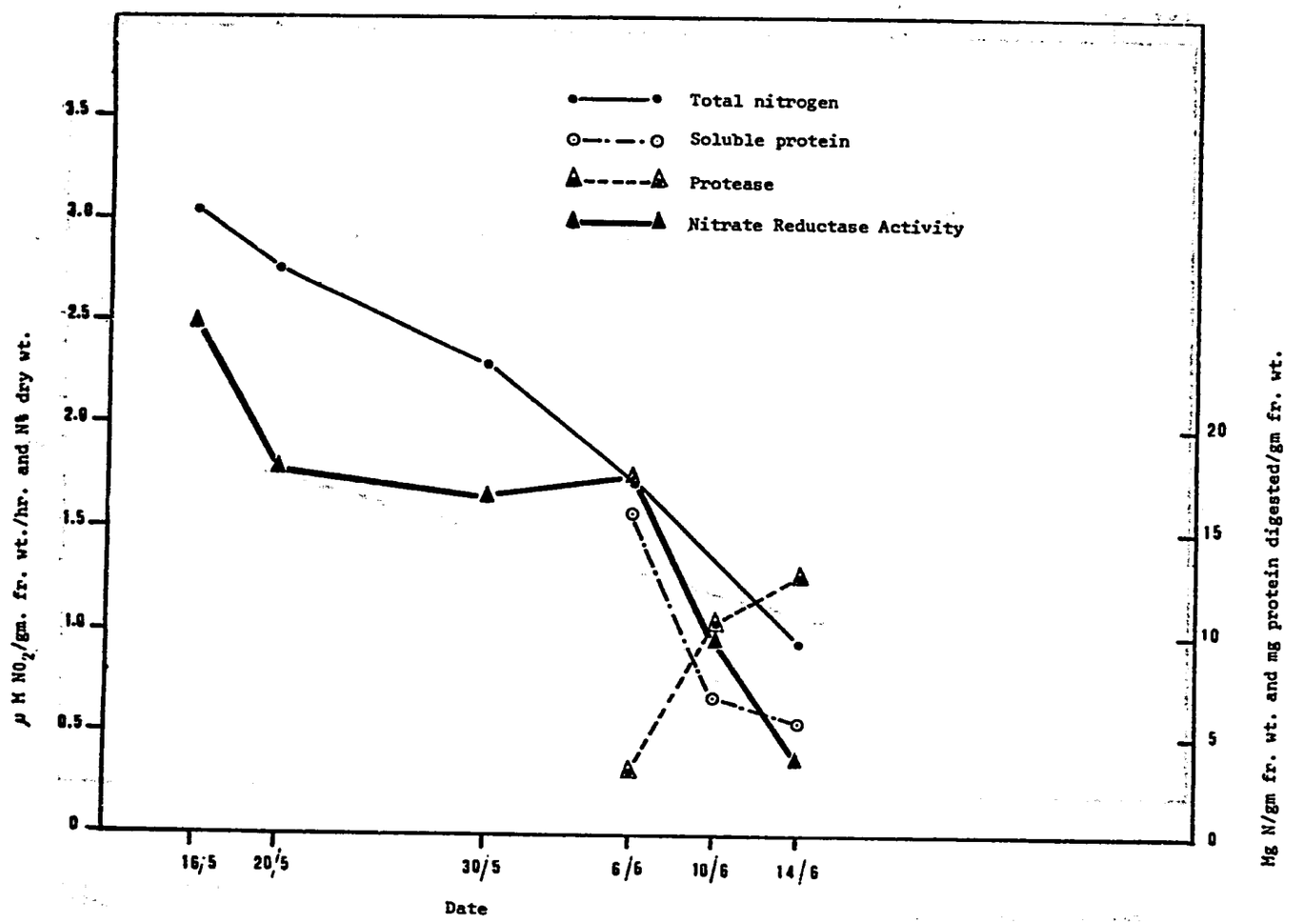


Figure 3. Effect of N fertilization on (A) percent of grain protein (o——o) and total grain protein (●——●), and on (B) N.R.A. (nitrate reductase activity) at heading stage (●——●) and as seasonal average (o——o).

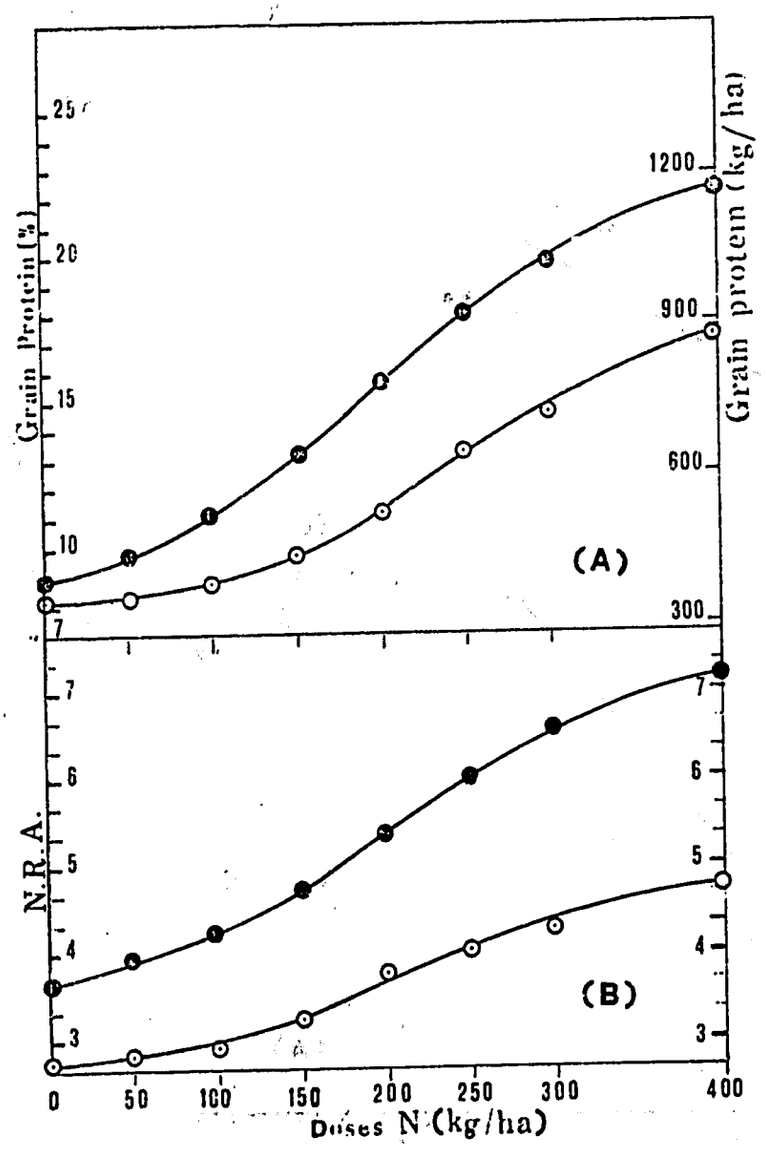


Figure 4. Relationship between N.R.A. (Nitrate reductase activity) at the heading stage and (A) grain yield, (B) grain and straw yield The figure given at each point is the level of nitrogen applied which generated this point.

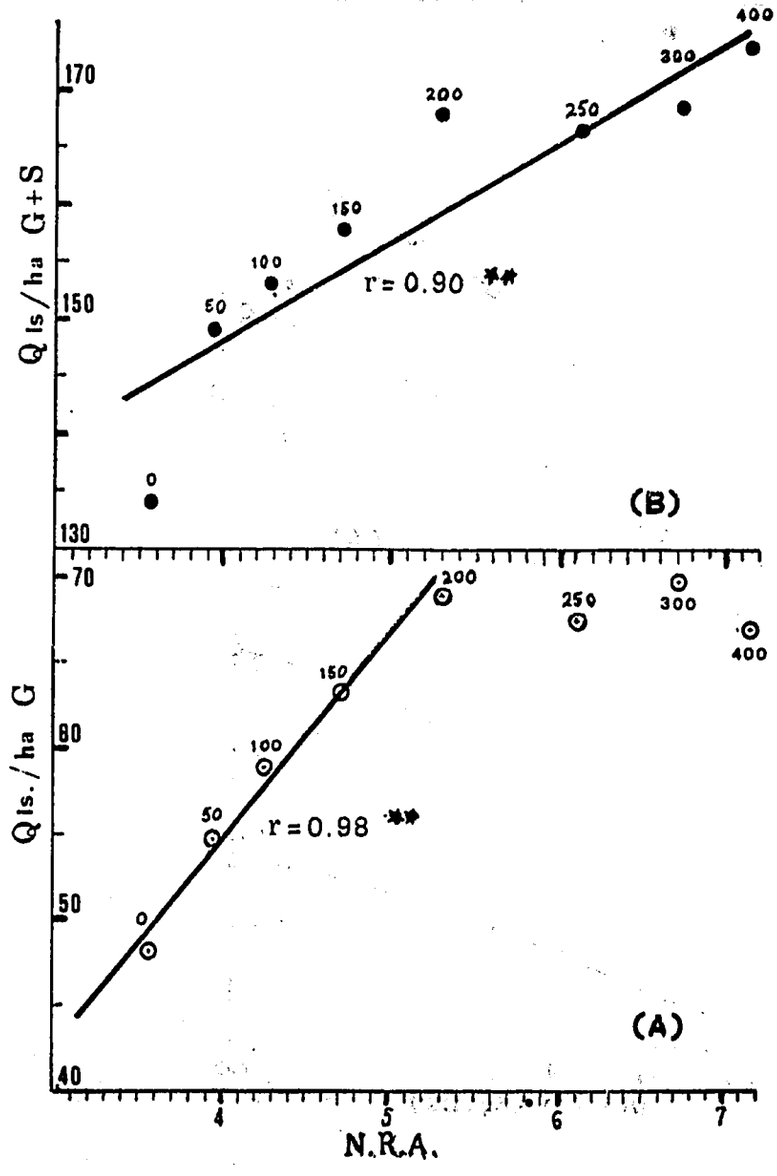


TABLE 1. Durum Distribution in the Mediterranean and Near[1/] and Middle Eastern Countries.

Countries	Total Wheat Area 1000 ha)	Total Durum Area (1000 ha)	Total Wheat Production (1000 M.t.)	Total Durum Production (1000 M.t.)	Durum Needs	Durum Area %	% Durum Production
Near and Middle East							
Afghanistan	2,336.0	467.2	2,850.0	841.0	1,000	20.0	29.5
Cyprus	80.0	40.0	95.0	45.0	40	50.0	47.7
Iran 2/	4,885.0	488.5	4,251.0	425.0		10.0	10.0
Iraq	2,000.0	240.0	1,500.0	270.0	270	12.0	18.0
Jordan	200.0	190.0	150.0	140.0	300	95.0	93.3
Lebanon	52.6	17.0	75.0	20.0	50	32.3	26.7
Saudi Arabia	60.0	30.0	90.0	40.0		50.0	44.4
Syria	1,500.0	1,000.0	1,600.0	900.0	300	66.7	56.3
Turkey	8,600.0	2,200.0	10,000.0	2,400.0	2,500	25.6	24.0
S. TOTAL	19,713.6	4,672.7	20,611.0	5,081.0		23.7	24.6
N. Africa							
Algeria 3/	2,100.0	1,300.0	1,400.0	800.0	1,000	61.9	57.1
Morocco 2/	1,837.4	1,375.0	1,872.0	1,362.4	1,500	74.8	72.8
Libya.	186.7	126.5	62.3	43.6		±70.0	
Tunisia	1,050.0	800.0	750.0	520.0	500	76.2	69.3
S. TOTAL	5,174.1	3,601.5	4,084.3	2,726.0		69.6	
Med. Europe							
Portugal 4/	568.0	80.0	454.0	80.0		14.1	
Spain 4/	3,587.0	232.0	5,449.0	259.0	200	6.5	
France 4/	4,034.0	100.00	14,459.0	250.0		2.5	
Italy 4/	4,218.0	1,380.0	9,585.0	2,100.0		32.7	
Greece 4/	1,078.0	290.0	1,724.0	426.0	320	26.9	
S. TOTAL	13,485.	2,082.0	31,671	3,115.0		15.4	
Ethiopia	1,091.6	982.4	839.5	657.7		90.0	78.3
G. TOTAL	39,464.3	11,338.6	57,205.8	11,579.7		28.7	20.2

1/ Data based on the reports given by the respective countries

2/ Personal estimate based on FAO and other publications

3/ Proc. 1st Wheat Workshop 1971 Mexico

4/ Based on FAO Production year book 26, year 1969 and FAO/RF Turkey Wheat Seminar

6

NEEDS OF DURUM WHEAT IN THE NORTH AFRICAN AND NEAR AND MIDDLE EAST REGIONS

G. Varughese

I. Place of Durums in the Region

Durum wheat occupies about 11.5 million hectares in the countries of the Mediterranean, Near and Middle Eastern region. These 11.5 million hectares are distributed: close to 5 million in the Near and Middle East, 3.5 million in North Africa, 2 million in the European part of the Mediterranean and about one million in Ethiopia. The proportion of durums to the total wheat area vary from country to country. In the countries of the Middle East and North Africa, durums constitute the major part of the wheat production. The area and production figures for individual countries are given in Table 1.

Table 2 gives the varietal distribution of the durums in this region*. Unimproved local varieties predominate in most of the countries. The current improved varieties in cultivation also do not have high yield potential. High-yielding varieties occupy a very low proportion of the area. Table 3 gives a list of high-yielding varieties under cultivation or multiplication as new varieties. Thus we can expect a change in the varietal pattern of the durum crop in this region.

Almost all of the durum crop is rainfed and is grown under an environment of high fluctuation (Table 4). In addition to this, in most of the countries the agriculture is still traditional. When traditional agriculture is coupled with high environmental fluctuations and unimproved varieties, the net result is low productivity.

II. Needs of the Region

a) Yield and yield stability

Durum wheat in the regions of North Africa and the Near and Middle East can be grouped into two major groups. The first group -- semi-winter wheat with some cold tolerance -- is needed for parts of afghanistan, Algeria, Iran, Iraq, Turkey and Tunisia. The second group -- spring durums -- are

* Unless otherwise stated, region comprises the countries of North Africa and the Near and Middle East.

adequate for the remaining countries and parts of the above countries. Late frost and lack of adequate rainfall during the last phase of the crop or high evapo-transpiration during this period are very common to almost all the durum areas. Lack of consistency in rainfall distribution during the season and varied intensity of the winter season are still other factors to be taken into account. Thus the varieties must have adequate drought tolerance and a wide adaptation, in addition to high yield potential through semi-dwarfing, high fertility and bold seeds.

Earliness is one of the ways to escape drought. It is possible to achieve this through modifying any one of the different developmental phases of the crop. It may seem better to have a type with a long vegetative phase and a short reproductive phase. In other words, a long duration germination to tillering (flower initiation) and tillering to anthesis and a short anthesis to ripening period. However, more detailed analysis is needed and will require the help of either CIMMYT or some universities to look into this fundamental question, i.e. the role of different growth patterns in relation to drought.

Wide adaptability of a variety is another practical measure to face the high fluctuations in the environmental conditions. In the past, plant breeders resorted to testing the variety for a number of years to achieve this. However, this wide adaptation of a variety can be measured today much faster through the help of regional and international testing. Thus it would be wise on the part of national programs to make use of these regional and international nurseries.

Disease resistance is another important factor in stabilizing the yield potential. Table 5 gives the potential diseases, their distribution and the number of times each one has been a limiting factor in wheat production during the past 10 years. It is evident that stripe rust, stem rust and leaf rust are the most important diseases in common for almost all the countries of the region. Septoria, smuts and bunts constitute the second group of diseases. These are more prevalent in the Mediterranean region. Other diseases are also prevalent, but their importance is less in comparison with the rusts and Septoria.

Research input in durum development and screening for sources of resistance is fairly new. As a result, we do not yet have many varieties combining multiple resistance or varieties carrying different sources of resistance for a single disease. The last few Regional Insect and Disease Screening Nurseries (RDISN), the experience of the International Rust Nursery of the USDA and isolated efforts of a few plant pathologists and plant breeders have assembled a number of valuable data with respect to the sources of resistance to different diseases. A list of these sources is added in the appendix. Thus, we have a base available to work with. But most of these sources are present either in very poor agronomic types or are present in some of the sub-species of T. turgidum, so the incorporation of these traits to the cultivated forms will take time and much scientific effort. Unfortunately, many of the programs in the region are not well equipped to carry out such a task. Thus, it would seem appropriate for CIMMYT to devote some of their efforts towards developing parents and to distribute them to the national programs.

The RDISN is an excellent vehicle in the region for identifying new sources for disease resistance. The success of this depends on the sources of material which go into the nursery. I would strongly recommend that the FAO germplasm collection program channelize its collection through this nursery for a faster utilization. At the same time, there are many small collections of durums in existence in many breeding programs. These collections also need to be assessed on a wider scale for the benefit of these programs as well as for the region as a whole.

Progress towards developing high-yielding varieties of wider adaptability has been achieved in many countries. The role of high yield and stability depends not only on the varieties but on how we grow them. The last regional workshop's main topic was devoted to this subject. I am sure our agronomic colleagues will continue to help us in this venture.

b) Quality

Durum wheat is indigenous to this area and as a result it is the main cereal for many of the indigenous food preparations. In addition, countries of this region used to be one of the major exporters of durum wheat to Europe. The European market demands durum types with a very low yellow berry percentage and a strong gluten. Thus, tradition and the past export experience are the two major factors determining the durum quality today.

Table 6 gives a classification of the mode of use of durums in the region. It is surprising to see that only 15.5% of the total durums of the region are used for spaghetti or pasta products and yet that 15.5% determines the quality requirements of the durums. It is possible that the quality for couscous and bulgur may be similar to that of pastas. However, this aspect needs further investigation. The main use of the durums in many countries of the region is for different types of bread. I am sure that the bread-making quality and the spaghetti or pasta quality are not the same. Thus this aspect of quality also needs detailed analysis.

Technical capability with respect to the number of cereal technologists available, a lack of definition of quality and a lack of methods of screening are probably the biggest bottlenecks towards the development of varieties with stable high yield and quality. Of the 12 reporting countries only 4 are seriously involved in using cereal technology in durum breeding (table 7). Iraq, one of the four, grows only 12% of its wheat area under durums. Cyprus does not have a cereal technologist but the screening is carried out by the breeder. Thus, Tunisia and Morocco are the only countries among the major durum growers of this region with an active cereal technology program. Thus, unless the situation changes with respect to the availability of cereal technologists; cereal technology laboratories; the lack of definition of couscous, bulgur or bread-making quality and the lack of early generation screening for pastas, development of stable high yielding varieties with the desired quality or qualities will be slow in many countries of this region.

Export of the durums is without doubt one of the first priorities of many governments as and when surplus becomes available. But this is something which we are to look for in the future. For the present the need is to fill the import gap of durums used for bread making, couscous or bulgur. Thus, if high-yielding, well-adapted varieties are available, they can go into production and the export quality can be incorporated over the years.

III. Collaboration Possibilities

i) Needs of different countries are slightly different from one another. However, there are many factors in common among many of the durum-producing countries.

ii) The role of regional and international nurseries is discussed in the context of yield stabilization as a means of measure for wide adaptability and as a scale for disease measurement. Descriptions and objectives of these nurseries are available for all the participants. In addition to achieving yield stability, these nurseries are excellent means for exchanging germplasm.

iii) CIMMYT is the major distributor of germplasm for the durums today. If we can provide CIMMYT with the most promising varieties and parents and our suggestions of certain parents for use in crosses, we can further enhance the quality of segregating material being sent out of CIMMYT.

iv) The success of a breeding program depends on how wide a genetic base is available to work with and how strong the selection pressures are. It is possible that some of the advance material which is discarded may be good for another country. If the breeder feels so it would be good to keep a few of these and pass them on directly to those countries or submit them for the regional nurseries.

DEVELOPPEMENTS RECENTS DES RECHERCHES SUR LE BLE DUR EN ITALIE

A. Bozzini

RESUME:

On essaie de donner quelques informations sur l'histoire et le développement de la recherche du blé durum en Italie en mettant l'accent particulièrement sur la production, sur les études physiologiques et les aspects agronomiques de sa culture. En rapport avec les principaux problèmes liés à l'ideotype morphologique et physiologique du blé durum, de différents essais sont illustrés par une description des variétés suivantes produites dans les 30 dernières années, pour trouver le germoplasme adéquat à atteindre le but proposé. Les problèmes de qualité sont ensuite pris en considération; quelques uns d'entre eux doivent etre encore résolus, surtout si les techniques d'élevage sont prises en considération. Enfin, l'absorption de l'azote, les recherches du métabolisme et de l'accumulation des proteines sont affrontées, particulièrement en rapport à la réaction à la fertilisation de l'azote par des enzymes de base comme le nitrate reductase et protease.

Original: Anglais

TABLE 2. Durum Varietal Distribution

Country	Area 1000 ha	% Local	% Improved	% High Yielding	Name and percentage of the varieties
Afghanistan	467.2	90	0	10	Mouri (80), Local short durum (10), GVZ 285 (5),Anhinga (2), FB55 (1), Albatros (2).
Algeria	1,300.0	85	0	15	Bidi 17 (30), Oued Zenati (25), M.B. Bachir (15), Hedba (15), Jori (10), Cocorit (5).
Cyprus	40.0	0	90	10	Kyperounda (60), Psathas (20), Tripolitico (10), Capeiti (10).
Ethiopia	982.4	100	0	0	A mixture of tetraploid species
Iran	488.5	100	0	0	
Iraq	240.0	25	65	20	Roshgull (10), Sorgull (10), Radhawiy + Kroka (5), S. Capelli (65), Jori (20)
Jordan	190.0	20	80	0	F8 Selection (35), Hornani Nawawi (45), Locals (20).
Lebanon	17.0	30	65	5	Huarani 27 (25), S. Capelli (40), Jori (5), Locals (30)
Libya	180.7	0	55	45	Mahmoudi (55), Badri (15), Cocorit (15) Inrat (15)
Morocco	1,375.0	50	50	0	Kyperounda (80), BD 3225 =Biskri x Bouteille (1), BD 2909 = Oued Zenati (15), Zeramek (4) , BD 1658, BD 272.
Saudi Arabia	30.0	100	0	0	Lokaimy (60), Kolani, Sindiyan, Herita Kassem, Herita-Madimi, Numrah-Daiar, Guroba-Kassem, Heijazi-Ahmar, Samma
Syria	1,350.0				Hamari, Horani, Senator Capelli Shihani, Jori
Tunisia	817.0	Tr	65	35	Inrat 69 + Badri (35), Mahmoudi, Chili, Sy-Mahmoudi, Mah-Kokini, Roussia (65) Locals Trace
Turkey	2,200.0				Akbasak 073/44, Berkman 469, Kunduru 1149, Kunduru 414/44, Akpusana, Karakilcik 1133, Bagacak, Sorgull, Beyaziye, Hauran, Iskender, Sahman, Aveyk
Pakistan					Local type 1. Trace " " 2. 60% " " 3. 30% " " 4. 10%

* Data based on the reports given by the respective countries.

TABLE 3. High Yielding Durums of the Region in Cultivation, or likely to be released in the Region*

Variety	Countries
Cocorit **	Algeria, Cyprus, Egypt, Iraq, Lebanon, Saudi Arabia, Turkey, Morocco, Syria
Jori **	Afghanistan, Algeria, Cyprus, Egypt, Lebanon and Saudi Arabia, Syria
Capeiti **	Algeria and Cyprus
INRAT 69 **	Tunisia, Algeria and Libya
Badri **	Tunisia and Libya
GVZ 285**	Afghanistan
Anhinga **	Afghanistan
FB. 55 (Creso) **	Afghanistan
IT-07	Afghanistan
IT-09	Afghanistan
Ent. 234	Afghanistan
V. 229	Iraq
D. Durum S.15 x Cr"s"	Lebanon
Amal	Tunisia
Maghrebi	Tunisia
Gediz (LD357E-Tc^2 x Al"s")	Turkey
Gerardo	Iraq
GAB-125	Syria
Georgio-331	Syria

* Data Based on the reports given by the respective countries
** In cultivation

TABLE 4. Agro-Climatic conditions of the Durum in the Region*

Country	Crop Season & Duration No. of days	Rain Average & Range mm	Rain during the season average and range: Pre-seeding	Seeding to tillering	Tillering to Boot stage	Boot Stage to Mid-Dough	Intensity and duration of the winter	Type of Agriculture R-rainfed I-irrigated T-traditional M-modern	Average Yield q/ha
Afghanistan	Oct - June 240	350 250 - 500	0 0 - 0	150 100 - 200	100 100 - 150	25 20 - 40	Mod - Sev 3 months	I - 100 T - 100	18.0
Algeria	Nov.Dec-June.Jul 240	500 300 - 700	100 no consistancy 50 - 150	150 100 - 200	150 100 - 200	100 50 - 150	Mild+Sev 4	R - 100 T.70 M.30	6.2
Cyprus	Dec - June 200	300 100 - 450	30 0 - 50	130 50 - 200	70 30 - 100	70 20 - 100	Mild 2	R-90 I-10 T-5 M-95	11.3
Iraq	Nov - June 225	625 450 - 1000	0 0 - 40	400 300 - 500	40 0 - 50	150 50 - 300	Mod - Sev 4	R-100	11.3
Jordan	Nov.Dec-May June 210	350 250 - 400	50 30 - 60	130 80 - 120	120 80 - 120	50 30 - 60	Mild 4	R-95 I-5 T-95 M-5	7.4
Lebanon	Nov - July 260	500 300 - 700	60 40 - 100	100 70 - 150	300 200 - 400	50 30 - 70	Mod 4	R-75 I-25 T-75 M-25	11.8
Libya	Dec - June 190	300	50	100	100	100	Mod 4	R-100	3.5
Morocco	Nov.Dec-June July 240	400 240 - 680	40 22 - 80	180 130 - 300	120 80 - 200	60 10 - 100	Mild+Mod 2	T-99.5 I-0.5 T-75 M-25	10.0
Saudi Arabia	Nov15-Dec15 April20-May20 155	350 250 - 650					Mild 2	R-20 I-80 T-100 M-0	13.3
Syria	Oct15-30Nov 15June-31July 240	350 250-- 450	35 0 - 70	160 - 150	140 100 - 150	55 40 - 80	Mod 3	R-95 I-5 T-35 M-65	9.0
Tunisia	Nov - June Dec - July 230	200 - 1000	no consistancy				Mild+Mod 5	R-100 I-0 T-75 M-25	6.5
Turkey Central Plateau	NovDec-JulyAug 290	350 275 - 600	30 no consistancy	175	75	50	Mod - Sev 5	R-100 I-0 T-80 M-20	10.7
Turkey Coastal Region	Oct15-Dec15 June 1 - 15 210	650 500 - 900	60 no consistancy	250	250	150	Mild 3	R-100 I-0 T-60 M-40	11.1
Turkey South East	OctNov-JuneJul 275	480 300 - 600	5 no consistancy	295	130	50	Mod 3	R-99 I-1 T-60 M-40	10.5
Ethiopia	EndJuly-Sep15 Jan-Feb 200	750 400 - 1000	300 200 - 550	200 150 - 280	80 40 - 140	20 10 - 30	Very Mild 3	R-100 T-90 M-10	6.7

* Data based on the reports given by the respective countries.

TABLE 5. Distribution of Diseases in the countries of North Africa, Near and Middle East*
Order of importance in each country rated from 1 - 11. (Number of times the disease limited production during last 10 years)

Diseases	Morocco	Spain	Algeria	Tunisia	Cyprus	Central Plateau Turkey	Coastal Region Turkey	South East Turkey	Ethiopia	Libya	Egypt	Saudi Arabia	Lebanon	Syria	Jordan	Iraq	Afghanistan	Pakistan
Stem Rust	3	2(3)	4	3	1(1)	4	1(1)	5	1(10)	1	1	1(6-8)	3	2	2(1)	-	2	1
Stripe Rust	-	1(2)	2(2)	7	3(1)	1(1)	1(1)	3	3(7)	-	2	4	1	5	-	2	1(2)	4
Leaf Rust	1(2)	3(4)	3	6	2(1)	6	6	4	2(8)	2	3	3	2	3	-	1	5	2
Smut	1	-	6	2	Tr.	3	5	2	4(6)	3	-	2(6-8)	-	4	-	-	4	-
Bunts	5	-	5(1)	1	Tr.	2	7	1	4(6)	-	-	-	-	1	1(2)	-	7	-
Mildew	4	4(1)	7	7	5	-	4	-	5(5)	-	-	-	-	-	-	-	6	-
Septoria	2(2)	5(3)	1(3-4)	4	4	-	3(1)	-	4(6)	-	-	-	-	-	-	Tr.	3	-
Alternaria	-	-	10	-	Tr.	-	10	-	6(4)	-	-	-	-	-	-	-	-	-
Helminthosporium	6	-	9	-	Tr.	-	9	-	6(4)	-	-	-	-	-	-	Tr.	-	3
Root Rots and Fusarium	-	-	8	5	Tr.	5	8	6	5(5)	-	-	-	-	-	-	-	8	5
Others	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-

* Data Based on the reports given by the respective countries.

TABLE 6. Durum use in some of the North African, Near and Middle East Countries*

Country	Production (1000 M.t.)	Pastas %	Bread %	Couscous Bulgur %	Others %
Afghanistan	841	20	60	8	12
Algeria	800	30	10	40	20
Cyprus	45	10	90	0	0
Ethiopia	658	35	5	0	60**
Iraq	270	40	50	10	0
Jordan	140	2	95	1	2
Lebanon	20	40	20	0	40
Morocco	1,500	7	85	5	3
Saudi Arabia	40	0	10	80	10
Syria	900	0	40	0	60
Tunisia	520	30	15	50	5
Turkey	2,400	10	60	30	0
TOTAL	8,133	15.50	50.25	18.50	15.75

* Data based on the reports given by the respective countries.

** Injera

TABLE 7. Technical Involvement and technical staff position in some of the countries of the North African, Near and Middle Eastern Region*

Country	% Durum wheat to total wheat	Number of Plant Breeders	Number of Plant Pathologists	Number of Cereal Technologists	Only varietal testing	Plant Breeding and Plant Pathology	Plant Breeding with Plant Pathology and Cereal Technology
Afghanistan	20	3	0	0		V	
Algeria	70	2	1	1		V	
Cyprus **	50	3	0	0			V
Ethiopia	90	10	4	0		V	
Iraq	12	5	0	3			V
Jordan	95	1	0	0		V	
Lebanon	32	2	1	0		V	
Libya	±70	2	4	1		V	
Morocco	75	3	0	3			V
Saudi Arabia	50	2	1	0	V		
Syria	67	3	0	0	V		
Tunisia	76	3	4	1			V
Turkey	26	15	8	1		V	

* Data based on the reports given by the respective countries.

** Plant breeder works on all the aspects of cereal improvement.

V - Organization of cereal improvement work.

Appendix

Some of the Durum varieties and lines with good resistance to Rusts and Septoria

a) Rusts

1 Khapli. 1
2 Yuma. 1
3 LD. 390. 1
4 Wells. 1
5 Lakota. 1
6 St. 464. 1
7 Beladi. 116. 1,2
8 Beladi. PI. 57662. 1
9 Gaza. 1, 2
10 Tremes Molle. 1, 2
11 Palestina. PI. 94701. 1
12 CI. 8155. 1
13 Kasuska. 1
14 Tai. 1
15 D-16. 1
16 D-56-1. 2
17 Kyperunda. 2
18 Rabicorno"s". 1, 2, 3
D. 31733-4m-3y-1m-0y
19 21563-Jo"s". 1, 2, 3
D. 31538-IL-0L-IA-0A
20 Jo"s" (GII"s"/61-130 x 60 - 115). 2, 3
D. 32864-7y-2m-2y-4m-oy
21 Jo"s" - Cr"s" x Gs"s" - AA"s". 2, 3
CM-9902-5m-oy
22 USA III - C x Cr"s". 2, 3
CM-532-0L-6A-0A
23 61.130 - Lds x GII"s". 2, 3
CM-547-0L-4A-0A

24 D. 68-5-3B-4A. 2, 3

25 21563 x BY_E - T_C5. 3
D.31544-IL-OL-IA-OA

26 Jo"s"/RD3 - 6 x Stw63. 3

27 GII"s" - 21564. 3
CM-83-OL-5A-OA

28 GAB - 125. 2

b) Septoria

1 Jaafri
2 Preto Amareleo
3 Lobeiro
4 Amarelejo
5 BD. 1645
6 Capeiti
7 Tremes Molle
8 Roussia
9 Lakota

NOTES

a) 1 = Stem Rust
2 = Leaf Rust
3 = Stripe Rust

b) Information obtained from the reports of Zitelli (Italy) and the RDISN Summaries.

c) LD. 390, Wells and Lakota carry the same genetic factor for the Stem Rust resistance, St. 464 has two factors for Stem Rust resistance and one is the same as Khapli. Beladi-116 seems to have three factors for Stem Rust resistance.

BESOINS DANS LE DOMAINE DU BLE DUR EN AFRIQUE DU NORD ET AU PROCHE ET MOYEN ORIENT

G. Varughese

RESUME:

I. L'importance du blé dur dans la région

(i) Superficie semée au blé dur et production par rapport à l'ensemble de la production céréalière de la région (Tableau 1).

(ii) Répartition des variétés de blé dur dans la région et classification de ces variétés selon les catégories suivantes: variétés locales, variétés améliorées et variétés à haut rendement (Tableau 2).

(iii) Conditions agro-climatiques sous lesquelles sont cultivées les blés durs dans la région (Tableau 3).

II. Besoins de la région

a) Rendement et stabilité dans les rendements

(i) Potentiel de rendement et sa relation aux caractéristiques agronomiques de la plante.

(ii) Stabilisation des rendements par le rythme de croissance de la plante.

(iii) Stabilisation des rendements par le moyen de types capables de s'adapter à des variations considérables dans les conditions climatiques.

(iv) Résistance aux maladies (Tableau 4).

b) Qualité (Tableau 5)

III. Possibilités de coopération régionale

(i) Chaque programme possède des objectifs, des priorités et des caractéristiques qui lui sont propres.

(ii) Si les besoins diffèrent d'un pays à un autre, il y a tout de même un grand nombre de facteurs qui restent les mêmes pour tous les pays.

(iii) Utilisation des essais régionaux et internationaux pour l'évaluation de la résistance des différentes lignées aux maladies et de leur rendement ainsi que du niveau de stabilité de ces rendements. Ces pépinières sont les suivantes: la Pépinière Régionale d'Observation des Maladies et des Insectes (RDISN), la Pépinière d'Observation Préliminaire (PON), l'Essai Régional de Rendements, l'Essai Régional du Rendement du Blé Cultivé en Sec, l'Essai International du Rendement du Blé Dur et les Essais Régionaux Uniformes de la FAO/IAEA. Ces pépinières sont organisées par la ALAD-CIMMYT/FAO, CIMMYT et FAO/IAEA.

(iv) Recommandation à CIMMYT d'utiliser certains parents prometteurs dans leurs travaux d'hybridisation extensive.

(v) Inclusion dans les pépinières régionales de lignées avancées susceptibles d'être éliminées d'un programme national de recherche mais qui seraient selon l'avis du sélectionneur intéressantes pour d'autres pays.

Original: Anglais

7

COMPTE RENDU SUR LE BLE DUR EN ALGERIE

L. Hachemi

La culture des céréales continue à être liée à l'influence des perturbations climatiques. A cet effet la réduction de l'écart entre la production et la consommation passe nécessairement par l'intensification des zones propices à la culture des céréales, et l'élimination progressive de celle-ci des zones marginales.

La culture des céréales restera à l'avenir d'une importance stratégique pour sa prédominance en matière de ressources nécaissaires pour l'homme des zones semi-arides.

6.000.000 hectares représentent environ la surface consacrée chaque année aux céréales en Algérie dont la moitié est amblavée et le reste en jachère avec une moyenne annuelle de superficie récoltée de 2.8 millions d'hectares.

Tableau I. Evolution des superficies récoltées. 1000 Ha.

Années	B.D.	B.T.	Orge	Avoine	TOTAL
1911-1930	1.120	270	1.230	230	2.850
1931-1950	1.100	400	1.130	200	2.830
1951-1970	1.200	420	1.000	100	2.720
1971	1.240	700	640	70	2.640
1972	1.340	890	800	80	3.100
1973	1.070	710	590	70	2.440
1974	960	690	550	60	2.260

Depuis 1970 il semble se créer un nouvel équilibre dans la répartition des superficies notamment par la regression des superficies en Orge et Avoine éliminées sur quelques zones marginales et une augmentation des superficies en blé tendre au détriment du blé dur dont les rendements très faibles en zones intérieures ne cessent de poser le

problème en termes économiques de rentabilité et d'amélioration de cette culture chère aux agriculteurs.

L'amélioration des rendements apparaît donc comme un des facteurs importants de croissance. Elle doit être au mesure de faire face au développement industriel, à la concentration urbaine et à la surface, à la courbe démographique.

Tableau II. Evolution de la production 1000 Qx.

Années	B.D.	B.T.	Orge	Avoine	TOTAL
1911-1930	5.500	2.100	7.600	2.000	17.200
1931-1950	5.700	2.700	6.000	1.600	16.000
1951-1970	7.700	3.700	6.600	700	18.200
1971	7.300	5.000	3.400	400	16.100
1972	8.700	8.400	6.000	400	23.500
1973	4.600	3.700	2.500	400	11.200
1974	5.000	4.200	2.800	300	12.300

L'influence du climat saisonnier sur la production globale est décisive si l'on se refère aux bilans de récolte. Ceux de ses quatre dernières années montrent bien cette dépendance de la production; son abondance et sa régularité sont sujettes à la répartition entre Octobre et Mai des précipitations ou de leur absence aux moments critiques.

Les gelées tardives vers la mi-Avril et les siroccos précoces (vent chaud du sud) dès les premières journées de Mai ne manquent aussi de contrecarrer les espérances de récolte.

De ces raisons multiples malgré les efforts ardus des programmes de développement depuis 1971 par l'introduction en Grande Culture de variétés semi-naines à haut rendement, a une cadence très rapide, il est difficile de noter l'augmentation de la production au cours des deux dernières campagnes 1973 et 1974 relativement sèches.

Ces conditions difficiles ne permettent pas encore, et notamment en blé dur, une amélioration sensible du rendement.

La présence de stocks sans cesse croissant de graines de mauvaises herbes, la difficulté de maitriser des méthodes modernes de travail du sol et de maintenance de la fertilité des terres entrainent à l'heure actuelle une perte sensible variant entre 30 et 60% suivant les secteurs de production.

Tableau III.

Années	B.D.	B.T.	Orge	Avoine	TOTAL
1911-1930	4,9	7,7	6,1	8,6	6,8
1931-1950	4,7	6,7	5,3	8,0	6,1
1951-1970	6,4	7,6	6,6	7,0	6,9
1971	5,8	7,1	5,3	5,7	6,0
1972	6,5	9,5	7,5	5,0	7,1
1973	4,2	5,2	4,2	5,7	4,8
1974	5,2	6,0	5,1	5,0	5,4

L'AUGMENTATION DES RENDEMENTS

Malgré la faiblesse des rendements, on sent qu'un effort d'amélioration est à noter par l'analyse beaucoup plus fine au niveau de microclimats ou une certaine maitrise des méthodes culturales et de l'utilisation des engrais commence à apparaître ainsi que l'introduction de nouveaux assolements du type Médicago-blé ou fourrage-légumes secs-blé, qui ont pour objectif l'intensification de la céréaliculture.

L'élimination des céréales des zones marginales au delà des 350 mm vers le Sud permettra une concentration d'effort sur ces cultures vivrières dans les zones de 400 à 600 mm.

L'utilisation de semences sélectionnées ne manquera pas aussi d'être un des moyens les plus sûrs et les plus les plus rapides à transformer l'état actuel des choses.

DEVELOPPEMENT DES BLES DURS

Le blé dur qui représente la moitié des superficies emblavées est et restera la céréale la plus cultivée en Algérie aux cours des décades à venir. Les besoins sans cesse croissant naissant d'une utilisation axquise depuis des siècles et multiforme domineront encore pendant longtemps le marché céréalier algérien.

Mais notre préoccupation actuelle est l'augmentation rapide du rendement à l'hectare par la mise en culture de variétés à potentiel élevé capables de supporter les aléas climatiques.

Nos variétés locales datant de plus de 20 ans sont très faibles sur le plan physio-pathologique. Variétés hautes sensibles aux rouilles (Puccinia) et à la Septoriose ont à leurs actifs les caractères de "Bons Semouliers" et de rusticité leur permettant de se plier aux exigeances locales.

Tableau IV. Caractères physio-pathologisues des blés durs cultivés

Variétés	Epiaison date	Hauteur(cm)	Pgt. Rouille noire	Pr. R. brune	Pr. R. jaune	Sept. trit.	Fusariose
Locales							
Hedba	27/4	150	S	S	S	MS/7	MS
Bidi	24/4	140	S	S	MR	S/8	MS
Oued Zenati 368	28/4	145	S	S	MR	S/9	MS
Mohamed Ben Bachir	28/4	155	S	S	R	MS/7	MS
Introduites							
Cocorit	25/3	85	MR	MS	R	MS/7	S
Jori C69	26/3	80	MR	S	R	S/9	S
INRAT 69	13/4	110	MR	MS	MR	MR/6	R
Montpellier (37856)	26/4	120	MS	S	MR	MS/7	MS
Triticompolonicum/Z.B.	24/4	140	S	S	R	MR/5	MR
Capeiti	2/4	120	S	S	MS	MS/7	S

L'AIRE DE CULTURE DE BLE DUR

La scupulation de blé dur par un acquis d'encouragement antérieur à sa culture se retrouve sur les trois zones que caractérisent les différentes isohytes de délimitation et sur le plan pédoclimatique des plaines littorales et sub-littorales argilo-calcaires de bonne pluviométrie jusqu'à la limite de la steppe.

Tableau VI. Les superficies par variétés, 1000 Ha

VARIETES		SURFACES
Locales		
	Heba 3	200
	Oued Zenati 368	300
	Mohamed Ben Bachir	200
	Bidi 17	400
Introduites		
	Cocorit 71	70
	Jori C69	130
	Montpellier 37256	Multiplication
	T. Polonicum/Z. B.	Multiplication
	INRAT 69	Multiplication
	Capeiti	Multiplication
	Total	1.300

Les variétés locales dont les caractèrent technologiques sont appréciables ne permetteront plus la suffisance de la production.

Les variétés introduites dont le potentiel est élevé ne peuvent pas supporter les conditions de sécheresse de nos zones de cultures. Cultivées en sec leur développement végétatif se trouve bouleversé par les différents facteurs d'un climat rude et exigeant.

Les variétés à hauteur normale telle que INRAT 69 n'échappent pas aux gelées de printemps et aux échaudages fréquents.

Ces considérations importantes nous ont poussé à concevoir un nouveau programme d'intensification et d'accélération de l'amélioration des blés durs.

L'objectif de notre programme est d'augmenter la production par un accroissement des rendements, en gardant tant soi peu le niveau de qualité caractéristique de nos variétés locales.

Le développement de ce type de programme est la création de variétés ayant un potentiel génétique de rendement élevé et une adaptation certaine aux zones de production.

Les programmes de création de variétés à potentiel élevé pour les zones semi-arides et ayant un grand pouvoir d'adaptation n'existe pas dans le monde en ce qui concerne le blé dur.

Il nous revient donc d'orienter notre programme en travaillant sur les conditions spécifiques de l'Algérie, afin d'augmenter la diversification de génotypes nouveaux, suivant notre objectif et par là même de pallier aux insuffisances actuelles.

La réalisation et la mise en application du programme de création de nouvelles lignées implique la définition des critères servant de base de recherches.

La capacité génétique de réaliser le rendement maximum possible dans des conditions d'intensification progressive sous nos climats irréguliers résultent de différentes considérations qui imposent donc les caractères génétiques suivants:

- une très grande fertilité de l'épi;
- une résistance à la verse avec une hauteur de la plante variant entre 100 et 115 cm;
- une rusticité proche de celle des souches locales permettant à la plante une plasticité du développement végétatif;
- une longue période végétative et une très courte période de maturation;
- une résistance génétique aux différentes races de rouilles notamment et à la Septoriose (Septoria tritici);
- une bonne qualité semoulières.

Le choix du matériel est fait selon les critères définis par l'existance de lignées mexicaines et italiennes notamment ainsi que l'exploitation d'autres sources, ayant démontrées leur supériorité en matière de fertilité, de résistance aux maladies et à la verse et de précocité. Ce matériel est considéré comme une base de variabilité en vue du développement de nouveaux génotypes nécessaires à la promotion de notre production, permettra d'améliorer nos variétés locales qui elles, possèdent les critères de qualité technologique et d'adaptation donc de rusticité en ces zones semi-arides.

A BRIEF REVIEW OF DURUM WHEAT IN ALGERIA

L. Hachemi

RESUME:

Cereal production in Algeria covers an area of six million hectares half of which is planted to cereals annually and approximately 2.8 million hectares are harvested. The yields from this area have remained stagnant at about 1.8 million tons annually with yearly fluctuations from 0.1 to 0.5 million tons. Present deficits between production and consumption are 0.7 million tons for wheat. Present consumption is 1.5 million tons for durum wheat and 1.0 million tons for bread wheat.

The lower yields of durum wheat have caused a marked reduction in total area even though they have a higher selling price than bread wheat and are preferred by the farmer. Barley and oats areas have also been reduced in the marginal zones. This has dirupted the previous equilibrium among the cereal species which can only be corrected through increased yields.

Diverse climatic conditions, mainly poor rainfall distribution or very limited amounts, late frosts and early Siroccos, are of major importance in the deviations of production.

Also a major importance in wheat production are heavy weed populations causing 30 to 60% losses in yield. There is increased sensitivity for reducing weed populations and increasing yields with improved cultural practices and introducing new rotations of the Wheat-Medicago type. The major concentration of effort for improvement is presently in the areas with more than 350 mm annual rainfall.

Durum wheat represents half of the total cultivated cereal area and consumer demands will maintain its importance in Algeria. Required yield increases demand replacement of disease susceptible and lower yielding local varieties; however, their seed quality and adaptation should be maintained. No introduced durum varieties to date have adapted to the required vegetative cycle in the major cereal area on the high plateau with late frosts and early Siroccos.

An accelerated durum improvement program was initiated to develop genetic potential for high yield, disease resistance, seed quality, plant height, heading date and adaptation. The classical method of hybridization was chosen for improvement and the Mexican and Italian durums serve as our basic germplasm. Many crosses were made with the local varieties and are being further top-crossed and doublecrossed to combine certain desired characters and increase genetic diversity. We strongly feel that this approach will result in meeting our objectives for future durum wheat varieties and increasing annual production.

Original: French

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AMELIORATION DU BLE DUR EN TUNISIE

A.R. Maamouri

I. Généralités

La culture du blé dur en Tunisie occupe près de 65% des emblavures en céréales dans le Nord soit 550,000 Hectares environ et 45% dans le Centre et le Sud soit 250,000 Hectares.

Cependant si dans le Nord, les superficies varient très peu, les variations sont très grandes dans le Centre et le Sud et sont essentiellement fonction des conditions climatiques.

Au cours de la période 1971-74 la production a été de 5,200,000 Qx en moyenne. Le niveau de production est étroitement lié aux conditions pluviométriques de l'année.

Néanmoins on note, au cours des dernières années, une nette tendance à l'augmentation due à l'amélioration des techniques culturales (emploi de variétés productives, utilisation croissante d'engrais azotés ....).

Cette production suffit actuellement aux besoins locaux, les années à bonne production une certaine quantité est disponible pour les exportations.

En Tunisie le blé dur est surtout consommé sous formes de produits dérivés de la semoule: le couscous et les pâtes alimentaires (80%). Sa consommation sous forme de pain très importante avant l'introduction du blé tendre au début de ce siècle - a énormément baissé aujourd'hui.

Enfin de faibles quantités sont utilisées en pâtisserie traditionnelle et pour la fabrication du bourghoul.

II. Historique de l'amélioration du blé dur

C'est en 1906 que l'amélioration du blé dur a commencé en Tunisie, les premiers travaux ont été consacrés à l'étude des populations locales très riches en formes diverses. De nombreuses lignées pures y ont été isolées en

s'attachant particulièrement à la recherche de bonnes aptitudes culturales. Certaines d'entre elles ont pris une grande extension en grande culture en particulier le Biskri AC2, le Mahmoudi AP4, le Sbeï 292, le Hamira AC5, le Mahmoudi 981 et le Roussia. Ces variétés se caractérisaient essentiellement par leur tardivité.

Parallèlement à ces travaux de sélection et du fait que le plafond des possibilités de cette méthode fut vite atteint, de très nombreuses variétés étrangères ont été introduites. Certaines sont passées en grande culture et avaient pris une grande extension, citons en particulier le Mahmoudi 552 originaire de Tel Aviv en Palestine et le Chili du nom de soy pays d'origine présumé. Cependant cette dernière variété plus résistante à la verse et au Charbon que le Mahmoudi 552 lui est identique à tous les autres points de vue. Il est à noter que malgré le volume des introductions, très peu de variétés se sont révèlées supérieures aux types locaux.

Les hybridations ont commencé en 1926 et pendant longtemps les croisements ont été réalisés entre un blé tunisien et une variété étrangère dont on attendait des qualités nouvelles.

Trois de ces croisements ont donné naissance à des variétés qui ont occupé une place notable en grande culture: le Syndiouk x Mahmoudi, demi précoce et productive, le D77 (Mahmoudi x Kokkini) demi précoce et rustique et D117 (Mahmoudi x Mrari) variété productive.

En fait on n'aboutit qu'à des résultats incomplets malgré les moyens mis en oeuvre: nombre d'hybridations élévé, étude d'un nombre considérable de lignées issues de ces hybridations. Tout au plus a-t-on gagné légèrement sur la précocité et la résistance à la rouille.

L'échec relatif peut être expliqué par la manque de diversité de cette espèce et par le fait que jusqu'à une date très récente, très peu de pays se sont penchés sur son amélioration.

Beaucoup plus tard - à partir de 1953 l'introduction de nombreuses variétés étrangères dotées de qualités intéressantes et le recours de plus en plus grand à des croisements complexes réalisés entre hybrides permirent l'amélioration du blé dur en Tunisie des progrès notables. L'utilisation de ce matériel étranger a permis la fixation sur les variétés tunisiennes de certains gênes de résistance à la rouille noire, de coloration des semoules, d'autres croisements ont permis de fixer les caractères de type printemps ou de rapidité de développement. Cependant la résistance à la verse faisait encore défaut faute de géniteurs valables. Ce travail a abouti à deux variétés intéressantes: INRAT 69 (Kyperounda x Mahmoudi 981 - lignée D 58-25) variété très productive, demi précoce et moyennement sensible à toutes les maladies en général et la variété BADRI (Zenati - Bouteille x Mahmoudi - Mrari - lignée D 56-3) très précoce et assez productive.

Depuis une dizaine d'années, nous assistons à une intensification des travaux sur l'amélioration du blé dur dans certains pays étrangers principalement aux Etats Unis, au Mexique et en Italie. Notre collection s'est trouvée de ce fait enrichie de très nombreuses variétés portant des gênes intéressants qui jusqu'alors nous faisaient défaut: excellente productivité, très bonne résistance à la verse, résistance à certaines maladis ...

Cependant bien que plusieurs d'entre elles se soient montrées très productives, elles ont manifesté cependant certains défauts qui leur interdisent une grande extension en grande culture: type de developpement limitant leur culture à certains micro-climats seulement, sensibilité à certaines maladies...

Nos travaux visent donce aujourd'hui à combiner tous les caractères favorables dont nous disposons sur des variétés adaptées aux conditions locales.

III. Variétés actuelles - Problèmes de production

Toutes les variétés actuellement cultivées en Tunisie sont des obtentions du laboratoire d'amélioration des céréales de l'Institut National de la Recherche Agronomique de Tunisie.

Certaines sont très anciennes, les variétés Chili et Mahmoudi 981 couvrent encore aujourd'hui près de 45% des superficies emblavées en blé dur dans le Nord du pays, elles sont surtout localisées dans les régions du Nord et du Nord - Ouest. Elles sont trop tardives et ont un feuillage trop abondant ce qui s'explique par leur type de développement assez hiver. A cause de caractère ces blés sont très exposés à l'échaudage et se prêtent mal à l'application des engrais azotés et ceci constitue un sérieux obstacle à l'amélioration des rendements.

Les variétés D 77 (Mahmoudi x Kokkini) et Syndiouk x Mahmoudi sont localisées dans la zone appelée intermédiaire, elles y couvrent environ 20% des superficies de blé dur. Quoique bien adaptées à ces zones à pluviomètrie faible et irrégulière, elles sont trop sensibles à la verse.

Enfin la variété Roussia, très tardive est localisée surtout dans les bas fonds humides de la plaine de Mateur.

Depuis 1971 les deux nouvelles variétés INRAT 69 (Kyperounda x Mahmoudi) et Badri (Zenati - Bouteille x Mahmoudi - Mrari) nettement plus productives que les anciennes variétés prennent régulièrement de l'entension, elles occupent actuellement près de 35% des superficies de blé dur au Nord.

Malheureusement si du point de vue variétal de gros progrès ont été réalisés, la production ne suit pas au rythme souhaité.

En effet d'autres facteurs limitent cette production. Mentionnons-les par ordre d'importance décroissante:

- Envahissement des terres par les mauvaises herbes et notamment par les graminées (Folle avoine, Ray grass)

- Mauvaise préparation du sol

- Emploi non-rationnel des variétés

- Utilisation encore faible des engrais azotés

- Facteurs climatiques

Problèmes de l'amélioration du blé dur en Tunisie

L'amélioration du blé dur en Tunisie poursuit les objectifs que l'on peut regrouper sous deux titres différents.

- Obtention de rendements élevés et réguliers

- Amélioration de la valeur technologique

A. Rendement

- Type de développement

En Tunisie l'obtention de rendements élevés et réguliers dépend avant tout des conditions climatiques qui sont extrêmement variables non seulement d'une année à l'autre mais aussi d'une région à une autre. Cependant l'un des facteurs dominants du climat est le risque de sécheresse au printemps et à partir du mois de Mai les possibilités de coups de sirocco.

Nous nous efforçons donc de régulariser le rendement par une meilleure adaptation du type de développement aux différentes conditions du milieu. Nous pensons qu'il est intéressant d'obtenir des types demi-hiver précoces pour les régions froides en hiver et des variétés du type printemps précoce comme Florence-Aurore. La date d'épiaision a en particulier une grande importance et c'est le point aquel jusqu'à présent on a attaché le plu d'importance.

En effet si la sécheresse au printemps et les coups de sirocco sont toujours à craindre une épiaison trop précoce n'est pas souhaitable car le froid et les gelées tardives sont presque toujours fréquentes jusqu'à fin Mars début Avril.

D'autre part certaines des variétés actuellement cultivées (Mahmoudi 981, Mahmoudi x Kokkini) et certaines lignées en essais montrent une certaine résistance à la sécheresse indépendamment de leur précocité d'épiaison. On a pu constater, dans nos pépinières a Béjà au cours de la campagne écoulée caractérisée par un déficit pluviométrique important, que les croisements effectués avec ces variétés présentaient une résistance à l'échaudage supérieure aux autres.

En attendant de pouvoir entamer des études physiologiques sur la nature et l'importance des facteurs de résistance à la sécheresse l'utilisation des parents locaux occupe une place assez importante dans nos programmes de croisements.

En ce qui concerne le type de développement, le programme de croisements en cours est basé essentiellement sur quelques lignées issues de croisements réalisés à Tunis en 1968. Il s'agit de

D 68 - 5 = [(53 AB-5 x Kyp - Kamb) BD 1705][BD 1708 x BD 1419]

D 68 - 1 = [(552-LD 341) (552-BB-552) BD 1708] BD 1750

D 68 - 8 = [BD 1419xBD 1708] [BD 1705 (53 AB-5 x Kyp-Kamb)]

La plupart de ces lignées se sont montrées, en moyenne, plus productives que la variété INRAT 69 utilisé comme témoin. En outre elles possèdent une bonne qualité, une bonne résistance aux maladies en général, les lignées issues de D 68-8 présentent une bonne résistance à la sécheresse.

Cependant toutes ces lignées sont assez tardives et risquent d'échauder en cas de printemps sec.

- Résistance aux maladies

La rouille noire, la septoriose (Septoria tritici), la rouille brune, la rouille jaune, l'oïdium, les piétins, le charbon et la carie sont les principales maladies qui s'attaquent au blé en Tunisie.

Le charbon et la carie bien que pouvant être efficacement combattus a l'aide de traitements de semences avec des fongicides appropriés, provoquent encore actuellement les pertes les plus importantes.

Les autres maladies ne se développent pas régulièrement chaque année et sont nettement influencées par les facteurs ambiants. Jusqu'à présent on peut dire qu'elles ne constituent pas un facteur limitant de la production.

Cependant l'évolution des techniques de culture et en particulier l'utilisation de plus en plus grande d'engrais azotés, la possibilité d'apparition

de nouvelles races plus virulentes .... font que ces maladies peuvent évoluer et causer des dégâts plus importants aux cultures de blé.

Nous avons remarqué déjà que certaines maladies (septoriose, piétins) considérées il y a quelques années comme secondaires commencent à être plus fréquentes dans certaines zones actuellement.

Pour protéger la culture du blé contre cette éventuelle évolution des maladies nous poursuivons sans relâche notre effort de sélection de variétés résistantes en utilisant dans la mesure du possible différentes sources de résistance. Pour cela la collaboration avec des organismes étrangers, le recours aux pépinières internationales ou régionales nous paraissent indispensables.

Cependant les maladies étant influencées par les facteurs ambiants, elles ne se déclarent pas régulièrement dans nos pépinières et la réalisation de contamination artificielle n'a pas souvent donné les résultats escomptés, ce qui complique encore plus notre travail.

Du point de vue méthode de travail, nous disposons actuellement de géniteurs de sources diverses portant des gênes de résistance aux rouilles noire, brune et jaune, à l'oïdium et à la Septoriose, accumuler un à un ces caractères de résistance risquerait de necessiter un travail très long, nous préferons donc lorsque c'est possible utiliser des géniteurs portant plusieurs gênes de résistance combinés à une fertilité suffisante.

Quant à la résistance aux piétins et à la fusariose on ne connait que peu de choses actuellement sur ces maladies dont l'étude est en cours en Tunisie.

Les principaux géniteurs utilisés au cours de ces dernières années figurent sur le tableau 1.

- Résistance à la verse

Parmi les variétés de blé dur cultivées actuellement en Tunisie INRAT 69 et Badri présentent de point de vue résistance à la verse de gros progrès par rapport aux anciennes variétés.

En outre la création de nouvelles variétés résistantes ne se heurte plus à aucun obstacle étant donné que nous disposons d'un grand nombre de géniteurs à paille courte (en particulier les variétés mexicaines et les variétés américaines du Nord Dakota).

Cependant une paille trop courte expose la variété à la concurrence des mauvaises herbes. Nous nous orientons donc de plus vers la recherche de variétés à paille moyenne mais solide.

B. Amélioration de la valeur technologique

Près de 80% de la production du blé dur sont consommés sous formes de produits dérivés de la semoule: couscous et pâtes alimentaires; les qualités exigées par les industriels son: un bon rendement semoulier, gluten à bonnes proprietés plastiques et secondairement une bonne coloration, ce sont ces qualités que nous cherchons à améliorer.

- Rendement semoulier

Les éléments principaux de ce caractère sont: l'épaisseur et la couleur du son, l'échaudage et le mitadinage.

Nous nous reviendrons pas sur l'échaudage qui ne réduit le rendement semoulier que s'il est très accentué.

L'épaisseur du son n'a pas non plus une très grosse influence sur le rendement semoulier. La coloration du son, par contre, est plus importante, un son clair permet d'augmenter le taux d'extraction parce que les fragments d'enveloppe qui passent avec les semoules se remarquent moins.

Plus grave est le mitadinage qui réduit le rendement semoulier et se trouve encore plus lourdement pénalisé au niveau commercial. En bonnes conditions de culture et avec des apports d'engrais azotés cet accident est moins à craindre pour les variétés moyennement sensibles.

Cependant une attention particulière doit être portée quant au choix des géniteurs dans les programmes de croisement étant donné la difficulté d'éprouver la résistance des hybrides à un stade précoce.

- Propriétés plastiques du gluten

Nos moyens actuels ne nous permettent d'exercer le contrôle des lignées obtenues qu'à un stade tardif de la sélection. Nous utilisons le test direct consistant en la fabrication de pâtes alimentaires à partir d'échantillons de 1500 grammes de blé, sur ces pâtes différentes mesures sont effectuées.

Cependant il est utile d'effectuer des tests précoces, nous espérons acquérir très prochainement l'appareillage nécessaires utilisé du reste dans certains pays.

Remarquons qu'en ce qui concerne les caractéristiques technologiques des semoules servant à la fabrication du couscous, nous ne possèdons pas de bien définies. Nous utilisons les mêmes que pour la fabrication des pâtes alimentaires.

Enfin signalons que les anciens blés tunisiens étaient presque tous bons semouliers. Et ceci est à rapprocher du mode de consommation du blé dur en Tunisie, le couscous. C'est là une raison de plus pour utiliser les variétés locales comme base de tout programme d'amélioration.

- Coloration des pâtes

Ce caractère intéresse les industriels car les pâtes couleur jaune d'oeuf sont plus attrayantes pour les acheteurs; cependant en Tunisie, cette propriété n'est pas sanctionnée par une différence de prix d'achat du blé. On s'y intéresse dans la mesure où la Tunisie aurait des excèdents exportables.

Nous tenons compte de ce facteur dans le choix de nos géniteurs dans la mesure où ces derniers sont porteurs d'autres gênes intéressants. Des géniteurs de ce type existent actuellement dans nos collection et certaines lignées qui en sont issues donnent des pâtes de couleur jaune très agréable.

En conclusion nous pouvons dire que nos travaux sur le blé dur sont en bonne voie en ce qui concerne la création de variétés plus productives et plus résistantes aux maladies.

Deux nouvelles variétés ont été inscrites au cours de cette année: Amal 72 et Maghrebi 72 issues respectivement des croisements: (BellE - Tc2) (ZB-W) x (TME-Tc2) (ZB-W), (TME-Tc2) (ZB-W) x (Br 180-LAK) (GZ x 61.130) réalisés au Mexique et dont la sélection s'est poursuivie à Tunis.

Elles sont très précoces et productives (116%, 120% d'INRAT 69 en moyenne au cours des années 1971-72, 72-73 et 73-74). Cependant leur paille trop courte nous amène à ne les recommander que là où le problème des mauvaises herbes ne se pose pas.

DISCUSSION

COMMENTAIRE: Je voudrais ajuster quelque rensiegniment concernant les deux programmes en l'Algere et la Tunisée. En effet nous avons un collaboration très proche entre les deux programmes d'amélioration. Nous avons chaque année un échange des lignées provenant de les generations F_3 et au même temps nous discutons nos programmes respectifs, ainsi nous nous profitons de potential genetique existant en les deux pays.

Quelques géniteurs de résistance au maladies utilisées en Tunisie

Rouille noire

BD 1685 = Syndiouk - Mahmoudi x LD 341

LD 341

BD 1419 = LD 393

BD 1564 = Nugget x LD 371 - LD 408

BD 1565 = LD 390

BD 2026 = DM x 69-200 - 1A - 1A - 0A

D 68-1-62A-2A = [(BD 552-LD 341) (BD 552-BB-552) BD 1708] BD 1750

D 68-8-6A-1A = [BD 1419xBD 1708] [BD 1705 (53AB-5xKyp-Kamb)]

D 68-1-19A-7A = [BD 552-LD 341)(BD 552-BB-552) BD 1708] BD 1750

D 68-1-17A-4A = " " "

D 68-5-18A-5A = [(53AB-5xKyp-Kamb) BD 1705]/[BD 1708xBD 1419]

Rouille brune

BD 1407 = 53AB-5 x Kyperunda - Kamborico

BD 2002 = Jo"s" - Cr"s" - D 27591 - 53M-3y - 2M - 1y - OM

BD 2022 = DM x 69-200 - 1A - 41A - 0A

BD 2043 = (53AB-5xKyp-Kamb) BD 1751 - D67-54-4A-9A-0A

BD 2032 = DM x 69-190 - 1A-2A-0A

BD 2051 = (53AB-5xKyp-Kamb) BD 1705-D 67-19-10A-3A-0A

D 68-4-21A-8A =[BD 1419xBD 1708]/[(53AB-5 x Kyp-Kamb) BD 1705]

3) Rouille jaune

BD 1407 = 53AB-5xKyperunda - Kamborico

BD 1548 = Kyperunda - Yrallourico

D 117 = Mahmoudi x Mrari

BD 1716 = Du Roussia

BD 2002 = Jo"s" - Cr"s" - D 27591 - 53M - 3y - 2M - 1y - 0M

BD 2009 = Jo"s" - Cr"s" - D 27591 - 5M - 2y - 2M - 0y

D 68-5-18A-1A = [(53AB-5xKyp-Kamb) BD 1705] [BD 1708 x BD 1419]

4) Oidium

BD 1564 = Nugget x LD 371 - LD 408

BD 1565 = LD 390

Yuma

INRAT 69 = Kyperunda x Mahmoudi 981

Certains blés italiens

5) Septoriose

Yuma

BD 1548 = Kyperunda x Yrallourico

Roussia

Lobeïro

Senatore Cappelli

Capeïti

D 67-2 = [(BB-Mah 981) (Kenya 338 - EC)] BD 1419

BD 1407 = 53AB-5 x Kyperunda - Kamborico

BD 1565 x INRAT 69

quelques dicoccum

Quelques croisements interessants recoltés au cours

de la campagne 1973-74

D72-1 = Amal 72 - BD 1419 x BD 1708)

D 72-3 = Amal 72 (INRAT 69 x BD 1705

D 72-7 = Brant "s" (INRAT 69 x BD 1705)

D 72-21 = AA "s" (BD 1419 x BD 1708)

D 72-47 = DM x 69-200-1A-1A (INRAT 69 x BD 1705)

D 72-50 = DM x 69-200-1A-40A (53AB-5xKyp-Kamb) BD 1751

D 72-51 = ". " (INRAT 69 x BD 1705)

D 72-71 = (BD 981xKyp) (981-BB-981) (53AB-5xKyp-Kamb) BD 1751

D72-100 = INRAT 69 (Synd-Mahm x LD 341)/ INRAT 69 x BD 1705

D72-103 =

D72-105 = (BD 981-Kyp) (BD 981-BB-981)

D72-110 = (AA "s" /LD 357E-Tc2 x G11 "s") Badri

D 71-90 = BD 1279 x BD 1419 - BD 1708

D 71-222 = P 66/207 x CIT "s"

D 71-223 = (BB-Mahm 981) (Kenya 338-EC) BD 1419 x Jori-Cr "s"

D 71-235 = (BD 1419-BD 1708) (LD 393-BellE-Tc2) CIT 71

D 71-241 = (BB-Mah 981) (Kenya 338-EC) BD 1419 x Gs "s"

D 71-285 = (Synd x Mahm x LD 341) x Pinguino "s"

D 71-490 = (BB-Mahm 981) (Kenya 338-EC) BD 1419 Fg "s"

D 71-549 = Leeds mutant x Gaviota "s"

DURUM WHEAT IN TUNISIA

A.R. Maamouri

SUMMARY:

The durum wheat crop covers 550,000 hectares (65% of the cereal growing area) in the North, and 250,000 hectares (45%) in the Center and South of Tunisia. Unlike the Northern area, the Central and Southern areas vary enormously and are essentially a function of the climatic conditions.

The average durum wheat production is 5,200,000 qls for the period 1971-1974 which gives an average yield of 6.5 qls per hectare. In the North, where the climatic conditions are more favorable, the average yield varies between 8 and 10 qls/ha.

Durum wheat is used mainly in the form of products derived from semolina: couscous and pastas (80%); the remaining is used for bread-making in rural areas, for burghul and for traditional pastry.

All the varieties which are presently in cultivation have been developed by the National Agricultural Research Institute of Tunisia (INRAT). Some of these varieties are very old and are still used on almost 65% of the Northen durum wheat area; they are Mahmoudi 981, Chili, Mahmoudi x Kokkini, Syndiouk x Mahmoudi and Roussia. Two new varieties, INRAT 69 and Badri, were registered five years ago and are more productive by far. They presently cover about 35% of the total durum wheat area and they will predominate in the near future.

Despite the varietal progress achieved and the net tendency for increase in production, the yields remain low and are not increasing at the desired rate. The variety is in fact only one of many production factors; weeds in particular, soil preparation, and the still limited use of nitrogen are the limiting factors in durum wheat production at the present time.

Durum improvement commenced in Tunisia in 1906 and has been greatly intensified during recent years through close collaboration with some foreign programs, the better working means and particularly the new qualified Tunisian staff.

Our objective is the attainment of high and stable yields coupled with suitable quality for couscous and pastas.

We are trying to stabilize our yield at a high level by:

Good adaptation of our varieties to local climatic conditions. Two types of development seem to be suitable: early semi-winter type for regions with cold winters and early spring type for the other regions. Apart from earliness we are also looking for drought tolerance.

Satisfactory resistance to the main wheat diseases in Tunisia (stem rust, Septoria, leaf rust, stripe rust, powdery mildew and foot-rots). These diseases do not appear regularly every year and damage caused has not been too high so far. Nevertheless, with the crop intensification these problems have to be considered while developing new varieties.

Good resistance to lodging. We are presently looking for varieties of medium height which are less sensitive to weed competition than dwarf varieties.

From the quality point of view, we are trying to obtain the following desirable characteristics: good semolina yield, tenacious gluten and, when possible, good semolina and pasta coloration.

We have several parents carrying the different desired characteristics and we pursue the parent building for these characters. Interesting results have been obtained which permit us to be hopeful of achieving good progress in durum wheat improvement in Tunisia.

DISCUSSION

COMMENT: I would like to add some information concerning the 2 programs of Algeria and Tunisia. In effect we have a close collaboration between both breeding programs. We exchange F_3 material every year and we discuss our crossing programs, in order to take advantage of the potential existing in both countries.

DURUM WHEAT SITUATION IN TURKEY

P. Sölen, A. E. Firat, C. Dutlu, and E. Alkus

Turkey grows approximately 8.6 million hectares of wheat with an average annual production of 10.5 million tons. Recent estimates indicate that 25% of this hectarage is devoted to durums, i.e. 2.2 million hectares. Durum wheat is grown throughout Turkey and the total area is distributed in approximately the following manner: 20% in the coastal or spring durum areas, 50% in the Central Plateau and winter durum areas, and 25% in the Southeast which is a facultative or spring durum region.

In Turkey in the last few years there has been a shift from growing durum to bread wheat and the introduction of high yielding bread wheat has been largely responsible for this shift. In the coastal areas Penjamo 62 and Lerma Rojo 64 have replaced most of the native durums grown in the valleys but native durums are still being grown on the hilly and more marginal lands. In Thrace, Bezostaya currently occupies approximately 80% of the total wheat area, whereas five years ago the region was 60% durum. In the Southeast the situation is much the same. Eight years ago the region grew probably 70-80% durum wheat but now Penjamo 62, Bezostaya, and other improved varieties are grown on most of the area and durums occupy only 30-35% of the total area. In the Central Plateau and winter wheat region the shift is not as dramatic but Bezostaya and other improved varieties have displaced some durum wheat acreage.

Durum wheat is widely used in bread and is also popularly eaten in many areas as bulgur, a cracked durum product similar to couscous. The production and consumption of semolina products is also increasing. Although many farmers have shifted from growing durum wheats to bread wheats, their consumptive habits have not had a corresponding change. Since consumption and consumer demand are increasing for durum wheat while supply is decreasing, a premium is currently being paid for durums in most sections of Turkey. To reverse this situation and increase durum wheat production, new high yielding durum varieties are urgently needed for the various regions in Turkey.

In the coastal regions, the main breeding problems are associated with disease resistance, i.e. stripe rust, stem rust, and Septoria. Leaf rust and mildew resistance are also desirable characteristics in certain regions.

The coastal regions are characterized by high rainfall (500 - 800 mm) falling mainly in the wheat growing season which is November to June. The winters are mild and the summers are hot and quite dry. Improved spring wheat varieties occupy approximately 60% of the coastal regions and Penjamo 62 is grown on about 90% of this area.

The spring durum breeding program is centered in Izmir and selection and testing are also conducted at Adana, Adapazari, Istanbul, and Samsun. This program has screened thousands of lines from CIMMYT and other countries. Generally the Mexican durums are high yielding and well adapted but lack resistance to one or more of the major diseases. Lines with resistance to one or more of the prevalent diseases have been isolated but generally these lines lack yield potential or adaptation. An extensive crossing program utilizing the native durums and the best introductions is currently trying to combine broad base resistance to the major diseases with wide adaptation and high yield potential.

After six years of intensive selection and testing, the first durum variety for this region will be ready for release in the 1975-76 season. The line, $LD357_E$ - Tc^2 x AL"S" 27534-1M-1Y-1M-0Y, is tentatively being named Gediz I. It is moderately resistant to stripe rust and moderately susceptible to stem rust and Septoria. In two years of extensive trials it is approximately equal to Penjamo 62 in yield potential but is 80-100% higher in yield potential than the local durums. Its straw strength is good and its quality characteristics are acceptable. It is anticipated that Gediz I and another variety currently being released in the Southeast will soon occupy a sizeable portion of the durum area in the coastal region. Other promising lines are listed in Table 1.

The Southeastern region is characterized by moderately cold winters and hot, dry summers. The rainfall varies from 300 to 550 mm and falls from November to May. Both spring and winter wheat types can be grown in this area but currently spring types predominate. Average yields in this area are quite low and fluctuate widely from year to year. The farming practices in this region are still predominately traditional. Improved agronomic practices such as efficient weed control, better moisture conservation and seedbed preparation, and more efficient fertilizer use would significantly increase yields.

Since this region was once 75% durum and since there is a definite farmer preference for durum wheats, the breeding program for this region located in Diyarbakir has concentrated on the improvement of durum wheats. The main breeding objectives are earliness of maturity and adaptation to the hot, dry conditions characteristic of this region. Rust diseases seldom cause appreciable yield losses.

In 1974-75, Cocorit 71 was recommended for release in this region under the name of Dicle I. In three years of extensive tests, Dicle I has consistently outyielded the local durums of this region by 30-50% and is also 10-15% superior to the best bread wheat, Penjamo 62. It has consistently outyielded the best winter wheat variety, Bezostaya, by 25-30%. Dicle I is also being

recommended for release in the coastal areas where it has proved to be slightly superior to Gediz I in yield potential. However, Gediz I is somewhat superior in disease resistance and will be pushed where disease could become serious. Another fault of Dicle I is its tendency to yellow berry but this is not considered serious since it will be used primarily in making bread and bulgur. Current indications are that Dicle I will be readily adopted by the farmers of the Southeast and may soon replace a sizeable area currently being devoted to bread wheats.

Other promising lines for the Southeastern region are listed in Table 1. The two Dicle sibs designated as Dicle III and Dicle IV are very promising and are currently being considered for release. They are both similar to Dicle I in agronomic type but Dicle III has been consistently higher yielding and Dicle IV has equal yield potential but larger kernels and less yellow berry than Dicle I.

On the Central Plateau and in the Transitional Zones the winters are cold and the summers are warm. The average rainfall is 350-450 mm and is received from October to early June. The climate of this region is characterized by large fluctuations from year to year and from region to region. The farming in the region is still quite traditional but mechanization is increasing. The principal increase in yield in this region will be attained through improved agronomic practices such as better weed control, fertilizer usage, and more efficient water conservation. New varieties are also needed which will be better adapted to the highly variable conditions encountered in this region.

The durum varieties currently grown in this region are tall, weak strawed types with low yield potential and they are generally susceptible to all of the major diseases. Since the winters are long and cold, winter wheats with good levels of winterhardiness predominate. Unfortunately, most of the native durum varieties are facultative (semi-winter) types with moderate to low levels of winterhardiness, which occasionally results in winterkill or reduced winter survival.

The two breeding programs for this region are located at Ankara and Eskisehir. These breeding programs are making extensive use of the spring x winter x winter concept in their effort to isolate types with better yield potential, disease and cold resistance, and drought tolerance. In these breeding programs a spring durum (generally a Mexican durum) usually serves as the source of high yield potential. Durums from Turkey, Russia and Eastern Europe serve as the winter parent but unfortunately none of these durums have high levels of winterhardiness. True winter hardy durum parents would facilitate the recovery of types with good cold resistance. The winter parents are effective sources of drought resistance or tolerance and generally are sources of resistance to one or more of the prevalent diseases.

Six lines have recently been submitted to the National Testing Organization for final evaluation and these are listed in Table 1. The two BY_E^2-Tc

lines have good yield potential but lack winterhardiness. The other lines have displayed superior yield potential in preliminary tests and have reasonable cold resistance.

In summary, the current demand for durum wheat in Turkey is high and supply is not meeting demand. To reverse this situation, an aggressive extension program is needed to demonstrate improved tillage and agronomic practices to the millions of wheat farmers in Turkey. If this extension effort could be coupled with an aggressive wheat research effort, the main problems could be overcome within a short period of time.

DISCUSSION

Question: The list of promising wheat varieties presented in your paper include some varieties with high rust and Septoria records. Are these promising for yield only, regardless of resistance? and what degree of resistance do you require for recommending and releasing a variety?

Answer: First, the reason for these high readings was having a very high artificial epidemic. These promising lines were selected mainly for yield. Even with high disease readings they yielded 80-100% over standards or local checks. This does not mean that in our selection we ignore disease resistance. These promising lines are the first in a coming program. In Table 1 you will note that some of the Gediz I sisters are better than others in disease resistance.

Table 1. Lines used in the Turkish breeding program.

Promising Lines from the Coastal Area of Turkey

Cross and Pedigree	Disease Reaction		
	P.s.	P.g.t.	Septoria
LD357E - Tc^2 x AL 'S' = Gediz I 27534 - 1M - 1Y - 1M - 0Y	10S	10MS	8
LD357E - Tc^2 x AL'S' = Gediz I'S' 27534 - 13M - 4Y - 1M - 0Y	5S	90S	5
LD357E - Tc^2 x AL 'S' = Gediz I 'S' 27534 - 3M - 1Y - 2M - 0Y	10S	90S	8
LD357E - Tc^2 x AL 'S' = Gediz I 'S' 27534 - 14M - 1Y - 8M - 0Y	20S	10MR	8
LD357E - Tc^2 x AL 'S' = Gediz I 'S' 27534 - 14M - 1Y - 4M - 1S - 0S	10S	60S	8
61-130-Lds x G11 'S' / AA 'S' CM498 - 1S - 0S	60S	20MS	7
Jo 'S' - Cr 'S' 27591 - 5M - 3Y - 1M - 0Y	0	80S	8
Cr 'S' - Gs 'S' CM224 - 49M - 1Y - 1M - 0Y	20S	60S	8
Cocorit 'S' 27617 - 18M - 3Y - 0M	60S	30MS	8
Pinguino 'S' 28984 - 52Y - 2M - 500Y - 0M	0	20MS	4
Pinguino 'S' 28984 - 62Y - 2M - 1S - 2S - 0S	0	20MS	6
USA IVA - Ci 'S' CM9628 - 2S - 0S	10S	15S	8
Plc 'S' - Jo 'S' 31769 - 4M - 2S - 0S	10MS	70S	8
21564-AA 'S' (D. Buck x D# 2E - Tc^2 / Lak) 28951 - 3Y - 3M - 4Y - 0M	15S	10MR	8
Anhinga 'S' 22234 - 52M - 3Y - 1M - 0Y	80S	15MS	8

Promising Lines from the Coastal Area of Turkey (Cont'd.)

Cross and Pedigree	Disease Reaction		
	P.s.	P.g.t.	Septoria
Gaviota 'S' 31725 - 3M - 8Y - 1M - 0Y	0	20MR	8
AA 'S' - Cr 'S' x Ci 'S' CM10187 - 15S - 0S	20S	40MS	6
Flamingo 'S' 27582 - 8M - 13Y - 1M - 0Y	15MS	5MS	4
Akpusana (Local check)	25S	30S	4

P.s. = Stripe rust P.g.t. = Stem rust

Promising Lines in the Southeastern Region of Turkey

Variety or cross	Pedigree
Cocorit 71 = Dicle I	
Dicle I "S" = (Dicle II)	27617 - 18M - 6Y - 1M - 0D
Dicle I "S" = (Dicle III)	27617 - 18M - 6Y - 2M - 0D
Dicle I "S" = (Dicle IV)	27617 - 9M - 5Y - 5M - 0Y
BY_E^2 - Tc x TAC_E - Tc^4	29595 - 2M - 1Y - 1M - 0Y
Gediz I and Sister Lines	
Few Flamingo, Stork, and Rabicorno Sibs	

Promising Lines in the Central Plateau of Turkey

Variety or Cross	Pedigree
BY_E^2 - Tc	22252 - 15A - 2A - 8A - 0A
BY_E^2 - Tc	22252 - 15A - 1A - 14A - 0A
61-130-414/44	1A - 24A - 0A
Uveyik 162-61-130	16A - 1A - 0A
Uveyik 162-61-130	17A - 3A - 0A
Uveyik 162-61-130	39A - 1A - 0A
377/2	
1229/1	
13-Hamari	

SITUATION DU BLE DUR EN TURQUIE

P. Sölen, A.E. Firat, C. Dutlu et E. Alkus

RESUME:

En Turquie, la production annuelle de blé est de 10.5 millions de tonnes pour une surface cultivée de 8.6 millions d'hectares. De récentes évaluations ont indiqué qu'environ 25% de cette superficie était consacrée au blé dur, à savoir 2.2 millions d'hectares. Les zones cultivées en blé dur en Turquie sont réparties approximativement de la façon suivante: 20% dans les régions côtières (régions du blé dur de printemps), 55% sur les plateaux du centre (régions à blé dur d'hiver) et 25% dans la région du Sud-Est (région de blé dur de printemps ou de blé demi-hiver).

Au cours des dernières années, il y a eu une tendance à remplacer la production de blé dur par celle de blé tendre. L'introduction de variétés à haut rendement telles que le Penjamo 62, le Lerma Rojo 64 et le Bezostaya a largement contribué à ce changement. Pour contrecarrer cette tendance et augmenter la production de blé dur, on a absolument besoin de nouvelles variétés de blé dur à haut rendement pour les diverses régions de la Turquie.

Dans les régions côtières, les problèmes majeurs concernant la création de nouvelles variétés sont dus à la résistance aux maladies telles que la rouille jaune, la rouille noire et la Septoriose. Un programme intensif de création de nouvelles variétés est en cours depuis cinq ans à Izmir et an 1975-76 on sera en mesure de mettre sur le marché une nouvelle variété de blé dur; le Gediz I - LD357^{2}xAL"S". Cette lignée représente une résistance modérée à la rouille jaune et est modérément prédisposée à la rouille noire et à la Septoriose; elle équivaut à Penjamo 62 en ce qui concerne le potentiel de rendement, mais possède un potentiel de rendement supérieur de 80 à 100% à celui des variétés locales de blé dur. Plusieurs autres lignées sont tout-à-fait prometteuses et devraient être commercialisées dans les deux ou trois prochaines années.

Dans le Sud-Est, les principaux objectifs du programme de création de nouvelles variétés sont de trouver des variétés qui mûrissent tôt et qui peuvent s'adapter aux conditions climatiques de la région, à savoir, la sécheresse et la chaleur. Dans cette région, la rouille ne présente pas de problèmes sérieux. En 1973-74, la station d'expérimentation située à Diyarbakir, a commercialisé une variété, le Dicle I, équivalant au Cocorit 71.

Cette variété a constamment donné un rendement supérieur de 30 à 50% comparativement aux variétés locales de blé dur dans cette région et a même dépassé de 10 à 15% les rendements d'une des meilleures variétés de blé tendre, le Penjamo 62. Bien que le potentiel de rendement de Dicle I soit excellent la qualité de la graine ne l'est pas; elle présente une tendance à metadinage. A cause de cet inconvénient, on s'efforce de trouver de meilleures variétés et plusieurs lignées semblent extrêmement prometteuses, par exemple deux soeurs de Cocorit que l'on désigne sous le nom de Dicle III et Dicle IV. On pense que ces variétés et d'autres nouvelles variétés remplaceront bientôt les variétés locales de blé dur actuellement utilisées.

Sur le plateau Central, on sème des variétés de blé dur à tiges longues, et à paille faible qui donnent un faible rendement et sont prédisposées à toutes les maladies. La majorité de ces variétés sont des types demi-hiver peu résistantes au froid. Un important programme d'amélioration a été mis en place dans les stations d'expérimentation d'Ankara et Eskisehir où l'on essaie d'isoler des variétés à haut rendement, plus résistantes aux maladies et au froid. Pour cette région, il faut également tenir compte des facteurs suivants: résistance et tolérance à la sécheresse, ou une meilleure utilisation de l'eau. Etant donné la variabilité des caractéristiques agro-climatiques du Plateau Central, la tolérance à la sécheresse et une grande adaptabilité des variétés sont cruciales pour obtenir un rendement stable.

Six lignées ont été soumises à l'Organisation Nationale de Contrôle pour une commercialisation éventuelle. Dans ce groupe, on trouve deux lignées obtenues à partir du croisement BY_E^2 -Tc (II-22252), une lignée à partir du croisement 61-130-414/44, et trois selections locales 377/2, 1299/1 et 13-Hamari, qui semblent supérieures aux variétés actuellement plantées, Un programme intensif de croisement est actuellement en train d'essayer de transférer le haut potentiel de rendement du blé dur mexicain aux types adaptés au Plateau Central; cependant, cet effort est entravé par la nécessité de trouver du blé dur d'hiver local ayant les caractéristiques requises.

Original: Anglais

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PROGRAMME DE LA DIVISION AGRONOMIQUE (ACSAD)[1/] POUR LE BLE DUR

H. Kayyal

Introduction:

L'agriculture est considérée comme très importante dans les pays arabes, puisque plus de 60% de leurs populations travaillent dans ce domaine, notamment dans les grandes cultures (field crops) qui fournissent, par ailleurs, environ 65% du revenue agricole totale.

Les conditions pluviométriques (faible quantité et mauvaise répartition dans l'année) exerce une influence sur la culture du blé.

Le blé dur occupe environ 50% de la surface emblavée. La plupart est ensemencée en variétés locales bien adaptées aux conditions climatiques et tout particulièrement à la secheresse, ce qui se traduit par un rendement supérieur par rapport aux variétés étrangères mis en essais dans les régions non-irriguées (à une pluviométrie moyenne de 250 à 350 mm/an). La production des pays arabes de 8,9 millions de tonnes ne suffit pas à la consommation annuelle (qui s'élève à 14,4 millions de tonnes) en raison du faible rendement (10,67 Qx/ha) qui provient, par ailleurs, des facteurs suivants:

I - Variétés:

Malgré le fait que la plupart des variétés locales cultivées sont plus ou moins homogènes, il est certain que la culture traditionnelle et l'absence d'un programme d'amélioration sont les causes des rendements assez faibles.

Ces variétés se caractérisent par:

- une productivité assez faible.
- une sensibilité aux maladies cryptogamiques. Ceci est plus important dans les années humides. (rouilles, caries, charbon).
- une sensibilité à la verse provenant de leur haute taille, ce qui limite l'emploi de la fumure azotée.

1/ Centre Arabe por les Etudes des zones Arides.

Des variétés étrangères (Italiennes et Mexicaines) sont bien réparties dans les régions à pluviometrie élevée (supérieur à 350 à 450 mm/an).

II - Conditions Climatiques:

Etant donnée que 80% de la superficie emblavée se trouve dans les régions non-irriguées, la production varie d'année en année pour les raisons déjà énoncées.

III - Techniques Culturales:

Malgré certaines modernisations (mécanisation), la technique traditionnelle subsiste toujours dans la plupart des pays.

Pour cette raison, le Centre Arable de Recherche dans des Zones Seches et Arides (division agronomique) a été crée en 1971 pour résoudre ces problèmes et arriver aux objectifs suivants:

1. Etudier les variétés locales et déterminer leurs caractéristiques importantes afin de les conserver pour un programme futur d'amélioration.

2. Augmenter la productivité des variétés resistantes à la secheresse soit par une sélection généalogique, soit par une hybridisation.

3. Moderniser les techniques culturales employées mécanisation-fertilisation-assolement-désherbage).

Travaux en Cours:

Notre travail est surtout consacré aux cultures des zones sèches et arides à pluviometrie moyenne (300 à 450 mm/an), c'est à dire, blé, orge, et sorgho.

Nous avons choisi la station d'Izraa au sud de la Syrie comme station principale, et, en second lieu, les stations de recherche de Tell-Affar en Iraq, Kafardan au Liban, Rabba en Jordanie, Zordo en Lybie, et Hymmo en Syrie.

L'Etude du Blé Dur se concentre sur les activités suivantes:

- Programme d'amélioration (sélection, introduction et hybridisation)

- Programme des techniques culturales.

- Programme d'étude morphologique et physiologique.
- Autres activités.

1. Le Programme d'Amélioration

a) Sélection:

La sélection a comme but:

L'amélioration des variétés locales par une voie généalogique de manière à isoler des lignées pures, plus productives, ou ayant certaines caractéristiques intéressantes comme celles de la taille-courte, de la précocité, de la résistance aux maladies, etc., tout en conservant leurs caractéristiques originales. Ils pourront être croisés avec des variétés étrangères. Cette sélection a été entreprise dans la population Haurani, et nous sommes arrivés à certaines lignées (mises en essai au cours de l'année 1975) pour les comparer avec la population d'origine. Deux essais sont realisés, un à Izra, l'autre à Karabau (Faculté d'Agriculture de Damas) en raison de 4 répétitions par essai. Cette méthode de sélection vient d'être appliquée sur d'autres variétés (Hamari, Sen. Cappelli) et sur quelques autres variétés de blé tendre.

b) Introduction:

La division reçoit des variétés et des lignées nouvelles par l'intermédiaire des établissements étrangers, soit dans des pépinières, soit dans des essais comparatifs regionaux RWYT. Ces lignées sont souvent semées dans deux régions, l'une irriguée, et l'autre sans irrigation. Nous choisissons ainsi les meilleures lignées présentant de bonnes caractéristiques pour les introduire dans notre programme d'amélioration.

c) Hybridisation:

Notre programme consiste à obtenir les semences F_2 et à les distribuer ensuite aux pays arabes concernés pour suivre la sélection dans les conditions climatiques propres à chaque pays. Nous réalisons des croisements entre variétés locales et variétés choisies par les pays concernés. Nous essayons d'obtenir les F_1 et les F_2 dans la même année en appliquant les techniques suivantes:

- Vue les conditions climatiques particulières de la station de Deer-Alla dans le Ghore de Jordanie, nous réalisons tres

tôt le semis des parents afin de faire des croisements au courant du mois de Fevrier. Les semences F_1 obtenues seront ensuite semées au début de l'été dans la station de Serghaia en Syrie ou le climat est convenable, permettant la distribution des grains F_2 au mois de Novembre.

2. Programme des Techniques Culturales:

Cette étude qui a été entreprise depuis 3 ans dans la station d'Izraa sera poursuivie pendant trois années encore puisque nous avons obtenu des résultats très variables en raison des conditions climatiques très changeantes. Cette étude comprend les essais suivants:

a) La date de semis:

Nous étudions le comportement de trois variétés (Haurani, Hamari, Florence Aurore) semées à deux dates différentes (avant et après la pluie), avec 6 répétitions.

b) La densité de semis:

Nous étudions:

3 espacements (15, 25, 35 cm interlignes)

3 doses de semis (60-100-140 kg/ha)

4 variétés (Haurani, Jori 69, Mexipak, C 306)

à 6 répétitions

c) La profondeur de semis:

Nous étudions:

3 profondeurs (2 - 4 - 8 cm)

1 variété (Haurani)

à 6 répétitions

d) Essais d'Assolements (Rotation):

Le blé après jachère est considéré comme assolement traditionnel dans les régions non irriguées. Il est à signaler que le blé dans ces conditions donne de très bons résultats, supérieurs au rendement du blé après legumineuses (lentilles). Notre étude d'assolement a été entreprise au cour de l'hiver

1972-73 en appliquant les rotations suivantes:

- blé-lentilles-jachère

- blé-cartame-lentilles

- blé-lentilles-vesce (Vicia ervilia)

- blé-fourrage mélange-fourrage mélange (Vicia sativa + orge)

Chaque traitement comporte 2 parcelles de 34 m^2 chacune. 1 parcelle a été semée traditionellement et l'autre par une technique nouvelle.

è) Sortes de Charrues:

Un essai des différents types de charrue a été réalisé au cours de l'année 1974-75:

- Disque

- Chisel

- Charrue à soc (défonceuse)

- Charrue à soc ameliorée

L'essai, comprenant deux espèces; blé + lentilles, est répété 3 fois, à 2 profondeurs de semis (7 + 14 cm.). La superficie de chacune des parcelles remonte à 300 m^2.

f) Etude Agro Ecologique:

Une étude du cycle de développement du blé Haurani a été entreprise en 1973-74 afin de determiner ses besoins en température et en photopériode. Elle se poursuivra pendant 3 années successives.

3. Programme d'Etude Morphologipe et Physiologique:

Ce programme consiste à determiner les caractéristiques morphologiques et physiologiques des variétés locales et doit prouver des rélations entre ces caractéristiques et la résistance de la plante à la secheresse. Il comprend:

a) une étude du système radiculaire.

b) une étude du système végétatif.

Système radiculaire:

Un essai de 6 répétitions a été efectué dans une serre pour caractériser le système radiculaire (Longueur - Nombre de Racine - Poids sec) de 10 variétés de blé tel-que: Haurani, Hamari F8, Haurani 27, et Senator Capelli comme blé dur. F Aurore, pitic 62, Mexipak, Saber Beck, et Salamouni comme blé tendre.

Les prélèvements sont prevus aux stades suivants:

- première feuille
- début du tallage (stade A 4 feuilles)
- 7 feuilles (stade B)
- dernière feuille:
- floraison
- 20 jours après l'epiaison
- a la maturité physiologique

Chaque prélèvement comporte 4 plantes par varieté et par répétition, les plantes sont étudiées séparement de la manière suivante:

- sur le système radiculaire nous avons mesuré:

  1. la longueur de la racine la plus longue.
  2. le nombre de racines de 2 profondeures moins et plus de 10 cm et nous avons calculé leur pids sec.

- sur le système végétatif:

  1. le pids sec total
  2. le nombre de feuilles
  3. le nombre de talles

Systeme végétatif:

Pour cette étude deux essais de 10 variétés (les mêmes étudiées précédement) et 6 répétitions ont été éffectuées en plein champ en 1975.

Le premier est consacré à l'étude de cycle de développement et es besoins en photo et en thermo-période et à réaliser les courbes de la

croissance des variétés étudiées.

Le deuxième sert aux analyses du rendement et de la productivité (grosseur du grain), nombre de tables et fertilité de l'epi et de quelques autres caracteres comme celle d'engrainage - precocité - resistance aux maladies etc.

Autres activités:

1. Conférences:

La division estime que la réunion des techniciens arabes a reussi à connaitre exactement les problèmes particuliers de chaque pays et a amélioré la connaissance des participants. C'est ainsi que la 1r. conference eut lieu à Damas en 1973 en présence de représentants de 7 pays. Une deuxième réunion a été faite en Lybie en 1974 en présence des représentants de la plupart des pays arabes.

2. Cooperation:

Nous constatons que les techniciens de Ford et Rockefeller Foundations, CIMMYT et la FAO sont de très bons coopérateurs en ce qui concerne l'amélioration des céréales dans les regions du moyen Orient.

Nous souhaitons que la relation avec ces groupes s'améliore et que leurs roles deviennent de plus en plus importants.

Nous sommes très reconnaissant aux messieurs les organisateurs de cette réunion pour leur chaleureuse invitation et nous les remercions.

DISCUSSION

Question: Are there cultural practice experiments other than those in your Center or are you coordinating different programs of this kind in other Arab countries?

Answer: Our work on cultural practices is mostly carried out at the IZRAA Station in Syria. However, other aspects of the program such as hybridization and introduction of varieties are accomplished by coordination between the Arab countries and our Center.

PROGRAM ON DURUM WHEAT AT THE AGRONOMIC DIVISION OF THE ACSAD[1/]

H. Kayyal

SUMMARY:

Introduction:

Includes:

Economic importance of durum wheat in Arab countries (acreage, production, yield and trade).

Origins.

Characteristics.

Problems.

The division's role in regions with a rainfall between 300 and 450 mm.

Work in Progress:

Including:

Program for the improvement of durum wheat and bread wheats (introduction, hybridization, selection).

Morphological, physiological and agronomic studies of certain varieties of Arab wheats.

Research on agricultural techniques (rotation depth and date of seeding, type of plows, fertilization).

Agri-ecological research (modification of climatic conditions, soil moisture and its influence of plant development and yields).

Objectives of the Division

1/ The Arab Center for the Studies of Arid Zones.

Original: French

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MAJOR DISEASE PROBLEMS OF DURUM WHEAT AND THEIR DISTRIBUTION WITHIN THE REGION

J.M. Prescott and E.E. Saari

Durum or macaroni wheats (Triticum durum) are grown in many regions of the world but are of significant importance in North Africa, Southern Europe, and the Middle East countries. In the Mediterranean - Middle East region - durum wheats are a favored dietary staple of the people. Accurate data on the production of durum wheat are not readily available as most reports do not separate bread and durum wheat production figures. Whatever the case it is generally understood that there is a ready market for all that is produced. However, at the present time, durum production does not meet the demand. One of the principal reasons is the lack of adapted, high yielding varieties with adequate resistance to the prevalent diseases.

As a class, durum wheats do not differ greatly from bread wheats with respect to the pathogens that can attack them. However, with our present state of awareness, there is a recognizeable distinction in the "forma speciales" or the physiologic races and biotypes of the pathogenic species involved. For example, there are many races or biotypes of stem rust (Puccinia graminis f.sp. tritici) that do not attack durum wheats while causing severe damage to the bread wheats. The other case is also true; that is, some races attack durum but not bread wheat. There is one physiologic race of stem rust, race 189, while capable of attacking both bread and durum wheats, appears to have a preference for durum wheats. Generally, there has been little effort expended on distinguishing between the diseases that affect bread and durum wheats.

In published plant disease surveys there are 36 species of fungi reported to be isolated from and associated with wheat diseases in this region. In addition, there are three bacteria species, five nematode species, and four viruses or mycoplasma organisms associated with wheat. Of these 48 pathogens the three that are presently considered to be of major importance are Septoria leaf blotch (Septoria tritici), stem rust (Puccinia graminis f.sp. tritici), and stripe rust (P. striiformis). In addition to these, there are several that appear to be of moderate importance: powdery mildew (Erysiphe graminis), leaf rust (P. recondita tritici), and scab (Fusarium spp.). The other pathogens, that attack wheat are usually present but on a more limited basis. Some of these pathogens include: the bunts (Tilletia caries, Tilletia foetida and T. controversa),

the smuts (Ustilago nuda, and Urocystis tritici), take-all (Ophiobolus graminis), foot rot (Cercosporella hepotrichoides), root rots (Helminthosporium spp. and Pythium spp.), black chaff (Xanthomonas translucens), and basal glume rot (Pseudomonas atrofaciens).

The magnitude of the disease resistance situation of durum wheats varies with respect to each disease and country or sub-region within this Mediterranean - Middle East area. The six major and moderately important diseases are found in all countries within the region. However, local conditions within each country dictate the diseases (or even races) that limit production. Temperature and moisture are probably the most important environmental considerations. In general, septoria leaf blotch, stem rust, and leaf rust can be important region-wide while powdery mildew and scab are limited to the coastal or high rainfall areas, and stripe rust to the cooler areas of the region.

To illustrate the disease resistance situation of durum wheats within the region, eleven varieties commonly grown or used in breeding programs and their reaction to stem rust are presented in Table 1. In Egypt, the varieties Wells, Leeds, and Hercules provided excellent protection to the 1971-72 virulence spectrum. However, in Turkey, for the same period, the resistance of these three varieties was not effective. The main point is not that there are obvious differences in the pathogen population but that within this population there are entities that can overcome the resistance genes of these varieties. In the same context, the advanced lines presented in Table 2 and their range of reaction to stem rust convey a similar idea.

To further illustrate the endemic virulence and resistance trends a comparison of the average coefficient of infection for the three rusts among local (checks), improved and dwarf durum varieties for the three year period 1972-74 is presented in Tables 3, 4, and 5. An average coefficient of infection greater than 10 suggests that the varieties in this class have less than adequate resistance, and should be replaced. A value between 5.0 and 10.0 suggests reasonable levels of resistance, however, new sources of resistance may be needed shortly. A value less than 5.0 suggests the presence of adequate resistance. Based on the data assembled from the Regional Trap Nursery (RTN) over a three year period it can be said that the local or check varieties do not have adequate resistance for the three rusts and that they could sustain heavy damage whenever the conditions for an epidemic are suitable. The improved varieties, as a class, vary according to the rust but generally speaking their resistance levels are barely adequate and new sources of resistance are needed. The dwarf varieties appear to have adequate resistance to stripe rust but only reasonable levels of resistance to stem and leaf rust.

When the durum classes are compared to the bread wheat classes (Table 3, 4, and 5) it appears that the bread wheats have more effective protection from stem and stripe rust and approximately the same levels of protection from leaf rust. This might be somewhat expected by virtue of the intensive effort to improve the bread wheats in the past.

A nursery for screening both spring and winter durums has been established in the region. Tables 6 and 7 summarize the observations on winter durums for resistance to the major diseases and the level of winterhardiness. Tables 8 and 9 summarize observations of disease resistance in the RDISN (Regional Disease and Insect Screening Nursery) for the spring habit durums.

In summary, there are a number of pathogens attacking wheat but little distinction of those attacking durum or bread wheats has been made. Whatever the case, there are a number of pathogens that limit the production of durum wheats within the Mediterranean - Middle East region. There is a real need to widen the genetic base of the durum wheats, particularly with respect to disease resistance. Increased efforts are needed to identify, test, and release adapted, high yielding durum varieties for this region.

DISCUSSION

Question: In tables 3, 4 and 5 what does "all durums" or "all wheats" include?

Answer: "All durums" or "All bread wheats (BW)" include "checks" which are local varieties plus the improved category and the dwarf category. The "improved" category includes varieties which have been developed to replace local types (example Capeiti). The "dwarf" category includes representatives from the Norin 10/ Brevor dwarfs (example Cocorit 71).

Question: How many locations are involved in RTN?

Answer: In 1973-74 150 Regional Trap Nurseries were sent out to 32 different countries. The Durum varieties included 4 local checks, 8 improved and 2 dwarf, making a total of 14.

Question: Is there any relationship between the stage of growth of certain varieties and resistance? In other words, could we consider a variety resistant in certain stages of growth to a particular race or biotype of stem or leaf rust, and susceptible when reaching later stages; or the opposite, heavily attacked when in the seedling stage but resistant later on?

Answer: Yes, there is a very good correlation between stage of growth and resistance. You find all categories but most fall in the groups of susceptible or resistant as a seedling and the same response as an adult. However, some are resistant as a seedling and susceptible as an adult and vice versa.

Question: Do you think that there is any kind of seasonality or cycling regarding the incidence of certain diseases such as stem rust or leaf rust? For example, did any of them become severe or epidemic once every 3 or 4 years?

Answer: As to seasonality, about the only influence is due to environmental conditions that influence rust carryover from year to year. Cyclic patterns are dependent upon the environment plus the traits of the pathogen population and the survival of inoculum. With the present status of knowledge we are not yet in a position to predict epidemic frequency.

Table 1. Reaction of Eleven Varieties of *Triticum durum*, to *Puccinia graminis tritici* in Egypt and Turkey, in 1971-72.

Variety	Egypt	Turkey		
		Ankara	Izmir	Diyarbakir
Wells	5MR	60S	20S	10MS
Leeds	5R	30S	30S	40S
Tehuacan	70S	100S	50S	20MR
Cocorit 71	60S	20MS	40S	30S
Hercules	10MR	80S	30S	60S
Chapala 67	40S	10S	60S	10R
Oviachic	40S	100S	50S	80S
Jori C-69	80S	80S	30S	TMR
Barrigon Yaqui E	-	20S	30S	10R
Langdon	-	60S	30S	20MR
Stewart 63	-	40MS	20S	20MS

Table 2. Range of rust reactions of various selections of *Triticum durum* in Turkey in 1971-72.

Variety/line	N. of lines tested	Pgt (Stem rust)	Prt (Leaf Rust)	Ps (Stripe Rust)
Anhinga 'S'	4	10S-50S	5S-60S	30S-50S
Crane 'S'	5	30S-80S	20S-30S	10S-60S
Ganso 'S'	4	80S	30S-40S	30S-50S
Garza 'S'	4	20S-70S	10S-60S	20S-80S
Pelicano 'S'	3	70S	40S-70S	20S-30S
Flamingo 'S'	7	70S-90S	TR-50S	30S-80S
Pinguino 'S'	8	20S-80S	10S-30S	40S-70S
Booby 'S'	9	30S-50S	20S-40S	20S-30S
Brant 'S'	3	5S-10S	50S-70S	5S-10S

Table 3. Comparison of the average coefficient of infection[1/] of several variety groupings within the Regional Trap Nursery for stem rust for a three year period.

	1971-72	1972-73	1973-74
Durum checks	33.08	18.65	14.60
All Durums	25.03	14.13	11.24
Imp. Durums	14.29	16.66	10.98
Dwf. Durums	-	7.09	5.15
BW checks	43.32	34.34	23.28
All BW	14.74	18.30	6.95
Imp. BW	18.19	14.32	9.92
Dwf. BW	6.69	6.24	2.62
All checks	36.49	26.50	18.94
All Entries	19.89	16.22	8.07

Table 4. Comparison of the average coefficient of infection[1/] of several variety groupings within the Regional Trap Nursery for leaf rust for a three year period.

	1971-72	1972-73	1973-74
All Durums	25.58	16.19	11.98
Durums Checks	37.61	20.26	18.05
Imp. Durums	9.54	18.60	8.96
Dwf. Durums	-	9.72	7.40
All BW	22.25	26.80	12.78
BW Checks	50.18	43.59	36.43
Imp. BW	23.59	20.68	16.32
Dwf. BW	11.53	16.15	7.62
All Checks	43.90	31.93	27.24
All Entries	23.92	21.50	12.58

Table 5. Comparison of the average coefficient of infection[1/] of several variety groups within the Regional Trap Nursery for stripe rust for a three year period.

	1971-72	1972-73	1973-74
All Durums	14.51	12.54	10.26
Durums Checks	15.94	20.65	17.65
Imp. Durums	12.57	10.86	7.72
Dwf. Durums	-	6.11	1.85
All BW	9.34	9.91	4.56
BW Checks	26.73	13.20	12.92
Imp. BW	8.49	8.43	4.37
Dwf. BW	7.21	8.10	4.85
All Checks	21.34	16.93	15.29
All Entries	11.93	11.23	6.03

1/ 0-5 = good resistance, 5-10 = reasonable resistance, above 10 = inadequate resistance.

Table 6. Sources of resistance to the rusts from 1st IWDSN (International Winter Durum Screening Nursery) with acceptable 1/ levels of winterhardiness.

Stripe rust:	
Capraz bugday 1018 - Leeds	C9-63
073/44 - Introd. 2498	D011-1A-10A-0A

1/ Acceptable equals the winterhardiness of Bezostaya.

Table 7. Sources of resistance to the rusts from 1st IWDSN with little or no winterhardiness.

Stem & Stripe rust:	
G11"S"(BR180-Lak/Gz-60-220x61-130	D26842-21Y-3M-0Y
Crane "S"	D23055-56M-5Y-2M-0Y
LD 357_E-Tc^2xJo"S"	D27534-1M-1Y-1M-0Y
D6647	
61-130-Leeds	D6659
Capraz bug-Leeds	C11-25
Cocorit "S"	D27617-18M-6Y-1M-0Y
61-130-Kunduru 414/44	D27617-1A-23A-0A
LD357_E-Tc^2 x Jo"S"	D27534-3M-1Y-4M-1Y-0M
21563-Gs "S"	27584-5M-1Y-3M-0Y
21563-Jo "S"	31538-14M-6Y-0M
Crane "S"	23055-56M-6Y-2M-0Y
LD357_E-Tc^2 x Jo "S"	27534-1M-1Y-1M-0D
D.Dwf.-S15xCr "S"	33312-9Y-2M-0Y

Stem & Stripe rust: (Cont'd.)

D.Dwf.-S15xCr "S"	33312-9Y-9M-0Y
Jo "S"-Cr "S"	27591-3M-3Y-0M
Cfn-Lan^2_E	A3433-201p-3p-20p-1p-0D
P67/1114	12:61 (GT).27-2T-0T-1T-0T
STW63/TM_E-Tc^2 x ZBW	23626-9A-4A-8A-0A

Stem rust:

ESK 8178	-
61-130-Leeds x Capraz bug 1018	C29-13
LD 308	-
61-130-Leeds	D6654
Bo "S"	21263-54-1Y-2Y-4M-2Y-100M-0S
Bo "S"	21263-54-1Y-2Y-5M-1Y-100M-0S
S/N-Ag.elong.xTAC125/ZBW	22299-5M-3R-1M-1R-2C-0R
AA "S" (CP^3_E-Gz x Tc^3 / BY^2_E-Tc)	31733-4M-6Y-2M-0Y
Masa -11Y-1M-0Y	-

Stripe rust:

Flamingo "S"	D27582-5M-3Y-1M-500Y-0D
Cr "S"/T.pol^2_E-Tc^2 x G11"S"	D31725-3M-8Y-0M
Cisne "S"	D27617-18M-6Y-0M
Crane "S"	D26055-56M-5Y-3M-0Y
BY^2_E-TAC_ExAA "S"	D27625-5M-2Y-2M-0Y
Kobak 2916-61-130	C21-6-0A
61-130-AKb253-39	C24-36-0A

Stripe rust: (Cont'd.)

Cocorit "S"	D27617-18M-6Y-2M-0Y
Üveyik 126-61-130	C23-9-0A
Berkman	-
B144	-
Masa-165y-0M	-
D.Dwf.-S15xJo "S"	33303-3Y-1M-0Y
D.Dwf.-S15xCr "S"	33312-9Y-5M-0Y
Gerardo Vz 469	-
Anhinga "S"	22234-18M-8R-0M
Ganzo "S"	22550-10M-5Y-1M-2Y-1M-0Y
CP-St 464	Ch 3268-3p-3p-0D
6684-6645	-
Cr "S"-Gs "S"	28980-28Y-13M-500Y-501M-0Y
61-130-Üveyik	1A-59A-0A
073/44	D011-1A-5A-0A
61-130-Lds x Gokala 24	C28-9-1

Table 8. Sources of resistance in durum wheats based on data from the RDISN.

Stem rust	Leaf rust	Stripe rust
Flamingo	NP 401	Moh'd. Ben Bachir
Durum variety 24	NP 404	Maliani 11 C
Valgerardo	NP 412	Quilafen
Egypt Local No. 8	P.I. 153774	Berkman
Tai	P.I. 297839	Flamingo
Kasuku	CI. 13160	Oviachic
CI. 8155	Moh'd. Ben Bachir	Chapala 65
D-16	Maghrebi 72	Castel del Monte
Stewart 63	Pelicano	Crane
Leeds	Kyperunda	Tehuacan 60
Hercules	Durum Variety 24	Capeiti
Jori C-69	Chapala	Senator Capelli
Langdon	Leeds	Sincape
Wells	Maliani 11 C	Maliani 8 D
Yuma	Valnova	Jucci
Anhinga	Saba	Raneiri
Maliani 11 C	Duro de Cardeite	Zenati Bouteille
Valnova		Chile-931
		Grec-46049

Table 9. Durum Wheat Varieties included in the 2nd RDISN 1971-72 with good resistance to Septoria tritici in the Near East and North Africa[1]

RDISN No.	Variety or Cross	Aver. Score[2]	High Score	Pd. Mild React.[3]
894	Jaafari	3.3	6	MS
1027	Lobeiro	3.5	5	S
1028	Preto Amarelo	3.5	5	S
1452	Leeds	3.5	7	MR
2330	Mouri	3.5	5	MR
1410	Golden Ball	3.8	6	S
1454	Wells	3.8	8	S
1029	Amarelejo	4.0	5	S
1455	Langdon	4.0	7	MS

1/ Based on data collected from Algeria, Ethiopia, Lebanon, Tunisia and Turkey.

2/ Based on disease score using the 0-9 scale.

3/ Powdery Mildew observations from Poland and France.

PROBLEMES MAJEURS CONCERNANT LES MALADIES DU BLE DUR ET LEUR REPARTITION DANS LA REGION

E.E. Saari et J.M. Prescott

RESUME:

Le contrôle des maladies du blé est considéré comme le facteur principal de la stabilisation de la production du blé. Ceci est particulièrement vrai en Asie et en Afrique du Nord où le blé est cultivé depuis des siècles; dans ces régions, on peut trouver un certain nombre de références sur les maladies folières et les oïdeums qui affectent le blé. En général, peu d'efforts ont été faits pour distinguer les maladies qui affectent le Triticum aestivum, et le T. durum.

Dans les enquêtes publiées sur les maladies des plantes, 36 espèces de fungi ayant un lien avec les maladies du blé de cette région, ont été identifiées. En outre, il y a 3 espèces bactériennes, 5 espèces de nématodes et 4 virus ou mycoplasmes associés au blé. Il y a d'autre part, 15 espèces de fungi qui peuvent endommager les graines en stockage. Fort heureusement, la plupart des espèces de pathogènes signalées sont relativement peu importantes.

Peu de travaux ont été faits pour déterminer à quelle fréquence les maladies se développent et les limites de leur répartition. Ceci est vrai pour la plupart des régions du monde où l'on cultive le blé. On a tendance à n'enregistrer que les maladies qui provoquent des épidémies ou des pandémies. En conséquence, nos données sur les maladies chroniques du blé sont pratiquement nulles. Les meilleures estimations des pertes dues aux maladies du blé en Afrique du Nord indiquent une perte annuelle minimum de 12%. Ce pourcentage ne fait pas de distinction entre les blés tendres et les blés durs.

D'après ce que nous connaissons à l'heure actuelle du problème, les maladies importantes du blé dur sont les mêmes que celles du blé tendre. Il y a une différence visible dans les forma speciales ou les races physiologiques des espèces pathogènes concernées. La classification de ces espèces en sous-classes peut souvent être effectuée seulement en laboratoire ou dans une serre.

Dans les efforts de développement d'une variété de blé dur à haut rendement pour l'Afrique du Nord, il faudrait essayer d'identifier une variété résistante en priorité à la Septoria tritici et ensuite à la Puccinia graminis. Plusieurs autres maladies existent et on ne peut pas les négliger si on veut améliorer le niveau technologique de la culture pour accroître la production du blé dur. Les maladies qui requièreront probablement toute notre attention à l'avenir sont: l'Helminthosporium, le oïdum et la pourriture des racines.

Original: Anglais

Performance of Durum Varieties in the Regional Nurseries

J. P. Srivastava

Durum wheat is a very important winter cereal for the region as a whole and particularly in the rainfed areas of North Africa, Ethiopia, Italy, Cyprus, Turkey, Syria, Transcaucasian USSR, Lebanon, Jordan, Iraq, Afghanistan and India. Durums bring higher prices as compared to breadwheat varieties in local markets and there is a heavy demand for durum wheats from Southern Europe. Traditionally North Africa and many of the Middle East countries were the suppliers of durum wheats to Europe and thus durum cultivation constituted an important source of foreign exchange. However, continuing low yields coupled with increased domestic consumption have changed most of these countries from durum exporters to wheat importers.

Most durum varieties planted in the region are local cultivars traditionally adapted to survive unfavorable growing conditions characteristic of rainfed culture. They lack satisfactory resistance to diseases, yield potential and stability and do not respond well to fertilizers under high rainfall or irrigation. It is imperative for these countries to identify and grow improved durum varieties of high yield potential with wide adaptation and possessing desired grain quality.

In the early 1960's, several varieties developed in Italy were tested in the region and Capeiti 8 was identified as high-yielding and well adapted in many countries. Since the late sixties, CIMMYT derived durum germplasm has been introduced into this region through CIMMYT and Regional Nurseries (ALAD-CIMMYT-FAO). A number of varieties/lines from CIMMYT material have been identified by the national programs for their

high yield potential and better adaptation to varying growing conditions. Jori 69 and Cocorit 71 have performed well under favorable growing conditions as well as under low rainfall areas where diseases are not a special problem. As a result these varieties are already occupying commercial acreage in countries like Lebanon, Turkey, Algeria, while in Syria, Jordan, Saudi Arabia and Egypt they are under large scale seed multiplication.

The FAO/IAEA/CNEN Near East Uniform Regional Trials of Radio Induced Durum Wheat Mutants has been carried out for several years in the region. Creso, Castel del Monte and GAB 125 have been identified as high yielding mutants from this program. These varieties are under test in the regional and national programs.

Summaries from CIMMYT and Regional Nurseries, grown in collaboration with national programs in the region for several years, identify new genotypes with high yield potential, good adaptation and better disease resistance than the indigenous varieties.

Table 1: Performance of some entries in the Third International Durum Yield Nursery (40 locations)

Variety or Cross	Origin	Yield t/ha	Test wt kg/hl
Cocorit 71	Mexico	4.3	76.2
Cajeme 71	Mexico	4.3	74.4
Crane 'S' (B)	Mexico	4.2	71.1
Cocorit 'S'	Mexico	4.2	77.9
Brant 'S'	Mexico	4.1	73.1
Crane 'S' (A)	Mexico	4.0	74.3
Jori 'S' x Crane 'S'	Mexico	3.9	71.8
Anhinga 'S'	Mexico	3.9	78.3
T. Dic. Var. Vernum	Mexico	3.8	69.2
Jori C-69	Mexico	3.8	75.9
Local check		3.8	70.0
Capeiti	Italy	3.6	77.3

In the Third Durum Yield Nursery, Cocorit 71 gave an average yield of 4.3 ton/ha (average of 40 locations) which was equal to the breadwheat check, Cajemi 71. These two varieties were closely followed by newer CIMMYT developed lines Crane 'S', Cocorit 'S', Brant 'S', Crane 'S' (A), Jori 'S' x Crane 'S' and Anhinga 'S'.

Table 2: Performance of some Durum entries in the First and Second Regional Rainfed Wheat Yield Trial (low fertility and rainfed conditions)

	1st RfWYT, 1972-73 12 locations			2nd RfWYT, 1973-74 18 locations		
	Mean yield kg/ha	Rank according to yield	Frequency in high yielding group *	Mean yield kg/ha	Rank according to yield	Frequency in high yielding group *
Capeiti	2,089	4	7	2,498	11	4
Jori 69	1,864	6	3			
Haurani	1,383	8	2	2,219	23	2
Senator Capelli	1,375	9	1			
Kyperounda	1,313	10	1			
Cocorit 'S'				2,938	2	12
Gerardo 572				2,769	5	7
Gerardo 512				2,681	6	7
Creso				2,471	12	2
Castel del Monte				2,349	21	0
Dw. Durum S-15				2,535	8	7
Breadwheat						
Super X	2,434	1	7	2,841	3	8
Sonalika	2,160	3	6	2,423	16	3

* Frequency of the variety appearing in the first significantly high yielding group

In the Regional Rainfed Wheat Yield Trials, Jori 69 and Cocorit 'S' have performed better than presently grown indigenous and improved durum varieties. However, the grain quality of both these varieties and particularly of Cocorit 'S' is inferior to

presently grown indigenous durum varieties. In addition, Capeiti 8, Gerardo 512 and Gerardo 572 gave good yields, fair adaptability and their grain quality is superior. As a class durums did not exhibit yield superiority over breadwheat variety Super X under rainfed conditions. Cocorit 'S', Gerardo 512, Gerardo 572 and Capeiti appear to be well adapted durum varieties. Table 3 shows average yield of some durum and breadwheat varieties in the third, fourth and fifth Regional Wheat Yield Trials grown under high production environment. On the whole breadwheats performed better under these conditions although Cocorit 71 exhibited the same production potential as Super X or Mexipak.

Table 3: Performance of Durum entries in the Third, Fourth and Fifth Regional Wheat Yield Trials (high fertility and high rainfall or irrigated conditions)

	Mean Yield in kg/ha and Varietal Ranking					
	3rd RWYT 1971-72 50 varieties 30 locations		4th RWYT 1972-73 25 varieties 14 locations		5th RWYT 1973-74 25 varieties 18 locations	
	Y	R	Y	R	Y	R
Durum						
Cocorit 71	4,074	16	4,359	7	4,662	4
Jori 69	3,776	29				
Pelicano			4,025	17		
Giorgio VZ 300	3,304	43				
Inrat 69	3,245	44				
Breadwheat						
Mexipak	4,265	6			4,534	9
Siete Cerros			4,473	3	4,647	5
Chenab 70	4,302	4	4,355	8		

The Third Preliminary Observation Nursery included 50 durum entries and data was summarized from 26 locations. Entry No. 12 CIT'S'-Gaviota 'S' CM9921-17m-0y and entry No. 18, Cr'S' x T. dic. S. Vernum-Gll'S CM199-29m-1y-1m-0y were reported to be

best entries from most of the cooperators, based on yield, resistance to rusts and plant type. The entries most frequently indentified as superior lines are presented in Table 4.

Table 4: Best 10 Durum entries in Third Preliminary Observation Nursery, 1973-74

Entry No.	Designation	Ranked according to yield	Frequency of appearing in best 20 entries from 26 locations	YR	LR	SR
				Average coefficient of infection		
12	CIT'S'-Gaviota'S' CM9921-17-0y	4	17	2.1	15.8	12.7
18	Cr'S'xT. dic. S. Vernum-Gll'S' CM199-29m-1y-1m-0y	1	14	12.4	14.2	10.9
9	Maghrebi x H.O. CM9772-28m-0y	3	14	16.2	21.4	19.2
26	Gll'S'-Lds-RL3601/Jo'S' CM32929-8y-1m-1y-2m-0y	7	16	6.7	21.3	24.4
2	D. Dwarf S-15-Cr'S' D33312-7y-3m-1y-0m	5	15	17.6	27.6	5.2
3	D. Dwarf S-15-Cr'S' D33312-8y-4m-2y-0m	9	14	2.6	15.3	13.4
19	Cr'S'-Gs'S' CM224-1m-1y-4m-0y	8	13	5.2	23.0	18.4
29	AA'S'-Plc'S' D33041-16y-3m-2y-0m	2	10	28.7	10.6	20.6
27	21564-Cr'S' CM32929-8y-1m-1y-2m-0y	21	13	3.0	14.3	7.6
47	21563-Garza ID31534-3L-0L-1a-0a	34	7	3.0	10.8	4.6

Stork 'S' CM470-1m-3y-0m-0y and Jori 'S -Cr'S D27591-5m-3y-1m were identified for good yield and grain quality by several national programs and, consequently, they have been

included in the Sixth Regional Wheat Yield Trial for further evaluation.

In the Fourth Regional Disease and Insect Screening Nursery 400 durum varieties/lines were tested for disease resistance. Only 2 entries, RDISN No. 1989 Rabicorno CM31733-4m-2y-1m-0y and RDISN No. 2104, 21563xJori'S' ID31538-1L-0L-1a-0a were found to possess good resistance to yellow and leaf rust and moderate resistance to stem rust. A number of lines have been identified for resistance to yellow and leaf rusts. None of the varieties exhibited high degree of resistance to stem rust. It is considered necessary to build germplasm with adequate resistance to three rusts to be used in crossing programs in the region.

More complete yield and disease reaction data is given in the appendix.

At this stage the national wheat programs in the region are devoting less attention to durum as compared to breadwheat programs. Durum Crossing Block from CIMMYT and a Regional Crossing Block constituted in Beirut from durum lines, found suitable in the region for yield, maturity, adaptation to low and high rainfall areas, superior grain quality and resistance to prevalent diseases in the region, are supplied to national programs for initiating their own hybridization program to cater to their specific environmental conditions. The following CIMMYT and Regional Durum Nurseries have been supplied to national programs in the region to accelerate their durum improvement program.

Table 5: Durum Germplasm Distributed in the Region through CIMMYT and Regional Nurseries 1974-75

Nursery	Number of Entries
International Durum Screening Nursery	240
Crossing Block	144
Segregating Populations (F_2)	
International Durum Yield Nursery	25
Elite Durum Yield Trial	25
Regional Disease & Insect Screening Nursery	600
Preliminary Observation Nursery	93
Regional Crossing Block	100
Rainfed Wheat Yield Trial	5
Regional Wheat Yield Trial	2

Gradually most of the national programs have started to expand their efforts in durum improvement programs. A number of high yielding lines with better yield stability and disease resistance than the local durum strains have been identified from the international nurseries. These may be used as a base to further improve them to suit the local requirements while maintaining their high yield potential. The International Durum Screening Nursery and the Preliminary Observation Nursery carry a wealth of germplasm with considerable variability and the individual programs may select the lines suitable for their specific requirements. Further selection pressure may be put by the national programs and their best selections may be recycled in the regional testing programs to obtain more information on disease resistance, yield stability, grain quality and other genotype by environment interactions which may be used as additional information in their decision making regarding the release of a variety in the country.

In the past few years there has been remarkable awareness of the possibilities of increasing durum production in the region. According to Borlaug, "despite present limitations, durums have probably the best yield potential among wheats". With accelerated national durum improvement programs in the region, coupled with the adoption of improved production technology and the availability of improved durum germplasm through the international and regional nurseries, increased yield potential of the durums can be exploited in the near future.

DISCUSSION

Question: How many countries in the Middle East and North Africa are growing the RDISN?

Answer: 1. Algeria 2. Tunisia 3. Egypt 4. Turkey
5. Lebanon 6. Jordan 7. Syria 8. Iran
9. Afghanistan 10. Pakistan

Question: A variety may perform well at 80% of the locations but not at the remaining 20 percent of the locations. Should we not diversify the varieties and encourage other varieties in those areas?

Answer: There is considerable diversity of durum varieties in the region. Sometimes a variety is reported from a location as low yielding but this may be because of bird damage, poor soil or other factors and not necessarily an indication of the genetic yield potential. If the yield of a variety is high at 80 percent of the locations, it must possess high adaptability.

Comment: In Saudi Arabia we cannot distribute varieties which have good disease resistance in 80% of the locations but poor resistance in 20% of the locations. We always look with suspicion at a variety which shows disease susceptibility at any location. Low yield or adaptability may be ignored, but not disease.

APPENDIX

Performance of Durum Entries in the Third Preliminary Observation Nursery 1973-74 (Average of 26 locations)

Entry No.	Designation	Mean yield g/plot	Rank	Frequency of appearance in best 20 entries	YR Average coefficient of infection	LR	SR
1	Jori	553	6	11	9.2	27.2	3.2
2	D. Dwarf S15-Cr'S' D33312-7y-3m-1y-0m	559	5	15	17.8	27.6	5.8
3	D. Dwarf S15-Cr'S' D33312-8y-4m-2y-0m	535	9	14	2.6	15.3	13.4
4	Jo'S'-Cr'S' D27591-5m-2y-1m	516	17	15	25.8	28.8	8.8
5	Jo'S'-Cr'S' D27591-5m-3y-1m	525	11	11	18.8	30.5	9.3
6	Gaviota'S' D31725-3m-8y-0m	477	31	11	19.3	31.0	28.9
7	21563-Jo'S' D31538-14m-3y-0m	481	30	13	16.5	18.8	10.2
8	21563-Gr'S' D31543-7m-2y-0m	490	25	7	15.6	24.8	18.8
9	Maghrebi x H.O. CM9772-28m-0y	568	3	14	16.2	21.4	19.2
10	Maghrebi 21563-AA'S' CM9776-50m-0y	517	16	9	20.6	22.8	21.7
11	Jo'S'-Cr'S'xGs'S'-AA'S' CM9902-5m-0y	524	12	10	19.4	17.6	10.0
12	CIT'S'-Gaviota'S' CM9921-17m-0y	561	4	17	2.1	15.8	12.7
13	(AA'S'(Cpe^3-Gz x Tc^3/ BY$_E^2$-Tc))Gs'S'-Gll'S' CMI0165-14m-0y	452	39	9	18.2	15.3	6.2

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Entry No.	Designation	Mean yield g/plot	Rank	Frequency of appearance in best 20 entries	YR	LR	SE
14	Stv'63-Gl'S'xGs'S'-Cr'S' CM10251-A-2m-0y	511	20	11	22.7	16.2	9.3
15	CIT'S'-AA'S'xFg'S' CM10352-C-1m-0y	483	29	11	17.2	15.1	17.7
16	Cr'S'-Gr'S' CM2912-18y-6m-0y	501	24	10	10.6	28.0	20.7
17	Cr'S'-Gr'S' CM2912-27y-1m-0y	517	15	13	22.0	41.0	18.3
18	Cr'S'xT dic. Vernum-Gll'S' CM199-29m-1y-1m-0y	684	1	14	12.4	14.2	10.9
19	Cr'S'-Gs'S' CM224-1m-1y-4m-0y	540	8	16	5.2	23.0	18.4
20	Cocorit	521	13	9	5.9	8.6	5.6
21	Gerardo VZ469-Gr'S' CM362-21m-2y-1m-0y	476	33	7	18.6	16.6	16.8
22	Gerardo VZ439-AA'S' CM363-5m-4y-3m-0y	486	28	6	30.2	20.1	12.0
23	Gerardo VZ469-AA'S' CM363-5m-4y-5m-0y	477	32	9	31.0	13.4	10.2
24	Gerardo VZ469-Cr'S' CM366-30m-4y-1m-0y	508	23	11	22.7	21.5	2.1
25	Gerardo VZ469-Plc'S' CM373-3m-2y-1m-0y	525	10	16	19.7	17.8	11.9
26	Gll'S'-Lds-RL3601/Jo'S'	544	7	16	6.7	21.3	24.4
27	21564-Cr'S' CM32929-8y-1m-1y-2m-0y	511	21	12	3.0	14.3	7.6
28	Pelicano'S' D25609-1m-1y-2m-0y	486	26	8	27.0	9.1	5.3
29	AA'S'-Plc'S' D33041-16y-3m-2y-0m	592	2	10	28.7	10.6	20.6

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Entry No.	Designation	Mean yield g/plot	Rank	Frequency of appearance in best 20 entries	YR	LR	SR
30	Gaviota'S' D31725-6m-2y-2m-0y	439	45	2	17.8	31.0	4.[illegible]
31	Cr'S'-Gs'S' D23980-23y-13m-5y-1m-0y	451	40	11	22.2	17.3	15.7
32	BY^2E-Tc^2/Z-BxW D22232-3m-3y-1m-0y	467	36	8	2.8	22.9	11.0
33	Jori'S'(BY_E^2-Tc/Z-BxW D31453-7L-0L	442	44	9	14.0	40.3	38.3
34	67-144-64L-0L	433	46	5	23.2	33.4	3.3
35	Giorgio 447	445	42	7	15.0	10.4	19.8
36	Flamingo D27582-9m-8y-3m-500y	515	18	13	9.3	13.8	7.3
37	Pg'S'-31810 CM10071-45m-0y	513	19	9	17.0	14.6	1.4
38	Cr'S'(TAC_E-Tc^4)^{2}Z-BxW D28984-52y-1m-500y	466	37	9	13.8	14.4	3.2
39	HI-7597	327	49	3	69.3	7.6	2.3
40	Check Cocorit	463	38	10	18.8	21.6	2.2
41	HI-7527	292	50	1	75.2	16.0	5.8
42	HI-7720	403	47	2	47.8	0.0	8.3
43	Grulla-21564 ICM83-0L-5a-0a	521	14	11	11.4	27.5	2.0
44	Grulla-21564 ICM83-0L-6a-0a	447	41	5	2.0	27.6	20.3
45	USAIII-CxCrane'S' ICM532-0L-2a-0a	509	22	9	17.5	27.4	12.5
46	21563-Jori'S' ID31538-1L-0L-1a-0a	344	43	4	12.5	7.8	2.6

APPENDIX

Entry No.	Designation	Mean yield g/plot	Rank	Frequency of appearance in best 20 entries	YR	LR	SR
47	21563-Garza ID31534-3L-0L-1a-0a	475	34	7	3.0	10.8	4.3
48	21563-(BYE-Tc/Z-BxW) ID31543-7L-0L-2a-0a	471	35	7	8.2	32.7	37.6
49	21563-(BYE-Tc^5) ID31544-1L-0L-1a-0a	486	27	8	4.7	24.8	3.1
50	Jori'S'/RD3-6xStw63 ID31553-4L-0L-2a-0a	392	48	7	12.1	19.9	4.9

APPENDIX

Performance of Durum Entries in the Third Preliminary Observation Nursery 1973-74

Frequency of Varieties appearing in the first 20 High Yielding Group out of 50 entries (data from 26 locations)

Entry No.	Variety	Frequency	Locations
1	Jori	11	Oman, Afghanistan, India(1) Sudan(1), Saudi Arabia, Jordan France(1), Spain(1), Lebanon(2) Syria, Egypt.
2	D. Dwarf S15-Cr'S' D33312-7y-3m-1y-0m	15	Lebanon(1), Greece, Iran, Spain(1) France(1), Iraq, Saudi Arabia, Nepal, Sudan(1), India(1), Oman, Lebanon(1), Mexico, Cyprus, Egypt
3	D. DwarfS15-Cr'S' D33312-8y-4m-2y-0m	14	Lebanon(2), Oman, Afghanistan, India(1), Nepal, Saudi Arabia, France(2), Spain(1), Spain(2), Greece, Lebanon(1), Mexico, Cyprus, Egypt.
4	Jo'S'-Cr'S' D27591-5m-2y-1m	15	Syria, Greece, France(1), Spain(2) Iraq, SaudiArabia, Sudan(2), Sudan(1), Afghanistan, India(1), Oman, Lebanon(2), Mexico, Cyprus, Egypt.
5	Jo'S'-Cr'S' D27591-5m-3y-1m	11	Lebanon(1), India(1), Afghanistan, Sudan(1), Sudan(2), Spain(1), Greece, Syria, Lebanon(2), Uganda, Egypt.
6	Gaviota'S' D31725-3m-8y-0m	11	Syria, Lebanon(2), Greece, France(1), France(2), Saudi Arabia, Sudan(1), Korea, Afghanistan, Lebanon(1), Egypt.
7	21563-Jo'S' D31538-14m-3y-0m	13	Korea, Nepal, India(1), Sudan(2), Saudi Arabia, France(1), France(2), Lebanon(2), Mexico, Cyprus, Uganda, Egypt, India(2).
8	21563-Gr'S' D31543-7m-2y-0m	7	Syria, Saudi Arabia, Sudan(2), Lebanon(1), Mexico, Cyprus, Egypt
9	Maghrebi - H.O. CM9772-28m-0y	14	Oman, Afghanistan, Sudan(1), India(1), Sudan(2), Saudi Arabia, Iran, Spain(1), Spain(2), France(2), Syria, Mexico, Cyprus, Egypt.

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Entry No.	Variety	Frequency	Locations
10	Maghrebi 21563-AA'S' CM9776-50m-0y	9	France(1), France(2), Iran, Sudan(1), Korea, Afghanistan, India(1), Uganda Egypt.
11	Jo'S'-Cr'S'xGs'S'-AA'S' CM9902-5m-0y	10	Nepal, India(1), Korea, Afghanistan, Sudan(2), Iraq, Saudi Arabia, France(1), Spain(2), Egypt.
12	CIT'S'-Gaviota'S' CM9921-17m-0y	17	Syria, France(1), Greece, France(2), Spain(2), Iraq, Saudi Arabia, Sudan(1), Sudan(2), Lebanon(1), India(1), Nepal, Mexico, Cyprus, Egypt, India(2).
13	(AA'S'(Cpe^3-GzxTc^3/ BY$_E^2$-Tc))Gs'S'-Gll'S' CM10165-14m-0y		India(1), Korea, Iraq, Spain(1), Lebanon(2), Saudi Arabia, Mexico, Cyprus, Egypt.
14	Stw63-Gr'S'xGs'S'-Cr'S' CM10251-A-2m-0y	11	Lebanon(2), Syria, Greece, Spain(2), Iraq, Jordan, Oman, Afghanistan, Mexico, Cyprus, Egypt.
15	CIT'S'-AA'S'xFg'S' CM10352-C-1m-0y	11	Nepal, Korea, Afghanistan, Lebanon(1), Sudan(2), Sudan(1), Iraq, Iran, Greece, Egypt, India(2).
16	Cr'S'-Gr'S' CM2912-18y-6m-0y	10	Syria, France(1), Spain(2), Iran, Iraq, Sudan(2), Sudan(1), Lebanon(1), Korea, Egypt.
17	Cr'S'-Gr'S' CM2912-27y-1m-0y	13	Nepal, Oman, Sudan(2), Sudan(1), Jordan, Iran, France(1), Spain(1), Spain(2), Lebanon(2), Mexico, Cyprus, Egypt.
18	Cr'S'xT. dic. S. Vernum-Gll'S' CM199-29m-1y-1m-0y	14	Syria, Greece, France(2), Spain(2), Iran, Iraq, Sudan(2), Sudan(1), Oman, Lebanon(1), Korea, India(1), Nepal, Egypt.
19	Cr'S'-Gs'S' CM224-1m-1y-4m-0y	16	Bangladesh, Nepal, Oman, Lebanon(1), Sudan(2), Sudan(1), Iraq, Jordan, Greece, France(1), Spain(2), Syria, Mexico, Cyprus, Egypt, India(2).
20	Cocorit	9	Syria, Greece, France(1), Iraq, Bangladesh, Korea, Mexico, Cyprus, India(2).

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Entry No.	Variety	Frequency	Location
21	Gerardo VZ469-Gr'S' CM362-21m-2y-1m-0y	7	Iraq, Greece, France(1), Mexico, Cyprus, Egypt, India(2).
22	Gerardo VZ469-AA'S' CM363-5m-4y-3m-0y	6	Syria, Spain(2), Greece, France(1), Lebanon(1), Egypt.
23	Gerardo VZ469-AA'S' CM363-5m-4y-5m-0y	9	Korea, Nepal, Oman, Sudan(1), Sudan(2), Jordan, Greece, France(1), Egypt.
24	Gerardo VZ469-Cr'S' CM366-30m-4y-1m-0y	11	Spain(1), Spain(2), France(2), France(1), Jordan, Sudan(1), Afghanistan, India(1), Mexico, Cyprus, Egypt.
25	Gerardo VZ469-Plc'S' CM373-3m-2y-1m-0y	16	Afghanistan, Korea, Bangladesh, India(1), Lebanon(1), Sudan(1), Sudan(2), Spain(1), Greece, France(1) Syria, Mexico, Cyprus, Uganda, Egypt, India(2).
26	Gll'S'-Lds-RL3601/Jo'S' CM429-8m-3y-1m-0y	16	Syria, Greece, Spain(1), Spain(2), France(2), Iran, Iraq, Jordan, Oman, Korea, Afghanistan, Bangladesh, Sudan(2), Cyprus, Egypt.
27	21564-Cr'S' CM32929-8y-1m-1y-2m-0y	12	Sudan(2), Korea, India(1), Bangladesh, Jordan, Iran, Spain(1), Spain(2), Greece, Mexico, Cyprus, Egypt, India(2).
28	Pelicano'S' D25609-1m-1y-2m-0y	8	Bangladesh, India(1), Sudan(2), Jordan, Iran, Spain(2), Spain(1), France(2).
29	AA'S'-Plc'S' D33041-16y-3m-2y-0m	10	Spain(2), Spain(1), France(2), Greece, Saudi Arabia, Sudan(2), Nepal, India(1), Korea, Bangladesh.
30	Gaviota'S' D31725-6m-2y-2m-0y	2	Korea, Greece
31	Cr'S'-Gs'S' D28980-28y-13m-5y-1m-0y	11	Lebanon(2), France(2), Iran, India(1), Nepal, Bangladesh, Mexico, Cyprus, Uganda, Egypt, India(2).
32	BY^2E-Tc^2/Z-BxW D22232-3m-3y-1m-0y	8	Nepal, Saudi Arabia, Jordan, France(1), Spain(1), Oman, Egypt, India(2)

APPENDIX

Entry No.	Variety	Frequency	Location
33	Jori'S'(BY$_{E}^{2}$-Tc/Z-BxW) D31543-7L-0L	9	France(1), Jordan, Iraq, Saudi Arabia, Bangladesh, Mexico, Cyprus, Uganda, Egypt.
34	67-144-64L-0L	5	Bangladesh, Nepal, Saudi Arabia, Iran, France(2).
35	Giorgio 447	7	Bangladesh, Afghanistan, Korea, Lebanon(2), France(2), Iran, Nepal.
36	Flamingo D27562-9m-8y-3m-500y	13	Bangladesh, Afghanistan, Nepal, Sudan(1), Jordan, Iraq, Iran, Oman, Spain(1), Spain(2), Syria, Egypt, India(2).
37	Pg'S'-31810 CM10071-45m-0y	9	Syria, Oman, France(2), Spain(2), Iran, Saudi Arabia, Sudan(2), Nepal, Egypt.
38	Cr'S (TAC$_{E}$-Tc^{4})^{2}Z-BxW D28984-52y-1m-500y	9	Korea, Iran, Oman, France(1), Syria, Mexico, Cyprus, Egypt, India(2).
39	HI-7597	3	Lebanon(1), Iraq, Bangladesh.
40	Check - Cocorit	10	Korea, Afghanistan, Iran, France(1) Spain(1), France(2), Mexico, Cyprus, Egypt.
41	HI7572	1	Lebanon(1)
42	HI-7720	2	Lebanon(1), Oman.
43	Grulla-21564 ICM83-0L-5a-0a	11	Syria, Oman, Lebanon(1), France(2), Spain(2), Iran, Saudi Arabia, Jordan, Afghanistan, Bangladesh, Kenya.
44	Grulla-21564 ICM83-0L-6a-0a	5	Afghanistan, Bangladesh, Lebanon(1), Spain(1), Mexico, Cyprus.
45	USAIII-CxCrane'S' ICM532-0L-2a-0a	9	Lebanon(1), Greece, Spain(1), Spain(2), France(2), Bangladesh, Nepal, Mexico, Cyprus.
46	21563-Jori'S' ID31538-1L-0L-1a-0a	4	Jordan, Saudi Arabia, Mexico, Cyprus.

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Entry No.	Variety	Frequency	Location
47	21563-Garza ID31534-3L-0L-1a-0a	7	Spain(1), Iraq, Afghanistan, Bangladesh, Mexico, Cyprus, India(2).
48	21563-(BYE-Tc/Z-BxW) ID31543-7L-0L-2a-0a	6	Sudan(1), Iraq, Iran, Lebanon(1), Mexico, Cyprus.
49	21563-(BYE-Tc^5) ID31544-1L-0L-1a-0a	[illegible]	Lebanon(1), Oman, Spain(1), Iran, Iraq, Jordan, Mexico, Cyprus, Kenya.
50	Jori'S'/RD3-6xStw63 ID31563-4L-0L-2a-0a	7	Bangladesh, Jordan, Oman, Mexico, Cyprus, Kenya, India(2).

Location Names

Lebanon(1)	AUB, Lebanon	India(1)	Gudaspur, India
Lebanon(2)	Tel Amara, Lebanon	India(2)	New Delhi, India
Sudan(1)	Shambat, Sudan	Spain(1)	Aranjuez, Spain
Sudan(2)	Khasm El Girba, Sudan	Spain(2)	Lerida Espana, Spain
France(1)	Emsa, France		
France(2)	Aver de Vendome, France		
Greece,	Thessaloniki, Greece	Iraq	Talafar, Iraq
Iran	Karaj, Iran	Kenya	Njoro, Kenya
Bangladesh	Joydevpur, Bangladesh	Jordan	Deir Alla, Jordan
Cyprus	Athalassa, Cyprus	Saudi Arabia	Dirab, Saudi Arabia
Nepal	Khumaltar, Nepal	Mexico	Sonora, Mexico
Afghanistan	Kunduz, Afghanistan	Syria	Izraa, Syria
Oman	Wadi Quriyat, Oman	Korea	Suwon, Korea
Egypt	Giza, Egypt	Uganda	Karamoja, Uganda.

APPENDIX

Performance of Breadwheat and Durum Entries in the 2nd Rainfed Wheat Yield Trial 1973-74
Grain Yield in kg/ha and Varietal Ranking

Variety / Cross	Origin	Species	Middle East		South East		Africa		Europe		Overall Locations		Frequency in 1st high yielding group *
			Y	R	Y	R	Y	R	Y	R	Y	R	
1. Sabar Bek	Iraq	B/W	1548	25	866	25	585	25	1206	25	1302	25	0
2. Houreni	Syria	Durum	2032	15	2178	15	2275	22	2521	21	2219	23	2
3. Capeiti 8	Italy	Durum	2227	8	2211	13	2684	18	3031	13	2498	11	4
4. Giorgio 447	Italy	Durum	2078	14	2553	3	2657	19	3126	12	2513	10	3
5. Giorgio 532	Italy	Durum	1957	18	2209	14	2209	14	2947	14	2368	20	1
6. Gerardo 512	Italy	Durum	2030	16	2331	9	3292	11	3689	3	2681	6	7
7. Gerardo 572	Italy	Durum	2137	10	2394	7	3438	6	3736	2	2769	5	7
8. Gerardo 598	Italy	Durum	1936	17	2334	8	3327	10	3537	7	2625	7	3
9. Creso	Italy	Durum	1774	23	2145	16	3629	2	3319	10	2471	12	2
10. Castel Nuovo	Italy	Durum	2105	12	2252	10	2863	16	2914	17	2438	15	5
11. Castel del Monte	Italy	Durum	1891	21	2215	12	2960	13	2920	16	2349	21	0
12. FD-1024	Italy	Durum	2128	11	2114	17	2869	15	2963	15	2440	14	2
13. FD-1608	Italy	Durum	1913	20	2015	19	3228	9	3377	9	2520	19	2
14. FD-2302	Italy	Durum	1785	22	1977	20	2900	14	3408	8	2392	17	4
15. Maristella	Italy	Durum	2184	9	1915	23	2328	8	2869	18	2345	22	3
16. Cocorit 'S'	Mexico	Durum	2385	4	2728	2	3777	1	3614	4	2938	2	12

APPENDIX

Continued

Variety / Cross	Origin	Species	Middle East		South East		Africa		Europe		Overall Locations		Frequency in 1st high yielding group *
			Y	R	Y	R	Y	R	Y	R	Y	R	
17. Najah	Lebanon	BW	2420	3	1942	22	2649	20	2490	24	2385	18	7
18. Dw. Durum 5-15	Mexico	Durum	2275	6	2437	5	3518	4	2618	22	2535	8	7
19. Sonalika	India	BW	2095	13	2533	4	2979	12	2659	20	2423	16	3
20. Fitic 62	Mexico	BW	2464	2	2437	6	3619	3	3864	1	2977	1	12
21. P.106-19	Lebanon	BW	2525	1	2220	11	3469	5	3214	11	2770	4	8
22. Super X	Mexico	BW	2244	7	2844	1	3418	7	3582	5	2841	3	8
23. SA 42	Pakistan	BW	2369	5	2106	18	1733	24	2808	19	2376	19	6
24. Kyperounda	Cyprus	Durum	1753	24	1812	24	2324	22	2504	23	2035	24	0
25. Local check			1952	19	1946	21	2494	21	3579	6	2463	13	4

* Frequency of the variety appearing in the first significantly high yielding group out of 18 locations

Y - Average yield in kg/ha

R - Average rank on the basis of yield out of 25 varieties

APPENDIX

Multiple Disease Resistance
Durum Wheat

Below are durum (T. durum) varieties and lines in the 4th RDISN with a maximum average coefficient of rust infection to the rusts of YR = 5.0, LR = 5.0, SR = 20.0 *

RDISN No.	Variety/Cross Pedigree	YR ACI	YR HS	LR ACI	LR HS	SR ACI	SR HS	Source
Groupings 1 *								
1989	AA'S'(CpE^3-GzxTc^3/ BY$_E^2$-Tc) 31733-4m-3y-1m-0y	3.0	10S	2.4	5S	18.7	40S	4 RCB 26
2104	21563-Jori'S' ID31538-1L-0L-1a-0a	1.4	5MS	0.5	TrS	20.0	20S	3 PON 46
1856	Jo'S'(Gll'S'/61-130x60-115) D-32864-7Y-2m-2y-4m-0y	1.3	5S	4.0	40R	30.7	70S	5 IDSN 56
1908	Plc'S'-Cr'S'(Z-B. LKx 60-120/Gll'S') CM-13414-1y-2m-0y	2.6	10S	4.4	15MR -5S	43.3	70S	108
1909	Plc'S'-Cr'S'-(Z-B. LKx 60-120/Gll'S') CM-13414-1y-3m-0y	2.6	5S	4.7	40 MR	30.0	80S	109
1979	Mohammed Ben Bachir	2.5	5S	4.1	10S	73.3	80S	4 RCB 16
2069	Jo'S'-Cr'S'xGs'S'-AA'S' CM-9902-5m-0y	1.8	5S	4.4	15MR -10S	30.0	50S	3 PON 11
2214	USA III-CX Cr'S' ICM532-0L-2a-0a	3.0	10S	3.0	15 MR	26.6	40S	Tun. Sel. 18
2215	USA III-CX Cr'S' ICM532-0L-6a-0a	3.0	10S	1.7	5S	26.1	40S	Tun. Sel. 19
2216	61-130xLdsxGll/ Ganso'S' OC. 547-0L-4a-0a	3.0	10S	1.7	5S	21.7	40S	Tun. Sel. 20
2221	IDSN 045	3.0	10S	3.1	10MS	72.5	80S	Tun. Sel. 24
2258	D68-5-3b-4a	1.3	5S	3.5	15MR -5S	28.0	50S	Tun. Sel. 60

APPENDIX

RDISN No.	Variety/Cross Pedigree	YR ACI	YR HS	LR ACI	LR HS	SR ACI	SR HS	Source
Groupings 3								
1881	P66/253-Fg'S'xPg'S' Cit-71 CM18040-A-2m-0y	3.0	10S	20.2	80S	11.0	20S	5 IDNS 81
2107	21563-(BYE-Tc^5) ID3154-1L-0L-1a-0a	2.0	5S	20.6	60S	14.0	40S	3 FON 49
2108	Jori'S'/RD3-6xStw63 ID31563-4L-0L-2a-0a	0.0	0S	24.8	60S	16.1	40S	50
2109	Grulla-2a564 ICM83-0L-5a-0a	2.0	5S	14.1	40S	18.0	60S	Cyprus Sel.
Groupings 4								
1893	Chap-21563xCr'S' CM-12857-16y-1m-0y	35.5	80S	4.0	40MR	12.5	40S	5 IDSN 93
1972	Jori 69-BY$_E^2$-Tc x TAC$_E$-Tc^3 21570-9m-6r-1m	6.4	20S	4.8	20MS	17.5	60S	4 RCB 9
1983	Maghrebi 72-Gll(Br. 180 xLak/Gz-220x61-130 26842-21y-3m-0y	12.3	40S	3.5	20MR	20.0	40S	23
2021	Flamingo 'S' 27582-8m-13y-2m-0y	3.4	10S	4.0	40R	12.5	40S	57
2037	AA((Tgl$_E^2$-Pli)xRami-field Source)S34-3L	8.0	30S	4.6	40R	20.0	40S	74
2247	D68-4-21a-6a	5.0	10S	3.2	15MR -5S	13.7	40S	Tun. Sel 49

* Groupings 1 - 3R - satisfies selection criteria for the 3 rusts
2 - YR LR - leaf & yellow rusts
3 - YR SR - yellow & stem rust
4 - LR SR - leaf and stem rust

RENDEMENT DES VARIETES DE BLE DUR DE LA REGION

J.P. Srivastava

RESUME:

La plupart des variétés de blé dur cultivées dans la région sont d'origine locale et sont naturellement adaptées aux conditions de culture en sec, peu favorable à la culture du blé. Leur résistance aux maladies et leur potentiel de rendement ne sont pas satisfaisants et elles ne réagissent pas bien aux engrais en cas de fortes pluies ou d'irrigation.

Au début des années 60, plusieurs variétés développées en Italie ont été testées dans la région et l'on a constaté que le Capeiti 8 avait un rendement élevé et s'adaptait bien dans de nombreux pays. Depuis plusieurs années, FAO/IAEA/CNEN (Comité National Italien pour l'Energie Nucléaire), poursuivent leur programme de recherche visant à produire, sur le blé dur, des mutations induites par l'énergie nucléaire et à tester ces lignées dans la région du Moyen-Orient. On a constaté que le Castel del Monte, le GAB125 et le Creso sont les variétés à haut rendement les plus prometteuses issues de ce programme.

Depuis la fin des années 60, le germoplasme du blé dur provenant de CIMMYT a été diffusé dans la région à partir des pépinières de CIMMYT et des pépinières régionales (ALAD-CIMMYT-FAO). Les programmes nationaux ont identifié des variétés/lignées provenant de CIMMYT ayant un potentiel de rendement élevé et une meilleure faculté d'adaptation. Le Jori 69 et le Cocorit 71 ont donné de bons résultats dans des conditions de croissance favorables de même que dans des régions à faible précipitations où les maladies ne posent pas de problème particulier. En conséquence, ces variétés sont déjà cultivées au Liban, en Turquie, en Algérie alors qu'en Syrie, en Jordanie, en Arabie Séoudite et en Egypte, les semences de ces variétés sont en cours de multiplication.

De nouvelles lignées telles que le Crane 'S', le Brant 'S', le Jori 'S'x Crane 'S' ont donné les meilleurs rendements dans la Troisième Pépinière Internationale de Rendement du Blé Dur. Dans la Pépinière "Essais de Rendement du Blé Cultivé en Sec" le Jori 69, le Cocorit 71, le Capeiti 8, le Gerardo 512 et le Gerardo 572 donnent de bons rendements et font preuve d'une bonne adaptabilité. Les lignées CIT 'S'-Gaviota 'S', T.dic.S.vernum-G11'S', le Stork 'S' Jori 'S'-Cr'S', AA'S' (CPE^3-GzxTc/BY_ETc et 21563xJori'S' sont quelques uns des bons génotypes identifiés par les programmes nationaux dans les pépinières régionales et celles du CIMMYT.

Des lignées présentant une résistance aux maladies et identifiées dans les Pépinières "Insectes et les Maladies Régionales", ont été mises à la disposition des programmes nationaux pour être utilisées dans leur programme d'hybridation. Du germoplasme très diversifié de blé dur a été distribué dans la région pour faire face aux besoins des différents programmes génétiques. Plusieurs pays ont identifié des lignées de blé dur ayant un potentiel de rendement et une résistance aux maladies supérieurs et sont en train de les multiplier pour accroître la disponibilité de ces semences.

Original: Anglais

13

SEED INDUSTRY DEVELOPMENT NEEDS AND OPPORTUNITIES FOR THE REGION

E. Douglas

Did you ever hear of only one-half of an hourglass? Of course not. Two parts must be present or it isn't an hourglass. Similarly, wheat research and variety development without a seed multiplication and distribution program is equally difficult to imagine. The two must be connected.

In considering programs in the region, we might ask ourselves what kind of a connection exists. How well do the two parts fit together? Is the connection actually a bottleneck? How rapidly do new varieties move from research plots to farmers' fields? It is necessary to ask these questions in each country and in the region in general.

The hourglass also symbolizes the passage of time. Pressures are building. Time is running out. The building of strong, dynamic seed industries to match the research programs that are rapidly gaining strength cannot wait.

Before continuing, perhaps the term "seed industry", as utilized here, should be clarified. "Seed industry" is used in its broadest sense. At the 1973 International Seed Symposium, sponsored by FAO, the seed industry was interpreted to include:

1. Crops research and development
2. First stages of seed multiplication
3. Seed production, processing, storage and marketing at the commercial level
4. Seed quality control
5. Extension or advisory services

Briefly, the "seed industry" is a complex of technical and commercial operations through which varieties are developed and maintained and good quality seeds are produced and supplied to users. All segments of the seed industry must be present and functioning well in order to achieve a successful program.

What Kind of a Seed Industry Exists?

An attempt to evaluate the seed industry in the region is a hazardous undertaking. Current information is not readily available. However the results of a global seed survey were published in the FAO Seed Review 1971-72 (Review 1971-72). It contains useful information about 16 countries in the region. Reports from previous regional meetings were also helpful. I have spent short periods in five of the countries in the region and prepared reports about their seed industries.

No attempt has been made to assess the crops research and development programs because many in this audience are already familiar with the strengths and weaknesses of this aspect of the program.

The first stages of seed multiplication, commonly called Breeder Seed and Basic Seed[1] in certified seed programs, are closely tied with the crops research programs. Review 1971-72 identifies no specialized agencies concerned with the multiplication of these classes of seeds. In some cases, responsibility for Basic Seed production is assigned to agencies concerned with the production of Certified or Commercial Seed.

The Review 1971-72 shows the seed production, processing, storage and marketing handled as follows in the region:

1. Seed production (which appeared to be associated with seed processing) is handled in three countries by cooperatives, in five countries through a blend of government farms and government agencies contracting with farmers and in seven countries with the production totally on government farms. No information was reported from one country.

2. Seed distribution is handled principally by the ministry of agriculture or an agency closely associated with it. In a few cases cooperatives, wheat boards and commission agents were playing a role.

Seed quality control can usually be assessed by determining the presence of an operative seed certification program and/or the existence of some kind of seed legislation. The Review 1971-72 shows nine countries with

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1/ The Association of Official Seed Certifying Agencies in North America use the term Foundation Seed instead of Basic Seed.

standards for wheat and some inspection activities. Seven countries reported none. Regarding seed legislation, three countries reported they have a seed law, three were considering or preparing legislation, nine had none, and one did not report.

Seed testing is an essential part of quality control. Seven countries in the region are members of the International Seed Testing Association (ISTA). This normally indicates that at least one seed testing laboratory in the country is capable of testing seeds at a level acceptable for international trade.

An assessment of extension or advisory services is difficult. The Review 1971-72 used the term "seed promotion" to cover this aspect. Eleven countries reported a wheat seed subsidy, one relied primarily on credit, one indicated a fixed price, and three did not answer. Where subsidies or a fixed price were involved, it appeared that most seed was priced 5% to 15% above the grain price.

The amount of seed distributed is an indicator of the success of the seed multiplication program and particularly of the extension and advisory services. From the information available in the Review 1971-72, the amount of seed distributed officially can be compared with the total needs of each country. The chart below summarizes calculations for the region.

No. of Countries	Percentage of the Wheat Production Area Being Supplied With Seed From Official Sources
4	Supplying Above 20%
2	Supplying 3% to 20%
6	Supplying less than 3%
4	No information

Although some countries use radio, television and newspapers, my personal observations indicate that demonstrations in the field are the primary educational device used to contact farmers.

In summarizing the country reports in the Review 1971-72, primary attention was given to remarks regarding wheat and cereals in general. As is noted on a global scale, (Review 1971-72), "Compared with cereals, seed production of grain legumes, feed crops, pastures and vegetables are less developed and would need substantial support in many countries". Thus, the summary just made would tend to reflect the strongest aspects of the seed industry in the region.

Dr. Hafiz assesses the situation in the region in Cereal Improvement and Production Information Bulletin in 1972 as follows: "The controlled seed production and distribution program so essential when using high yielding varieties to increase production is lacking in many of the countries". His statement was made in 1972, and progress is being made in all countries. However, recognizing the time needed to build strong programs, it can be assumed that the position is better today, but not strikingly better. A seed industry is started, but it is in its early stages of development in many countries.

What Do We Want?

It is easy to agree that basically we want more good seed of the best wheat varieties available to more farmers. An examination of successful seed programs identifies certain components as inherent to success. (Douglas, 1973). Without attempting to enlarge on each point, a brief listing of some of these factors includes:

1. Clear responsibilities and goals and a means to insure a good working relationship among the various segments of the seed industry.

2. Strong government support for the development of a seed industry.

3. Good varieties clearly superior to varieties currently in use.

4. Adequate Basic Seed supplies and a means for assuring its continued availability.

5. Rapid seed multiplication at the Commercial and Certified Seed level, usually through interested seed multipliers and within a good quality control program.

6. Well organized and managed seed enterprises with adequate processing and seed storage facilities.

7. A strong marketing program which requires no subsidies to sell the seed.

8. An economically sound program which has the means for rapid, independent growth.

9. Adequate supplies of capital, often through credit, for seed multipliers, seed enterprises and seed users.

10. Highly motivated and trained personnel.

Each country needs to examine its own program to determine: 1) which of these components already exists, 2) how to strengthen them and 3) how to incorporate into the program those needed.

A publication from Mississippi State University (Delouche and Potts, 1971), indicates that in some countries "the various components of the program are so unevenly developed that the 'weak links' become bottlenecks and stifle progress". Those concerned with wheat research and development must be equally alert to all of the components needed for the total seed industry and work for their effective operation.

What Can We Do As A Region?

Over and beyond what each individual country can do, it seems wise also to examine what can be done to strengthen the seed industry regionally. Much cooperation already exists in the crops research programs. No attempt will be made to suggest what should be done except as it relates to seed multiplication. Good variety descriptions are one of the greatest needs. Developing descriptions is basically the responsibility of the plant breeders. Although varietal purity is important, "describe it like it is". If morphological variations do exist, the plant breeder should describe those variations so that people concerned with seed multiplication can do their work properly. Equally important is the free exchange of information so that varieties are described uniformly throughout the region.

Crops research programs must also bear special responsibility for Breeder Seed production and maintenance. Although this is primarily an in-country need, the increase of Breeder Seed of new varieties could be made in cooperation with other countries. The increased sharing of Breeder Seed of new varieties can strengthen the total regional program. Similarly, in the case of Basic Seed each country needs to assure that it has the capability for properly handling this increase. In some cases, it would be beneficial to prearrange for the multiplication of Basic Seed of certain new varieties in a country for use in a number of other countries in the region. Basic Seed should be free to move from one country to another easily.

Most Certified Seed and Commercial Seed of wheat needs to be produced and distributed within a country. However, the seed supplies of some countries are currently augmented by the purchase of seed from neighboring countries. Some countries do have natural advantages and/or stronger seed enterprises which should be utilized to increase seed supplies of new varieties to the maximum. Seed enterprises will be strengthened by an "intercountry" market. Unusual weather conditions can greatly reduce seed supplies in one area while another has abundant supplies. This information needs to be shared and attempts made to meet the seed needs of the entire region.

Regionally many opportunities exist for cooperation on quality control activities. The evaluation of seed certification programs and the movement of this seed throughout the region, would be greatly enhanced by the development of uniform certified seed standards, procedures, terms and labeling information. Seed legislation relating to the proper labeling of all seed being sold, to phyto-sanitary regulations and to seed law enforcement procedures could also be achieved more easily and effectively through a united regional effort. Although the International Seed Testing Association encourages uniformity in seed testing, this aspect of the program would be strengthened regionally by special efforts such as referee (comparative) testing and the sharing of information about testing procedures. Uniformity in all of these areas would greatly facilitate regional training opportunities with respect to quality control.

Developing educational and promotional material on seeds is costly and time consuming. However, it would be possible to develop certain kinds of material for use throughout the region. Once the basic lay-out and ideas were developed, the material could be printed in Arabic, French or English, depending upon the needs of each country. Few countries will undertake the development of a film only about good quality seed. However, as a regional activity a basic film could be made with the sound track changed to meet the language needs for each country.

Most seed technologists continue to be trained outside the region. Training within the region has many advantages -- the primary one being that the training can be more relevant to the needs of the area. The trained manpower needs justify top-priority to the development of good regional training programs in seed certification and quality control, seed testing, seed enterprise-management, seed marketing and seed processing. Adequate follow-up with former trainees is imperative to assure that they are properly utilized.

Many questions regarding seed processing equipment, the organization and lay-out of seed processing facilities, seed storage facilities, seed testing laboratories, continue to arise. Countries search for answers from many different sources. A single location in the region could be developed to provide objective, first-rate information and service to these areas. Such a location would be highly useful.

Degree programs with special emphasis on seed technology are available in only a few locations in the world. Although such a program in each country is not necessary, this region does need a strong, college-level program to train future leaders of the seed industry.

Many countries could benefit by working together in a region to achieve all of these objectives. (Douglas, 1974). However, this particular region has arrived at the stage where it can move ahead rapidly through joint action to build a much stronger seed industry.

The Time is Short!

At the International Seed Seminar held at Vienna Dr. J.R. Cowan said, "In the course of the next 10 to 20 years each country must set up an effectively operating seed program if the needs of the anticipated populations of the world are to be met". If the fruits of your research programs are to be utilized, stronger seed multiplication programs are needed. Each country needs to look at the components of its own program and assess the steps required to strengthen it. Stronger ties need to be developed within the region to help one another achieve these objectives. Seed must not be a bottleneck. It is essential that we find ways and means to increase new varieties faster.

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BESOINS ET PERSPECTIVES EN CE QUI CONCERNE LE DEVELOPPEMENT DE L'INDUSTRIE DES SEMENCES DANS LA REGION

Johnson E. Douglas

RESUME:

Un sablier se compose de deux sections reliées par un rétrécissement étroit. Sans les deux sections ce n'est plus an sablier. De même, la recherche en matière de blé et la mise au point de variétés doivent être associées à un programme efficace de multiplication de semences si l'on veut atteindre notre objectif principal, à savoir un plus grand nombre de variétés améliorées en production chez les agriculteurs.

Dans son sens le plus large, une industrie de semences se compose: 1) de recherches et de la mise au point de variétés, 2) des premiers stades de multiplication des semences, 3) de la production, du conditionnement, du stockage et de la distribution des semences à l'échelle commerciale, 4) du contrôle de la qualité des semences, et 5) des actions de vulgarisation et de l'encadrement des agriculteurs. Pour assurer la réussite dans ce domaine, it faut que chacune de ces opérations se déroule de façon efficace.

Le Rapport FAO sur les Semences 1971-72 montre que les différents éléments d'une industrie de semences solide sont réunis dans plusieurs pays de la région mais qu'il reste beaucoup à faire dans ce domaine.

Les industries de semences les plus réussies sont caractérisées par: 1) une coordination étroite entre les différentes composantes, 2) un appui solide de la part de l'Etat, 3) des variétés qui sont réellement supérieures, 4) la capacité de multiplier rapidement les semences des variétés choisies, et ce, dans le cadre l'un contrôle efficace de la qualité, 5) des établissements de semences opérant selon une organisation rationnelle et sous une gestion efficace, 6) de bons canaux de commercialisation des semences, 7) des capitaux suffisants, et 8) des cadres et des ouvriers motivés et bien formés.

Les besoins régionaux et les opportunités qui se présentent dans le domaine des semences sont les suivants: 1) de meilleures descriptions morphologiques des variétés améliorées; 2) des quantités plus importantes de semences-mère, de semences de base et de semences certifiées; 3) une meilleure exploitation des avantages naturels et des industries plus fortes

dans un certain nombre de pays, dans le but de multiplier le maximum de semences - surtout les générations précoces des nouvelles variétés - à l'intention des pays voisins; 4) une coopération plus étroite entre les gouvernements de la région en ce qui concerne l'institution du contrôle de la qualité, coopération ayant pour but d'arriver au maximum d'uniformité possible quant aux procédures, aux normes et à la terminologie; 5) l'étude des avantages d'une collaboration éventuelle entre les différents pays dans la préparation de documents et d'aides audio-visuelles pour la formation dans le domaine des semences et pour la vulgarisation et la publicité; 6) l'instauration, à l'intention des technologistes de semences, de programmes de formation et d'études sanctionnées par un diplôme; 7) la possibilité de créer un service capable de guider les gouvernements et les organismes non-étatiques pour le choix de matériel et de plans pour les usines de conditionnement, les centres de stockage et les laboratoires d'analyse.

Il faudrait que chaque pays revoit la situation de son industrie de semences en relevant aussi bien les réalisations que les points faibles. Et il faudrait simultanément étudier les moyens qui permettraient, par des actions communes, d'asseoir la production de semences à l'intérieur de la région sur des bases plus solides.

Original: Anglais

14

PRODUCTION ET CONTROLE DES SEMENCES DE BLE EN TUNISIE

M. KOUKI

I. HISTORIQUE

La nécessité d'organiser la multiplication des semences céréalières, particulièrement du blé de la contrôler et de la réglementer a été sentie depuis fort longtemps en Tunisie. En effet, dès 1922 un projet de contrôle fut soumis à l'étude. Ce projet avait fonctionné pendant une dizaine d'années sans faire l'objet d'un texte législatif, jusqu'au mois de Juin 1932 où fut l'apparition d'un premier decrêt portant création d'un registre des plantes pédigrées et instituant légalement un contrôle de la production des semences. Ce decrêt fut ensuite completé par 3 arrêtés d'application datant du 21 et 22 Juin 1932 et une instruction technique du Service Botanique et Agronomique de Tunisie. L'ensemble de ces textes prévoyait en plus du registre des plantes pédigrées, les formalités d'inscription à ce registre, le principe de contrôle et un début d'une législation commerciale; il définissait également les catégories de semences et les modalités de leur contrôle.

Entre les années 1930 et 1940 et suite à l'évolution des structures de production et de commercialisation (création de l'Office Interprofessionnel des Céréales avec sa section Tunisienne STONIC et le développement des coopératives céréalières) dans le pays, la révision de ces textes étaient inévitables. -

Aussi le decrêt de 1932 fut il remplacé par celui du 12 Aout 1937, créant au Service Botanique et Agronomique un registre des variétés de blé susceptibles d'être multipliées en Tunisie. Les arrêtés de 1932 furent à leur tour abrogés et remplacés, d'abord par ceux du 14 Aout 1937, ensuite par l'arrêté du 17 Septembre de la même année, relatif au registre des variétés de blé, aux conditions de contrôle, de circulation et de vente des blés de semences.

Dans le cadre de ces derniers textes, la décision d'inscription au registre des variétés de blé était confiée à une commission groupant des techniciens, des administrateurs et des professionnels, la multiplication étant du ressort des coopératives céréalières; quant au contrôle, celui-ci relevait des competences du service botanique et agronomique.

Mais, les expériences des années 1942 à 1945, aggravées encore par les évenements de la deuxième guerre mondiale, avaient montrer l'inefficacité de cette organisation ainsi que son impuis-

sance à conserver la qualité des semences. Telles furent les raisons principales de la création de la Coopérative de Semences de Tunisie (COSEM) à la fin de l'année 1946.
La création de cette Coopérative avait éxigé une refonte des textes, refonte qui fut effectuée par:

- le decrêt du 23 Janvier 1947: Ce decrêt ne comportait aucune modification de principe par rapport à celui de 1937, mais remplaçait uniquement le mot blé par "céréales" (mot limité au blé, à l'orge et à l'avoine),

- et l'arrêté du 22 Octobre 1951.

Ces deux derniers textes constituaient le statut de la production et du contrôle des semences en Tunisie jusqu'à l'année 1966 ou ces textes ont été remplaçés par ceux du 14 Septembre 1966 qui sont actuellement en vigueur.
Selon ces derniers textes, qui sont, à quelques modification près, identiques à ceux de 1947, seul le contrôle sur champs est obligatoire. Les analyses au laboratoire ne sont exigées qu'au cas ou le champs n'a pas été agrée définitivement "par suite de certaines considérations particulières". - Dans ce dernier cas l'échantillon est prélévé par le producteur lui-même pour être soumis au laboratoire spécialisé de l'Institut National de Recherches Agronomiques (INRAT).Par ailleurs, ces textes ne prévoient aucun contrôle au niveau de la commercialisation des semences.
Compte tenu de ces lacunes et la nécessité d'éxaminer l'ensemble du système de multiplication et de distribution de toutes les espèces agricoles, nécessité dictée d'ailleurs, par l'évolution générale de l'agriculture tunisienne, la revision des dits textes de 1966 était devenue obligatoire.
C'est dans ce contexte, que le Ministère de l'Agriculture a élaboré depuis 1971 un projet de législation relatif à l'organisation et au contrôle de la production et de la commercialisation des semences agricoles, aussi bien céréalières, maraîchères, fourragères qu'arboricoles.
Ce projet est actuellement en cours de promulgation.

II. ORGANISATION ACTULLE DE LA MULTIPLICATION ET DE LA PRODUCTION DE SEMENCES CEREALIERES EN TUNISIE

Le système de multiplication et de production de semences de céréales s'articule actuellement sur les organismes suivants:

L'Institut National de Recherches Agronomiques (INRAT) qui est chargé de création, de l'expérimentation et de la conservation des variétés ainsi que du contrôle des semences mères -

La Coopérative de Semences de Tunisie (COSEM) qui est spécialisée dans la multiplication et la production des semences céréalières. Elle compte plus de 50 coopérateurs qui sont des multiplicateurs agissant dans le cadre de contrat de multiplication.

- La Coopérative Centrale de Semences et Plants Sélectionnés (C.C.S.P.S.) qui produit en plus des semences et plants d'autres espèces agricoles, les semences céréalières sur plus de 50 exploitations privées, coopératives et étatiques dans le cadre également de contrats de multiplication.

Quant au schema de multiplication, celui-ci se présente comme suit:

Année	Activités	
1ère Année: Epis	50 épis fournis par l'INRAT, qui sont plantés en lignes	Ce différentes étapes passent sur les champs d'épurations des Coopératives de Semences. La sélectiom se fait sous le contrôle de l'INRAT
2ème Année: S.E	La production des lignes sélectionnées est groupée pour produire les semences épurées (SE)	
	1 q	
3eme Année: $S.M_1$	Les S.E. sont groupées pour donner les semences de première multiplication ($S.M_1$)	
	10 à 20 qx	
4ème Année: $S.M._2$	Les $S.M_1$ (SM_2) → Semences de 2ème multiplication	Chez les multiplicateurs sous contrat de multiplication. Le contrôle se fait selon la procédure indiquée au paragraphe IV.D.
	200 qx	
5ème Année: S.P.O	$S.M._2$ (S.P.O) → Semences pédigrées d'origine	
6ème Année S.P.R	S.P.O → S.Pédigrées de réproduction	
	Vente aux utilisateurs	

III. PROJET DE LEGISLATION SUR LES SEMENCES : ELEMENTS ESSENTIELS

A. Dispositions communes à toutes les semences

1.) Généralités

La législation, actuellement en cours de promulgation, contient toutes les prescriptions relatives aux conditions de production et de commercialisation des semences agricoles et décrit les modalités de leur éxecution.

Les éxigences minimales relatives aux principaux caractères déterminants des semences de qualité et qui sont mentionnés ci-après sont également indiquées:

- Pureté genétique (ou variétale)
- Faculté germinative
- Pureté spécifique (ou mécanique)
- Teneur en graines de mauvaises herbes
- Etat sanitaire
- Poids spécifique, teneur en eau, etc...

Les conditions sous lesquelles les semences peuvent être classées, agrées, étiquetées et commercialisées sont aussi fixées.

2.) Organisation de la production

a) Catalogue officiel

La législation sur les semences dont il s'agit a en outre, institué un catalogue officiel de variétés de plantes agricoles, qui comportera les variétés, ayant une valeur économique et d'utilisation pour la Tunisie. Par ailleurs, seules peuvent être certifiées les variétés inscrites a ce catalogue qui est tenu par l'Institut National de Recherche Agronomique de Tunisie (I.N.R.A.T.).

b) Comité National Consultatif de Semences

Pour permettre à l'Administration d'élaborer et mettre en pratique une politique rationnelle en matière de production et de commercialisation de semences, la législation sus-visée a prévu un organe consultatif dénommé: "Comité National Consultatif de Semences". Cet organe étudie et propose à l'Administration toutes mesures d'orientation et d'éxecution de sa politique en la matière.

Le comité dont il s'agit est placé sous la présidence du Directeur de la Production Agricole et est composé de 14 membres représentant tous les secteurs intéressés.

c) Catégories de semences

Conformément à la réglementation de la communauté européenne avec laquelle la Tunisie entretient des relations étroites, les semences agricoles sont classées dans les 4 catégories ci-dessous.

Semences de base (1)

Les semences de base, sont des semences qui ont été produites à partir de matériel parental, produit sous la responsabilité de l'obtenteur ou du selectionneur, selon les régles d'usage de la sélection conservatrice, en ce qui concerne la variété (équivalent de S.P.O.)
Elles sont prévues pour la production de semences certifiées (S.P.R.). Elles sont soumises à un processus de certification.

Semences certifiées (1)

Sont des semences issues des semences de base. Elles sont également soumises à un processus de certification.

Semences standard

Ce sont des semences qui possèdent suffisamment d'identité et de pureté variétales et qui repondent à certaines normes et conditions de qualité.

Semences commerciales

Ce sont des semences qui possèdent l'identité de l'espece et qui repondent à certaines normes de qualité.

(1) Pour les blés seules ces deux catégories sont autorisées pour la commercialisation, sauf dérogation spéciale au cas ou l'apparissionement en ce deux catégories est insuffisant.

3.) Certification de semences

La certification de semences a pour but essentiel de maintenir et de mettre régulièrement à la disposition des utilisateurs des semences des variétés les meilleure.

La certification de semences comporte plusieurs étapes constituant le système de certification.

- Une ou plusieurs inspections au champ en cours de végétation, par les agents contrôleurs du Ministère de l'Agriculture et ce en vue notamment, du contrôle de la pureté variétale et de l'état sanitaire.

- Echantillonnage des semences à la station de conditionnement.
- Analyses au laboratoire d'essais de semences.
- Etiquetage et plombage des emballages contenant ces semences, permettant ainsi leur identification et garantissant la conservation de leur identité.
- Enfin le contrôle postérieur sur champ en vue de vérifier la bonne marche du système et de contrôler encore la pureté et l'identité variétale ainsi que l'état sanitaire.

4.) Contrôle à la commercialisation

Toutes les semences agricoles sont contrôlées au niveau de la commercialisation en vue de déterminer si les semences distribuées dans le pays sont conformes aux prescriptions de la-dite législation (étiquetage, emballage, fermeture etc....).

B. Production et certification des semences de blé

1.) Conditions de multiplication

a) Parcelle de multiplication

- La parcelle de multiplication d'une variété donnée doit être d'une superficie minimale de 15 Ha.

b) Précedent cultural

Toute culture effectuée en vue de produire des semences ne peut avoir lieu que sur terrain n'ayant pas porté de céréales l'année précedente.

c) Isolement

Les cultures voisines doivent être séparées par une allée; la distance entre un champ portant une culture de céréales, destinée à la production de semences et une autre culture de céréales ne peut en aucun cas être inférieure à 2 mètres pour les semences certifiées et 5 mètres pour les semences de base.

2.) Conditions de certification

a) Contrôle sur champ et conditions pour la certification quant à la culture

Toutes les cultures sont visitées au moins une fois après épiaison par les agents contrôleurs du Ministère de l'Agriculture en vue d'apprécier surtout la pureté variétale et l'état sanitaire.

Pureté variétale

Des comptages en nombre suffisant, portant sur l'ensemble de la parcelle en multiplication en des points pris au hasard, sont effectués en vue d'estimer la pureté variétale de la-dite parcelle.
Sont considérées à cet effet comme impurétés variétales, les plantes et épis de la même espèce qui ne sont pas typiques pour la variéte.

Ces impuretés ne sont tolérées que dans les limites de:

0,1% pour les semences de base (SPO)

0,3% pour les semences certifiées (SPR)

Etat sanitaire

La présences de maladies réduisant la valeur d'utilisation de semences peut être une cause de refus des cultures en multiplication.
Les maladies à incrimer, notamment les charbons, ne sont tolérées que dans les limites de 0,5% pour les 2 catégories "Semences de base" et "Semences certifiées".
L'état sanitaire sur champ est apprécié par des comptages effectués dans les mêmes conditions que pour la pureté variétale.

Etat cultural du champ

L'état cultural du champ de multiplication et l'état de développement de la culture doivent permettre un contrôle suffisant de l'identité et de la purété variétale ainsi que de l'état sanitaire. Ils peuvent constituer un motif de refus du champ en question.

Pureté spécifique

La présence de plantes dont les graines sont difficiles à éliminer lors des opérations de conditionnement est également contrôlée.

Remarque

Le résultat du contrôle sur champ est notifie aux établissements de semences et aux multiplicateurs sous forme de "compte rendu d'inspection sur champ" et ce après achèvement de l'opération.

b) Conditions auxquelles doivent satisfaire les semences

Les semences provenant des cultures en multiplication acceptées sur champ doivent, après conditionnement et essais au laboratoire, repondre à l'ensemble des normes définies ci-après:

1) Pureté spécifique et faculté germinative

Espèces	Catégorie	Pureté (mini) spécifique % du poids	Faculté germinative minimale des semences pures	Teneur max. en graines d'autres especes de plantes Nombre de graines par 500 gr.		
				Total	Autres espèces de céréales	Autres espèces de plantes
Avoine, Orge, Blé	Semences de base	98	85	4	1	3, dont 1 Raphanus raphanistrum, Avena stérillis, Lolium temulentum, faux-Fénouil
Avoine, Orge, Blé	Semences certifiées	98	85	10	5	7, dont 3 Raphanus raphanistrum, Avena stérillis, Lolium temulentum, faux-Fenouil

2) - La teneur en eau des semences est limitée à 12% du poids.

3) - Le poids spécifique minimum des semences de céréales ne devra pas être inférieur à 75 pour les blés tendres, 78 pour les blés durs, 55 pour les orges, 45 pour les avoines.

4) - La présence de maladies et de parasites n'est tolerée que dans la limité la plus faible possible.

IV. PREPARATIFS POUR LA MISE EN APPLICATION DE LA LÉGISLATION PROJETEE

A. Laboratoire d'essais de semences

La mise en application de la législation projetée nécessite la mise en oeuvre de certains moyens et instruments dont un laboratoire d'essais de semences, qui a pris le jour à partir du mois de Décembre 1971, grace à l'amicale et fructueuse coopération Tuniso-R.F.A.

Ce laboratoire constitue actuellement l'un des instruments essentiels du service de contrôle et de certification de semences du Ministère de l'Agriculture.

Il est chargé d'effectuer les essais relatifs à la détermination de la qualité des semences. Ces essais sont effectués selon les régles de l'Association Internationale d'Essais de Semences dont ce laboratoire est membre depuis le début de l'année 1973.

B. Description des variétés tunisiennes de blé

En l'absence d'une description complête, permettant la distinction des variétés entre elles, le service de contrôle et de certification de semences a depuis l'année 1973 entrepris la détermination des caractères morphologiques et physiologiques des variétés tunisiennes de ble.

La liste des caractères utilisés est annéxée au present rapport.

C. Formation du personnel technique

La compétence et les qualifications du personnel étant indiscutablement parmi les facteurs essentiels qui conditionnent le succés ou l'échec d'une entreprise quelconque, le Ministère de l'Agriculture a procédé, même bien avant la construction et l'équipement du laboratoire d'essais de semences, à la formation d'une équipe de techniciens spécialisés.

Cette formation a eu lieu, selon les cas, à l'étranger (R.F.A., France, Danmark) ou sur place.

Plusieurs stages de perfectionnement à l'étranger sont prganisés annuellement au profit du personnel dont il s'agit.

D. Rodage du système de certification - Exemple des campagnes 1972-1973 et 1973-1974

1) Procédure

A partir de la campagne agricole 1972-1973, il a été décidé d'effectuer le contrôle selon les textes en vigueur avec l'introduction de certaines prescriptions prévues par la nouvelle législation. Cette combinaison avait pour but:

- de roder le personnel technique qui sera appelé à exercer la certification des semences dans le cadre de la nouvelle législation, une fois promulguée.

- de vulgariser auprès des multiplicateurs et des producteurs de semences les normes projetées.

A cet effet, les inspections sur champ ont été effectués par deux équipes, groupant chacune 4 membres représentant l'I.N.R.A.T., l'Office des Céréales, l'Etablissements des Semences et le Service de Contrôle et de Certification. Ces deux équipes, dirigées par les représentants de l'I.N.R.A.T., sont chargées, l'une du contrôle des parcelles de multiplication relevant de la C.C.S.P.S., l'autre de celles relevant de la C.O.S.E.M.

Quant aux opérations relatives à l'échantillonnage, l'étiquetage, le plombage, les analyses au laboratoire et le contrôle postérieur sur champs, celles-ci ont été effectuées par le service de contrôle et de certification des semences.

2) Résultats

a) Inspection sur champs

Les superficies inspectées ainsi que celles agrées durant les deux campagnes en question, se repartissent conformement au tableau ci-après:

Pour ce qui est de l'état des champs contrôlés, les observants suivantes méritent d'être mentionnées:

- La pureté variétale des cultures visitées variait en général de bonne à excellente.

- Cépendant, quelques rares champs présentaient des impurétés variétales (notamment pour les nouvelles variétés).

- Certains champs étaient envahis de mauvaises herbes, notamment folle-avoine, Ray-grass, Phalaris et Chrysanthème, rendant parfois l'appréciation de la pureté variétale très difficile.

- Dans d'autres cas, l'état des champs a été sérieusement affecté soit par les inondations (campagne 1972-1973), soit par la grêle (campagne 1973-1974).

- La présence du charbon nu était constatée particulièrement dans les champs de Badri (D56.3A) d'INIA 66 et de Florence Aurore, mais le dégré d'attaque était inférieur aux normes projetées.

Superficies inspectées - 1972/1973 et 1973/1974 - Résultats

	Campagne 1972 - 1973				Campagne 1973 - 1974			
	Semences de base		Semences cert.		Semence de base		Semences certifiées	
	Superficie inspec.	Superficie agréée	Superficie inspec.	Superficie agréée	Superficie inspec.	Superficie agréee	Superficie inspec.	Superficie agréeee
Blé tendre:								
Florence Aurore	217,0	217,0	2055,0	2055,0	230,0	230,0	1749,0	1749,0
INIA 66	80,0	80,0	782,6	782,0	103,0	103,0	585,0	515,0
Tobari	60,0	50,0	120,0	120,0	22,0	22,0	153,0	153,0
Ariana 66 (T.21.23)	55,0	55,0	260,0	260,0	32,0	32,0	695,0	615,0
Total blé tendre	412,0	402,0	3217,6	3217,6	387,0	387,0	3182,0	3032,0
Blé dur:								
Roussia	20,0	20,0	50,0	50,0	28,0	28,0	75,0	75,0
Mahmoudi	140,0	140,0	1753,0	1753,0	124,0	124,0	931,0	874,0
Chili	28,0	28,0	311,0	245,0	90,0	90,0	301,0	301,0
Synd.Mahmoudi (D.52.24)	90,0	90,0	656,0	656,0	34,0	34,0	570,0	260,0
Kokini(D.77)	98,0	98,0	815,0	815,0	80,0	80,0	509,0	509,0
Badri(D.56.3A)	120,0	120,0	961,0	918,0	145,0	145,0	1916,0	1878,0
INRAT 69 (D.58.25)	150,0	150,0	2143,0	1848,0	152,0	152,0	3196,0	2952,0
Total blé dur	626,0	626,0	6689,0	6285,0	653,0	653,0	7498,0	6849,0
Total général	1038,0	1028,0	9906,6	9502,6	1040,0	1040,0	10680,0	9881,0

b) Echantillonnage

Les opérations d'échantillonnage ont été effectuées par les agents qualifiés du service de contrôle et de certification des semences, selon les prescriptions de l'Association Internationale d'Essais de Semences (I.S.T.A.) sur des lots homogènes de semences conditionnées et dont le poids maximum de chacun est de 200 qx.

Le nombre de lots échantillonnés durant les deux campagnes passées se présentait comme suit:

	Campagne 1972/1973		Campagne 1973/74	
	Semences de base	Semences certifiées	Semences de base	Semences certifiées
Blé tendre:				
Florence Aurore	13	87	14	48
I N I A (66)	2	53	3	31
Tobari	2	4	-	8
Ariana 66(T21.23)	4	13	3	47
Total blé tendre	21	157	20	134
Blé dur:				
Roussia	1	-	1	7
Mahmoudi	6	80	3	70
Chili	2	11	-	13
Syndiouk Mahmoudi	4	26	9	1
Kokini (D 77)	3	24	7	17
Badri (D 56.3A)	9	70	8	145
INRAT 69 (D58.25)	14	116	24	150
Total blé dur	39	327	52	403
Total général	60	484	72	537

Cependant, cette phase importante du système de certification s'est heurtée à des difficultés pouvant dans l'avenir porter préjudice à l'ensemble du système dont il s'agit. En effet, l'insuffisance de la capacité de stockage dont disposent les centres de conditionnement relevant des établissements de semences, ne permet pas de constituer un certain nombre de lots facilement identifiables.

Pour remédier àces difficultés, les établissements ont entrepris depuis l'année dernière des études en vue d'améliorer aussi bien leur capacité de stockage et de conditionnement que les conditions de travail dans les centres de conditionnement.

c) Etiquetage et plombage

Des scellés officiels ont été, conformement aux prescriptions de la nouvelle législation, distribuées pendant la campagne 1973-1974 aux établissements de semences, par le service de contrôle et de certification. -

Quant à l'étiquetage, le modèle prévu et qui porte tous les renseignements (espèce, variété, catégorie, N° du lot, date de récolte, etc....) relatifs au lot a été adopté par les deux établissements de semences depuis la campagne 1972/73.

d) Analyses au laboratoire

Les analyses qui ont été effectuée dans le cadre de la certification de semences de blé sur les échantillons (544 pour la campagne 1972/73 et 609 pour celle de 1973/74), soumis officiellement au laboratoire d'Essais de Semences, ont porté particulièrement sur la détermination des caractéristiques suivantes:

- Pureté spécifique
- Teneur maximale de graines de mauvaises herbes
- La faculté germinative
- La teneur en eau.

- La pureté spécifique

La pureté spécifique exprimée en pourcentage de semences pures de l'espèce analysée était d'une façon générale satisfaisante comme le montre le tableau ci-après:

Campagne agricoles	Pureté > 98 %		Pureté < 98 %		Observations
	Nombre de lots	%	Nombre de lots	%	
1972 - 1973	496	91,2	48	8,8	D'une façon générale la pureté spécifique variait de 96% à 100%
1973 - 1974	579	95,1	30	4,9	

Les impuretés rencontrées dans les lots sus-visés étaient:

- Des matières inertes

Ce sont surtout des grains cassés (surtout dans les blés durs), des glumes et des glumelles.

Ces impuretés ont été rencontrées dans presque tous les échantillons analysés, mais dans des pourcentages variant de 0,05% (traces) à 3,9% du poids.

- Des grains de mauvaises herbes

Les espèces de mauvaises herbes rencontrées sont:

- Galium aparine
- Bupleurum lancifolium
- Rapistrum rugorosum
- Phalaris sp.
- Mélilotus indicus - M.infesta et M.segelatis
- Echium plantaginum
- Bifora radians
- Convolvulus arvensis
- Silybum eburnéum et Silybum marianum
- Spoméa sibirica
- Scolymus hispanicus
- Capnopyllum perugunum
- Lolium rigidum
- Emex spinosus
- Krubera perigrina

Les trois premières espèces étaient les plus fréquentes. En effet, sur les 187 fiches d'analyses prises au hasard (des deux campagnes), il a été constaté la présence de:

- Galium aparine	dans:	30
- Bupleurum lancifolium	" :	21
- Rapistrum rugosum	" :	10
- Spoméa sibirica	" :	6
- Mélilotus indicus	" :	5
- Silybum eburneum	" :	4
- Convolvulus arvensis	" :	
- Echium plantaginum	" :	3
- Emex spinosus	" :	
- Krubera perigrina	" :	

- Les autres espèces ont été rencontrées chacune une fois.

- Des graines d'autres espèces cultivées

(voir paragraphe ci-après)

Les graines d'orge et d'avoine cultivées étaient présentes dans un grand nombre de lots.

- Teneur en graines d'autres espèces de plantes

Pour ce qui est de cette caractéristique qui s'exprime en nombre de graines d'autres espèces dans 500 grammes, les résultats obtenus appellent les observations suivantes:

- Absence totale d'espèces reconnues dangéreuses: Folle avoine - Faux fenouil - Lolium temulentum etc....
- Présence de graines d'orge et d'avoine cultivée dans un grand nombre de lots et dans des proportions parfois très élevées.
- Présence de blé dur dans des lots de blé tendre ou vice-versa.

Ceci étant, le nombre de lots qui aurait du être refusé à la commercialisation par suite de cette caractéristique, si la législation était en vigueur, était de:

24 (dont 1 lot de semences de base) soit 4,4% des lots contrôlés au cours de 1972-1973

65 (" 3 lots " " de base) soit 10,6% des lots contrôlés au cours de 1973-1974.

Le pouvoir germinatif

Les résultats obtenus quant au pouvoir germinatif doivent constituer un sujet de préoccupation, notamment pour les blés durs. En effet, si au cours de la campagne 1972-1973 seuls 13,2% des lots testés n'avaient pas un pouvoir germinatif supérieur à la limité minimale (85%), admise par la nouvelle législation, pour la campagne 1973-1974 ce pourcentage était de 20%, comme le montre le tableau ci-après:

	Germination > 85%		Germination < 85%		Observations
	Nombre de lots	%	Nombre de lots	%	
Campagne 1972 - 1973	412	86,8	72	13,2	
Campagne 1973 - 1974	482	80,0	127	20,0	Le pouvoir germinatif avait descendu jusqu'à 43% pour blé dur et 81% pour blé tendre

Il a été constaté en outre que sur les 20% des lots de 1973-1974, dont le pouvoir germinatif était inférieur à la limité admise, 87,4% appartaient aux variétés de blé dur et que la germination était faible par suite de la présence importante de différentes anomalies de germination.

Suite à ces constatations des échantillons ont été soumis aux laboratoires spécialisés de l'I.N.R.A.T. et de l'INAT, ainsi qu'à la Station d'Essais de Semences de Munich (R.F.A.),

avec laquelle le laboratoire d'essais de semences de Tunisie entretient des rélations très étroites.

Les essais effectués par ces différentes laboratoires avaient aboutit aux conclusions et hypothèses suivantes (les résultats obtenus étaient comparables entre eux et avec ceux obtenus par le laboratoire d'essais de semences de Tunisie):

- Absence de champignons transmissibles par les semences et pouvant affecter la germination de celles-ci.
- Présence de graines sans germe ou avec germe présentant des lésions parfois assez profondes. Cette anomalie pourrait être due aux mauvaises conditions de récolte et de battage.
- Le produit de traitement contre la carie, utilisé parfois à de fortes doses serait éventuellement à l'origine de certaines anomalies.

Ces dernières hypothèses seront encore parmi d'autres étudiées au cours des campagnes à venir, en vue de déterminer les origines du faible pouvoir germinatif des semences et d'en apporter ensuite les remèdes nécessaires.

- La teneur en eau

Cette caractéristique n'a été analysée que sur un nombre restreint de lots, étant donné que selon les archives, elle n'a jamais posé de problèmes pour le stockage du blé en Tunisie.

Cependant, et compte tenu des résultats obtenus sur les 35 échantillons qui ont été soumis au laboratoire par l'INRAT au cours de l'année 1974, cette caractéristique, bien qu'elle n'ait jamais dépassé la limité maximale de 12%, devra être étudiée convenablement au cours des années à venir afin d'eviter des surprises désagréables.

Teneur en eau	Nombre des échantillons
de 8,39 à 8,72%	4
de 9,01 à 9,12%	3
de 10,00 à 10,93%	8
de 11,00 à 11,70%	18
à 12%	2

Récapitulatif

En tenant compte de toutes les conditions auxquelles doivent satisfaire les semences, les lots qui seraient déclassés, si la législation était en vigueur, présentaient:

24,5% des lots testés au cours de 1972-73

31,0% des " " " " de 1973-74.

e) Contrôle postérieur sur champs

- But: Les essais de post-contrôle ont pour l'objet de vérifier le bon fonctionnement de tout le système de certification de semences.

  - Ils visent en particulier la vérification de l'identité et de la pureté variétale des lots de semences déjà certifiées, ainsi que l'état sanitaire de ceux-ci. -

  - Ils servent également comme moyen de préeontrôle des semences de base.

- Emplacement: Ces essais sont effectués à la Station de la Soukra, qui relève du Ministère de l'Agriculture, sur une superficie de 0,80 ha environ pour chaque campagne.

- Nombre des échantillons utilisés: Les échantillons de semences de base et de semences certifiées, semés en vue de leur contrôle à postériorité proviennent des lots détenus par les établissements de semences et qui avaient fait préalablement l'objet d'analyses au laboratoire.

  Le temoin utilisé aux fins de comparaison est représenté par les semences de 2ème multiplication(SM2), indiquées par l'I.N.R.A.T.:

	SM 2 (Temoin)	Semence de base	Semences certifiées	Observation
Echantillons des lots de la Campagne 1972_1973	22	45 de semences conditionnées	311 de semences conditionnées	Echantillons semés à partir du 20. Novembre 73 à la densité 1 quintal/ha
Echantillons des lots de la Campagne 1973-1974	22	70 dont 15 des semences brutes	229 dont 49 des semences brutes	semés à partir du 20. Novembre 74 à la même densité(les observations sont donc en cours)

- Méthode

  La méthode utilisée pour chaque variété et chaque catégorie est la suivante:

  - Semences de base: une répétition de 2 parcelles de 5 m^2 (1m x 5)

- Semences certifiées: une seule parcelle de $5m^2$ (1m x 5)
- Temoin (SM 2) : au moins une parcelle de $5m^2$, tous les parcelles des autres catégories.

- Remarque

Les échantillons de semences brutes ont été prélevés sur des lots provenant directement du champs de multiplication et au moment de leur reception à la station de conditionnement, tandis que les échantillons de semences conditionnées ont été prélevés sur des lots conditionnés, traités et ensachés.

Ces différents prélèvements avaient pour but de déterminer d'une manière plus précise à quel stade un mélange variétal éventuel a eu lieu.

- Observations

Les observations ont porté sur un ensemble de caractères morphologiques et physiologiques de chaque variété, caractères arrêtés en se basant sur ceux définis par l'I.S.T.A., l'U.P.O.V. et ainsi que ceux utilisés dans les systèmes allemands et français (voir liste en annexe).

Il est à préciser à cet effet, que toute plante d'une autre variété ainsi que toute plante variant dans un ou plusieurs caractères par rapport au temoin et aux autres plantes de la parcelle concernée est comptée comme "autres types".

Ces types différents ainsi que la présence de charbon sont exprimés en pourcentage du nombre de plantes dans chaque parcelle, nombre qui a été détermine déjà avant le tallage. -

- Résultats

Plus de 6% de semences certifiess au cours de la campagne 1972-1973 seraient, compte tenu des normes projetées, impropres à la commercialisation en ce qui concerne la pureté variétale (pour la campagne 1973-1974 les observations sont en cours).

Pour ce qui est du charbon, seules les variétés Badri, Florence Aurore, INIA et Tobari s'étaient montré très sensibles et présentaient souvent un pourcentage supérieur à 0,5%.

Compte tenu de ces résultats, il a été demandé aux établissements de semences de retirer du circuit commercial les lots ne repondant pas aux normes, de renforcer leur système de contrôle intérieur en vue d'eviter tous les risques de mélanges variétaux et de traiter systèmatiquement tous les semences de base et de prébase, appartenant aux variétés qui se sont rélevées très sensibles contre le charbon.

ANNEXE

SERVICE DE CONTROLE ET
DE CERTIFICATION DE SEMENCES
TUNISIE

ANNEXE

Caracteres morphologiques et végétatifs du blé dur utilisés pour la description variétale, le pre- et post-contrôle de semence certifiée

Morphological and vegetatif caracteristics of hard wheat used for the varietal description, the pre- and the post-control

Caractères Caractéristics			Méthode d'observation Method of observation	
I. Grain	1.Dimensions	Longueur	avant le semis sur 4 x 25 grains	petit — long
I. Grain	1.Size	Length	befor sowing, on 4 x 25 grains	small — large
	2.Dimensions	Largeur	avant le semis, sur 4 x 25 grains	étroit — large
	2.Size		before sowing, on 4 x 25 grains	thin — wide
	3.Forme		avant le semis, sur 4 x 25 graines	arrondie · ovoide - allongée
	3.Shape		before sowing, on 4 x 25 grains	round — ovoid — elongated
	4.Couleur		avant le semis, sur 4 x 25 grains	blanc — blanc-jaune - roux brunatre — noîratre
	4.Color		before sowing, on 4 x 25 grains	white - white-yellow red brownish — blackish
	5.Poils de la brosse		avant le semis, sur 4 x 25 grains	absent — très long
	5.Brush-hairs		before sowing, on 4 x 25 grains	none — very long

Caractères Caracteristics	Méthode d'observation Method of observation	
6.Réaction au phénol :	avant le semis, acide phénique de 1%	nulle — très foncé
6.Phenol-reaction :	before sowing, phenol acid of 1%	none — very dark
7.Poids de mille grains:	avant le semis, sur 8 x 100 grains	en g
7.Weight of 1000 grains:	before sowing, on 8 x 100 grains	in grams
II.Plantule:8.Coléoptile:pigmentation anthocyanique :	4 x 100 grains au laboratoire	nulle — forte
8.Coleoptile:anthocyan coloration :	4 x 100 grains in the laboratory	none — very dark
III.Plante :9.Port :	à la fin du tallage sur parcelle de 700 à 1000 plantes	dressé — étalé
III.Plant :9.Groth-habit :	at the end of tilleringstage on plots of 700 to1000 plants	erect — prostrate
10.Couleur : 10.Color :	comme III./9. as III./9.	vert-jaune — vert-foncé green-yellowish dark-green
11.Couleur :	au moment de l'épiaison sur parcelle de 700 à 1000 plantes	vert-jaune — vert-foncé
11.Color :	at the end of tilleringstage on plots of 700 à 1000 plants	green-yellowish dark-green
IV.Feuille:12.Port:Dernière feuille: IV.Leaf :12.Attidude:Flag leaf :	comme III./11. as III./11.	dressé — retombant erect — reflexed

Caractères Caracteristics	Méthode d'observation Method of observation	
13.Oreilleté:Dernière feuille: Pigmentation : 13.Flag-leaf:Auricles : Coloration :	comme III./11. as III./11.	nulle — très forte none — very dark
14.Oreilleté:Dernière feuille: Ciliation : 14.Flag-leaf:Auricles : Margins :	comme III./11.mais sur 50 plantes/parcelle as III./11.but on 50 plants/plot	nulle — très forte none — very strong
15.Dernière feuille : Glaucescence : 15.Flag-leaf : Glaucosity of sheath :	comme III./11. as III./11.	nulle — très forte none — very strong
16.Dernière feuille : Glaucescence sur limbe : 16.Flag-leaf : Glaucosity of blades :	comme III./11. as III./11.	nulle — tres forte none — very strong
17.Dernière feuille:longueur : 17.Flag-leaf :length :	après épiaison sur 50 plantes/parcelle after heading on 50 plants/plot	petit — très longue small — very long
18.Dernière feuille:largeur : 18.Flag-leaf :width :	comme IV./17. as IV./17.	étroite — très large narrow — wide
19.Dernière feuille:torsion : 19.Flag-leaf :twist :	après épiaison sur la parcelle de 700 à 1000 plantes after heading on the plot of 700 to 1000 plants	absent — très forte none — very strong
V. Tige: V. Culm:		
20.Glaucescence : 20.Glaucosity :	comme IV./19. as IV./19.	absent — très forte none — very strong

Caractères Caracteristics	Méthode d'observation Method of observation		
21.Section de la paille :	après épiaison sur 20 tiges au milieu du dernier entre-noeud	creux	pleine
21.Straw-section :	after heading on 20 culms in the middle of the last internode	hollow	solid
22.Section de la paille :	après épiaison sur 20 tiges 1cm au-dessus du 3ème entre-noeud compté d'en haut	creux	pleine
22.Straw-section :	after heading on 20 culms 1cm above the 3rd internode counted from above	hollow	solid
23.Dernier noeud:Pilosité :	entre épiaison et floraison sur 50 plantes	absent	très forte
23.Uppermost node:Hairiness :	between heading and flowering on 50 plants	none	very strong
24.Dernier noeud: Glaucescence :	comme V./23.	absent	forte
24.Uppermost node Glaucosity :	as V./23.	none	very strong
25.Torsion du dernier entre-noeud :	après épiaison sur la parcelle de 700 à 1000 plantes	absent	très forte
25.Shape of uppermost internode :	after heading on the plot of 700 to 1000 plants	none	very strong
26.Longueur :	à maturité, sur la tige-mère, sur parcelle de 700 à 1000 plantes	très court	très longue
26.Length :	at maturity, on the main-stem, on the plot of 700 to 1000 plants	very small	very long
27.Diamétre :	à maturité, sur la tige-mère de 20 plantes/parcelle, en mm	très mince	très large
27.Diameter :	at maturity, on the main-stem of 20 plants/plot, in mm	very thin	very thick

Caractères Caracteristics		Méthode d'observation Method of observation		
28.Couleur	:	à maturité, sur la parcelle de 700 à 1000 plantes	blanc jaune	rouge brun
28.Color	:	at maturity, on the plot of 700 to 1000 plants	white yellow	red brown
VI. Epi: VI. Ear:				
29.Anthères:Coloration	:	au moment de la floraison sur 50 plantes/parcelle	jaune-clair	rouge-foncé
29.Anthers :Color	:	at flowering-stage on 50 plants/plot	bright-yellow	dark-red
30.Glaucescence	:	au moment de l'épiaison sur la parcelle de 700 à 1000 plantes	absent	très forte
30.Glaucosity	:	at heading-stage on the plot of 700 to 1000 plants	none	very strong
31.Glaucescence	:	à la floraison sur la parcelle de 700 à 1000 plantes	absent	très forte
31.Glaucosity	:	at flowering-stage on the plot of 700 to 1000 plants	none	very strong
32.Couleur	:	après floraison sur la parcelle de 700 à 1000 plantes	vert-jaune ... vert-bleu	vert-gris ...
32.Color	:	after flowering on the plot of 700 to 1000 plants	green-yellowish green-greyish	green-blue-ish
33.Barbes: Longueur	:	comme VI./32.au-dessus du bout de l'épi	très court	très longue
33.Awns : Length	:	as VI./32. from the top of the ear ownwards	very small	very long
34.Barbes: Ruguosité	:	au début de la maturité sur 50 plantes/parcelle	absent	très forte
34.Awns : Rugosity	:	at the beginning of maturity on 50 plants/plot	none	very strong

Caractères Caracteristics	Méthode d'observation Method of observation	
35.Barbes: Divergance :	comme IV./32.	parallel — très divergante
35.Awns : Divergence :	as IV./32.	parallel — strongly divergent
36.Compacité :	à maturity sur 50 épis/parcelle, nombre des épillets/5cm de l'épi	très peu — beaucoup
36.Density :	at maturity on 50 ears/plot, number of spicelets/5cm of the ear	very few — many
37.Longueur :	à maturité sur 50 épis	très court - très longue
37.Length :	at maturity on 50 ears	very small - very long
38.Largeur :	comme VI./37.	très étroit - très large
38.Width :	as VI./37.	very narrow - very wide
39.Port de l'épi :	à maturité sur la parcelle de 700 à 1000 plantes	dréssé — retombant
39.Groth-habit of ear :	at maturity on the plot of 700 to 1000 plants	erect — deflexed
40.Barbes: Couleur :	à maturité sur plantes bien développées de la parcelle	blanc — roux - brunâtre — noîratre
40.Awns : Color :	at maturity on plants strongly developed on the plot	white - red - brownish — blackish
41.Article terminal du rachis:Pilosité de la face externe :	après récolte sur 50 épis/parcelle	nulle — très forte
41.Apical rachis segment Hairiness of convex surface :	after harvest on 50 ears/plot	none — very strong
42.Article du rachis du tiers moyen de l'épi Pilosité :	comme VI./41.	nulle — très forte
42.Middle third segment of rachis:Hairiness :	as VI./41.	none — very strong

Caractères Caracteristics	Méthode d'observation Method of observation	
43. Epillet du tiers moyen de l'épi:Glume inférieure : Longueur du bec :	comme VI./41.	très court — très long
43. Spikelet, mid-third of ear:lower-glume:beak-length:	as VI./41.	very short — very long
44. Comme 43: largeur de la troncature :	comme VI./41.	nulle — très large
44. As 43: shoulder-width :	as VI./41.	none — very broad
45. Comme 43: empreinte interne:	comme VI./41.	nulle — très développé
45. As 43: internal imprint :	as VI./41.	none — very large
46. Comme 43: Forme :	comme VI./41.	arrondie - ovoide - très allongée
46. As 43: shape :	as VI./41.	rounded - ovoid - strongly - elongated
47. Comme 43: forme de la troncature :	comme VI./41.	incliné - échancrée avec présence d'un 2ème bec
47. As 43: shoulder shape :	as VI./41.	sloping - elevated with 2nd point present
48. Comme 43: inflexion de la carène :	comme VI./41.	non inflechie — très fortement inflechie
48. As 43: keel-inflection:	as VI./41.	not inflected - very strongly inflected
49. Comme 43: forme du bec :	comme VI./41.	droit — genouillée
49. As 43: beac shape :	as VI./41.	straight — geniculate
50. Comme 43: glumelle:forme du bec:	comme VI./41.	droit — genouillée
50. As 43: lemma beak:shape:	as VI./41.	straight — geniculate

Caractères Caracteristics	Méthode d'observation Method of observation	
VII. Caractères physiologiques Physiological caracteristics		
51. Date de tallage : 51. Tillering-date :	50% des plantes/parcelle 50% of plants/plot	
52. Date de l'épiaison : 52. Heading-date :	comme VII./51. as VII./51.	
53. Date de maturité : 53. Maturity-date :	100% des plantes/parcelle 100% of the plants/plot	
Resistance au maladies Resistance against diseases		
54. Ustilago tritici 54. Ustilago tritici	en % des plantes/parcelle in % of the plants/plot	
55. Erysiphe graminis 55. " "	constatation "	nulle —— très forte none —— very strongly
56. Puccinia graminis 56. " "	comme VII./55. as VII./55.	comme VII./55. as VII./55.
57. Puccinia triticina 57. " "	- " - - " -	- " - - " -
58. Puccinia striiformis 58. " "	- " - - " -	- " - - " -
59. Septoria spp. 59. " "	- " - - " -	- " - - " -
60. Fusarium spp. 60. " "	- " - - " -	- " - - " -
61. Verse 61. Lodge	- " - - " -	- " - - " -

WHEAT SEED PRODUCTION AND REGULATION IN TUNISIA

M. KOUKI

RESUME:

The organization and regulation of cereal seed multiplication and official control of this sector have long been subjects of concern in the field of cereal production in Tunisia. Unofficial regulation was initiated in 1922; these efforts formed the basis for the first legislation in 1932 which provided for the creation, within the Tunisian Botanical Service (presently the National Agricultural Research Institute of Tunisia), of a cereal variety list. This legislation was made more specific and expanded in 1937 and again in 1947 to take into account the development of the cereal production and marketing structures in Tunisia (formation of the ONIC and its Tunisian division and the development of interprofessional production associations).

With the creation of the Seed Cooperative (COSEM) in 1946-47 in order to assure the conservation of the Tunisian varieties and encourage use on a wide scale of regulated seeds, new regulations were enacted in 1951. These regulations along with the legislation adopted in 1947 governed the multiplication of seeds and regulation of this sector until 1966. In that year, new legislation was enacted along the same lines as the existing regulations but taking into account the general development of the cereal sector in Tunisia. This last set of regulations constitutes the legislation in effect at present.

However, starting in 1969, the introduction in cultivation of new wheat varieties, the massive demand on the part of farmers for these varieties, the increased production of regulated seeds (approximately 200,000 qls) and the

KOUKI

creation of a second seed cooperative (the CCSPS) led to a situation in which this legislation was considered incomplete and even out of date.

The Ministry of Agriculture therefore decided to develop draft legislation to govern the organization and the regulation of seed production and marketing for all categories of agricultural seeds: cereals, vegetables, forage crops and trees.

The draft legislation, which is in the process of being enacted, provides for, among other items: the formation of a National Seed Committee, the creation of a list of agricultural plant varieties suitable for use in the country and a system of regulation and certification.

As concerns wheat in particular, it was decided, starting with the agricultural season 1972-73, to unofficially put the new regulations into effect, i.e.:

- Test the proposed standards before their application
- Inform the producers and merchants of the standards so that it will be possible to enforce the new legislation once it is enacted with a minimum of difficulties
- Train the personnel who will be responsible for the application of the new legislation and allow them to acquire experience in the field.

This decision, which was aimed at creating a climate favorable to the application of the legislation, was preceded by several actions, among which:

- The construction and equipping of a seed testing laboratory which is a member of ISTA
- The training of a team of qualified technicians in the fields of laboratory analyses and regulation and certification of seeds.

The results obtained over the past two years are given and interpreted in the general paper.

Original: French

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THE WEED SITUATION IN THE REGIONS OF NORTH AFRICA AND THE MIDDLE EAST

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This report attempts to summarize the overall weed situation in the production of wheat for the countries represented here at this conference. This report will point up, in a generalized way, the importance of weeds as a limiting factor in production, the species representation of the major weeds and the general situation on weed control for the region.

This report is a summation of the questionnaires received from representatives here. Two thirds of the countries responded, and all of the regions were well represented in the response. This report would be more accurate if all the countries had responded, however, the summary is probably representative of the region as a whole. No individual country data will be reported in this summary. Country representatives are more qualified to discuss their particular weed problems and questions for specific information should be addressed to them.

The questionnaire sent out requested information on the four weed species causing the greatest economic loss, wheat area infested by each and an estimate of yield losses by each. Information was requested on the intensity of tillage to evaluate in a general way if this could be a factor in weed population and control. Data on the herbicides, rates of application and area treated were requested. The questionnaire also attempted to get a general picture of research, extension and government participation in weed control.

In order to get some overall picture of the magnitude of loss due to weeds, calculations were made using F.A.O. statistics reported in 1972. All calculations were based on the mean yield and the average hectares of wheat harvested for the five year period 1968-1972. The data obtained are conservative because wheat abandoned due to weed infestation is not included. The yield losses were calculated for each individual country according to the average loss reported by the questionnaire.

Not all countries responded to all the questions in the questionnaire. It was not possible to report all categories from the same countries. Those countries not reporting in all categories involved less than 400;000

hectares total wheat production, and probably did not change significantly the general situation for the more than 30,000,000 hectares reported by the other countries.

Table 1. Wheat production and estimated yield loss from weeds reported by 13 countries in North Africa and Middle East.

	No. of Countries	Calculated Data
Hectares of wheat harvested 1/	13	30,900,000
Wheat Production (tons) 1/	13	26,600,000
Estimated Production Loss from 2/ Weeds (tons)	11	5,130,000
% loss reported (Ave.)	11	19.4

1/ F.A.O. Statistics 1968-1972.
2/ Calculated from estimated loss reported by each country.

What does this estimated yield loss mean in terms of the total needs of these countries?

To arrive at some estimate of the value of this wheat, this loss was compared to the estimated import needs of 13 North African and Middle Eastern countries, all of which were invited to this conference. F.A.O. statistics on average production for 1968-1972 was used as a production base. The consumption figures were those reported by ALAD in the publication by Arsvik. Ten of the 13 countries responded to the questionnaire.

Table 2. Wheat production, consumption estimates, and estimated wheat production losses from weeds for 13 North African and Middle Eastern countries. (Metric tons).

Wheat production 1975 Estimated	25,992,000
1975 Estimated Wheat Consumption	32,700,000
Import Needs	6,708,000
Est. Loss from Weeds 1/	4,938,000
Loss in % of Import Needs	74

1/ Calculated on an average 19% reported loss by weeds.

On the basis of these data, about three fourths of the projected short fall for 1975 could have been avoided by weed control over all of the wheat production. By 1980 an estimated 6,000,000 more tons of wheat will be needed. The importance of controlling the weeds will be even more significant then. The yield losses alone do not accurately reflect the total loss due to weeds. Additional losses from poor fertilizer efficiency, increased harvest costs, reduced quality and additional costs of handling and storing weed infested wheat all add to the total loss caused by weeds.

What species of weeds are prevalent in the region?

As might be expected, weeds of the same species, genera or family were reported by several countries. (Table 3)

Of special interest from the control stand point, over 15,000,000 hectares (about half of the wheat area) were reported to be infested with weeds readily controlled with 2,4-D. This is a relatively safe, low cost, easily applied herbicide, that is adapted even to back pack sprayers. A major effort to utilize this herbicide is indicated as an initial step to improve weed control in the region.

The percent loss reported for each species was higly variable indicating the relative competitive ability of that species under the environment of the wheat production in the particular country. Losses were reported as low as 1% and as high as 45% for an individual species. In general the losses from the grass-type weeds were greater than from dicotyledons, however, some high losses were reported from this class of weeds also. The total loss of wheat production from weeds in percent was calculated for those countries reporting percent loss by species. The total losses varied from 4 to 38% for the four major weeds reported.

A summation of the tillage data reported indicated that most of the countries had 3 to 4 tillage operations in land preparation for wheat production. One or two operations were before seeding for seed bed preparation. Only one country reported more than five tillage operations in wheat production. Since preplant weed control and good seed bed preparation are major factors in weed control for wheat production, this appears to be another area where improvement will benefit weed control. A uniform stand of wheat emerging before the weeds offers the best competition to weeds. Highest losses from weeds occur when weeds emerge before or with the emergence of wheat.

Applied research in the field of tillage was reported by nine of the countries. This indicates an awareness of tillage as a problem in wheat production in those countries. Basic research in tillage was reported by three countries. An increased store of knowledge on tillage practices is necessary for each country. The variable soil and climatic conditions within and between countries requires investigation to supply the necessary information for the

Table 3. The most common and important weed species affecting wheat production in North Africa and Middle East.

Species or Genera	Area infested Hectares[1]	Rank 1	2	3	4	No. times reported
Brassica, Synapsis, Rapistrum	5,831,800	3	2	0	3	8
Avena spp.	1,573,600	3	0	0	3	6
Lolium spp.	718,100	1	2	1	0	4
Convolvulus arvensis	2,062,600	0	2	2	0	4
Phalaris spp.	1,302,200	0	0	3	0	3
Chephalaria syrica	2,526,000	1	0	1	0	2
Cynadon dactylon	863,000	2	0	0	0	2
Chenapodium spp.	330,900	0	1	0	1	2
Malva spp.	44,000	0	1	1	0	2
Boreava orientalis	5,190,000	1	0	0	0	1
Carthanus oxyancanthus	2,110,000	1	0	0	0	1
Centauvea spp.	4,325,000	0	1	0	0	1
Ipomea kurdofan	------	1	0	0	0	1
Medicago spp.	------	1	0	0	0	1

1/ Area infested calculated from reported percent area infested.

extension effort. However, data from other countries within a climatic region can often be directly usable to develop wheat production and research programs.

The use of herbicides for wheat production was reported by 8 of the 14 countries. However, the area treated was very limited. Only 1,547,000 hectares were treated, which is only 5% of the total area reported. The maximum percentage of the wheat production treated by one country was 23%. Almost all the wheat was treated with 2,4-D, combinations with 2,4-D

or a 2,4-D type compound. Only 4,000 hectares were reported treated using herbicides for control of grass type weeds. There may have been more wheat treated as two countries reported herbicides being used, but gave no figures of the area treated.

It is apparent that herbicides could play a very important part in weed control for wheat production in the reporting countries. However, the application of herbicides requires specialized equipment, means to import or procure the herbicide, and the extension of the information on application. Each of these factors requires help from some government agency. Spray equipment, whether it is a back pack sprayer for the small farmer, a tractor mounted or trailer mounted sprayer or an airplane for large surfaces, are expensive and will probably have to be imported. They require exacting maintenance and operation. Calibration of the sprayer, the necessity for uniform speed and pressure, tank agitation, herbicide dosage and time of application are technics that have to be taught to the farm operator. Herbicide spraying is probably the most exacting operation in wheat production. A successful program of herbicide application in a developing country requires careful planning and direction of all agencies involved from the procurement of the herbicide and equipment to the extension of application information to the farmer.

What are the governments doing towards improving weed control? The survey reported that in thirteen of the fourteen countries the government was involved in at least one function of a herbicide program. Eleven of these countries were involved in regulatory functions. Five countries were involved in operating field and ground equipment for herbicide application. Four were involved in aerial application and five reported financial assistance in herbicides. This survey indicated there is an awareness of the need for government assistance in weed control by herbicides. To date most of the involvement by government agencies in most of the countries was regulatory.

Another indication of interest in herbicides by countries was the number reporting conducting applied research in herbicides. All but one reported activity in this field of research. It is important that some applied research be conducted within a country to verify recommendations for herbicide use. Herbicides are responsive to variations in climate, soil and growth patterns of both the weeds and wheat. Different climatic conditions between and within a country or region will alter recommendations for herbicide use. An active applied research program will identify these problems, improve recommendations and provide a base for evaluating new herbicides. The results and experience obtained in applied research programs are also the source of information necessary for a progressive extension program needed to develop a herbicide program in a developing agriculture.

Basic research activity in herbicides was reported by four countries. The need for this type of research is far less than applied research in a developing field production program. Only after the extensive use of

herbicides is adopted does the need for extensive basic research exist. In the developmental stages of a program, the applied research expenditures will be more beneficial than money spent on basic research. As the general knowledge and use of herbicide within a country increases, then the problems of a more basic nature become more important. This type of research will enable refinement in applied research and application as it seeks to solve specific problems that arise.

Extension activities were reported by 10 of the surveyed countries in tillage practices and/or herbicide application. The quality and intensity of the extension effort in these countries will be a major factor in the adoption of improved weed control either through tillage, herbicides or both. The total extension effort will affect the speed with which new practices are adopted. Extension of new farm practices takes place in many ways. Not the least of these is the farmer to farmer extension of new practices.

In summary, there is no question but what weeds are a major if not the major factor preventing the realization of increasing wheat production in the regions surveyed. There is no magical cure for the problem. However, with extension of knowledge and practices now in use, a major reduction in weed losses could be obtained. To do this, all government and private resources must be organized to make this knowledge available to the producer and to mobilize resources to supply the materials and equipment for weed control in wheat and other crops in the rotation.

LA SITUATION DES MAUVAISES HERBES EN AFRIQUE DU NORD ET AU MOYEN-ORIENT

W.L. Nelson

RESUME:

Il ressort des questionnaires envoyés par 14 des pays participant à la présente conférence qu'une perte moyenne de l'ordre de 19% dans la production de blé est imputable aux mauvaises herbes. Exprimées en tonnes de blé, les pertes annuelles se chiffrent donc à environ 5,130,000 tonnes pour ces 14 pays si l'on prend comme base de comparaison les chiffres de production énumérés pour les années 1968-72 dans l'Annuaire Statistique 1972 FAO.

On estime que la consommation de blé pour le 13 pays de l'Afrique du Nord et du Moyen-Orient pour l'année 1975 dépassera la production moyenne pour les années 1968 à 1972 de 6,700,000 tonnes. Sur ce total, 4,900,000 tonnes auraient pu être récupérées si une lutte efficace contre les mauvaises herbes avaient permis d'éviter les 19% de pertes signalés. Ceci représente approximativement 75% des importations qui seront nécessaires en 1975. D'ici 1980, ces mêmes pays auront besoin de 6,000,000 tonnes supplémentaires, et une lutte efficace contre les mauvaises herbes sera enconre plus nécessaire pour satisfaire ces besoins à l'avenir.

Dans les pays ayant répondu au questionnaire, des herbicides ont été utilisés sur 1,547,000 ha sur une superficie totale de 30,900,000, c'est-à-dire sur 5% seulement des emblavures.

Les estimations des pertes variaient entre 4% et 38%. Les pertes indiquées par les pays ayant signalé les graminées comme étant les plus nuisibles ont été très élevées, conséquence de la concurrence intense exercée par ces espèces.

Parmi les mauvaises herbes signalées, les différentes espèces de moutarde (Brassica, Synapsis et Rapistrum) ont été mentionnées huit fois, les espèces d'Avena six fois, Convolvulus arvensis quatre fois, les espèces de Lolium quatre fois et de Phalaris trois fois. Cynadon dactylon, différentes espèces de Chenapodium et Malva et Chephalaria syrica ont été mentionnés chacun deux fois. Une seule mention a été faite de toutes les

autres espèces. Les espèces ayant été signalées une seule fois comme étant les plus nuisibles ont été: Boreava orientalis, Ipomoea kurdofan, Carthamus oxyancantha et les espèces de Medicago et de Melilotus.

Les mauvaises herbes signalées comme étant les plus importantes par la moitié des pays répondant au questionnaire sont des espèces qui sont de façon générale éliminées par le 2,4-D.

Sur les 14 pays, huit se servaient de produits chimiques pour lutter contre les mauvaises herbes dans les céréales. Le chiffre maximum avancé a été 23% de la superficie traitée. Dans 13 des 14 pays l'Etat joue un rôle actif dans la lutte chimique contre les mauvaises herbes. Dans 11 pays il s'agit d'un contrôle officiel, dans 5 de l'opération de matériel pour le traitement par voie de surface, dans 4 du traitement aérien, et dans 5 de la subvention des produits.

Un seul pays a signalé plus de cinq opérations pour le travail du sol et la préparation du lit de semances; la moyenne était de trois.

Les pays ayant répondu au questionnaire étaient actifs dans la vulgarisation et la recherche dans le domaine de la lutte contre les mauvaises herbes. Dix ont indiqué des activités de vulgarisation ayant trait à la lutte contre les mauvaises herbes par le moyen de techniques culturales et de produits chimiques. Des recherches de base ont été signalées dans 3 pays dans le domaine des techniques culturales et dans 4 pays dans le domaine des produits chimiques. Quant à la recherche appliquée, 9 pays ont signalé des travaux ayant trait aux façons culturales et 13 des travaux dans le domaine de produits chimiques.

Original: Anglais

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WEED CONTROL ON THE HIGH PLATEAU OF TURKEY

H. M. Hepworth and C. Tezel

Turkey is situated in the northern Mediterranean area and has been a land bridge jointing Europe and Asia for many centuries. It is believed by many, and supported by considerable archeological evidence, that this region has been supporting same type of agriculture since the beginning of mankind. Due to its location it has been crossed and recrossed over the ages by every sort of traveller - armies, religious groups and wondering nomads. The result has been a mingling of plants of many species from many places.

As expected many of these plants are weeds today. Also as expected, the species which were most able to adapt to the prevailing ecological niches are now the dominant species.

Our concern here is wheat production and one of the major related problems; that of competition from these species of weeds which have made the area their habitat.

Turkey produces wheat on about 8.6 million hectares each year. This results in a crop of near 10 million tons for an average yield of 1100-1200 kilograms per hectare. About 70-80 percent of this wheat is produced on the Anatolian plateau where the fallow system is practiced. Lack of rainfall is the major limiting factor in production on the plateau.

No doubt farmers have always realized that weeds were reducing wheat yields. They have followed traditional methods of weed removal, some cultivation during the fallow season and some handweeding during the crop season. Obviously this has not been very successful.

One factor which complicates the weed control picture in Turkey is that of definition. When is a plant a weed? During the spring of the fallow year many farmers use the wild plant species (weeds) as a forage crop and thus they have a real value. This we believe is a very inefficient use of soil and water but the practice is widely followed. During the crop year however farmers seem to be agreed that weeds are detrimental.

The weed species which cause the greatest wheat losses are the broadleaved species yellowweed (Boreava orientalis) and cornflower (Centaurea

pp.), and Cephalaria syriaca, Syrian acabiosa. Several other species are resent but are much less dominant than the three mentioned. Lithospermum, amium, Adonis, Sysimbrium, and Erodium spp. are also common broad-eaved species in wheat. The major grass species causing problems are Bromus tectorum), downy brome grass, (Cynodon doctylon), bermuda grass, nd (Aegilops cylindrica) jointed goat grass. Some areas are infested with Alopecurus myosuroides) blackgrass and (Phalaris minor), canary grass.

Iow big is the problem?

According to the survey questionnaire at least 8 million hectares of the annual wheat crop are heavily infested with weeds of these major species.

If we assume a conservative figure of 20 percent yield increase which could be achieved from control of weeds; we see that an additional 2 million tons of wheat could be produced in Turkey each year. We also see that he problem is of such magnitude that it deserves a high priority from the Ministry of Agriculture.

What is being done about the problem?

As early as 1950 the Government of Turkey initiated a research and demonstration program in weed control. By 1953 phenoxy acid herbicides were applied to about 1350 hectares. By 1963 the use of herbicides had increased to an area covering 139,000 hectares. In 1973 herbicides were applied to 800,000 hectares. Since that time herbicide usage has leveled off and even declined. Now the situation is much worse due to the high prices and short supplies of herbicides. This year about 40 percent of the average annual herbicide tonnage will be available to farmers meaning that only 3 to 4 percent of the wheat crop will receive weed control.

During the past five years we have tried to raise the interest level of both farmers and government authorities in weed control. We hoped to see an increase in the tonnage of herbicides used.

To accomplish this goal we launched a research program to compare and evaluate available herbicides under Turkish conditions. We also carried on a series of adaptive research trials in wheat production in several provinces on the plateau. Timely weed control was an important part of the research procedure. For the past three seasons a series of wheat production demonstrations has been conducted in the central plateau and again weed control was an important element in the package.

What happened

Our early observations indicated that weeds were allowed to grow much too long before herbicides were applied. As part of our herbicide

evaluation effort we included a time of application variable. Data consistently show that early removal of weed competition results in significant yield increases.

For example in 1974 we recorded the data shown in Table 1.

Table 1. Yields[1/] from plots treated with herbicides at 3 dates Ankara, Turkey 1974.

Material	March 29	April 25	May 22
Bromoxynil	151	133	111
Bromoxynil - MCPA	162	188	121
2,4-D LVE	131	142	99
2,4-D - 2,4,5-T	144	128	116
2,4-D - Linuron	155	150	109
Control			91

1/ Kilogram/decare

This same trend has been recorded every year in our experimental plots. We feel it is very unfortunate that the farmers in Turkey spend their time and their money for equipment and herbicides but do not get optimum returns.

They must be educated to do a more timely job of applying herbicides.

Another example of the potential gain from timely weed control is illustrated below. In 1974 we applied herbicides to farmers' field which were farmed under the traditional system and also to adaptive research trials where improved farming methods were employed.

We later took samples from both treated and untreated areas of each field. We photographed the collected plant samples and counted the heads from each sample. We also took yield data from each area. The results are shown in Tables 2 and 3.

Table 2. Numbers of Wheat Heads from 6 samples.

Sample area	Weeds Controlled	No Weed Control	Percent Change
Farmer Field # 1	866	444	-49
Farmer Demonstration Field	833	415	- 50
Farmer Field # 2	358	252	- 30

Table 3. Wheat yields from weedy and weed free samples, Ankara, Turkey 1974.

Sample area	Weeds Controlled	No Weed Control	Kilograms Increase	% Increase Over Non Weeded
Farmer Field # 1	130	85	45	53
Demonstration Field	274	142	132	93
Farmer Field # 2	138	70	68	97

We also conducted a competition study in which we handweeded trial plots by two methods. In one series we kept the plots weed free by handweeding for periods of 4 and 8 weeks and then allowed the weeds to grow. In the other series we allowed the weeds to grow for 4 and 8 weeks and then handweeded the plots for the remainder of the season. Yields were compared with plots that were weedy throughout the season and with plots kept weed free all season. The results are compared in Table 4.

Table 4. Wheat yields from plots handweeded for various intervals. Ankara, Turkey 1974.

Treatment	Kgs/decare
Handweeded for 4 weeks	203
Handweeded for 8 weeks	207
Handweeded throughout season	205
Weedy for 4 weeks then clean for season	195
Weedy for 8 weeks then clean for season	160
Weedy for the season	121

This again illustrates the value of early removal of weed competition. It appears that early germinating weeds cause the greatest yield decrease.

For several years we have been comparing various herbicides for weed control in wheat. The phenoxy acid materials are doing a good job and certainly should continue to be used in Turkey. It is sad that only 8-10 percent of the wheat receives any weed control treatments. However, because these materials are usually applied rather late in the season and because they do not successfully control some of the weed species we believe there is and will be a need for other materials in Turkey.

Table 5 summarizes our findings in comparing several of the commonly used materials.

Table 5. Wheat yields and percent weed control from several herbicides. Ankara, Turkey 1974.

Material	Rate Kg/ha.	% Control Boreava	% Control Centaurea	Yield in Kgs/decare
Bromoxynil	.4	90	80	131
Bromoxynil plus MCPA	.4	95	95	133
Bromoxynil plus Lorox	.2-.3	94	80	114
Tribunil plus 2,4-D	1.3+.5	98	98	124
2,4-D	.85	85	80	123
2,4-D plus 2,4,5-T	.6	85	85	127
Control				91

We are aware that downy brome grass and bermuda grass are becoming more serious problems in certain areas. There now appear to be some exciting candidate herbicides for controlling these species as well as some of the perennial broad leaf species. Until these materials are fully tested a well managed summer tillage system is the best method for controlling the grassy weeds.

We are confident from the research work we have done that controlling weeds can produce a major increase in wheat for Turkey and the hungry world. During the past 2 years at numerous meetings and training seminars we have presented the case for weed control. Farmer interest is increasing rapidly. Several commercial chemical companies are building sales organizations and research development programs in Turkey.

We believe that a stronger effort is required in education and training. It is hoped that a much more ambitious weed control effort can be supported. The country sorely needs the wheat that is now being lost to weeds.

LUTTE CONTRE LES MAUVAISES HERBES SUR LES PLATEAUX D'ANATOLIE EN TURQUIE

H.M. Hepworth et Gengiz Tezel

RESUME:

Chaque année en Turquie, environ 8.6 millions d'hectares sont semés en blé. La majorité de ces terres à blé est située sur le plateau central d'Anatolie et la production de blé dépend entièrement d'une pluviométrie adéquate.

Le rendement moyen annuel dans la région du plateau est de 10 à 11 Qx par hectare en utilisant des méthodes de cultures traditionelles. Cependant, des expériences effectuées au cours des cinq dernières années ont démontré que, si on luttait efficacement contre les mauvaises herbes la production pourrait etre considérablement augmentée.

Les mauvaises herbes annuelles, en particulier la Boreava orientalis et la Centaurea cyanus provoquent une diminution du rendement de l'ordre de 25 à 50% selon l'importance de l'infestation.

Les herbicides communément employés sont le 2,4-D et un mélange de 2,4-D et de 2,4,5-T. Malheureusement, ces herbicides bien qu'extrêmement efficaces sont en général appliqués tard dans la saison quand les dégâts sont déjà faits et la production déjà diminuée.

Des herbicides tels que le bromoxynil et des mélanges de bromynil et d'autres herbicides sont prometteurs car ils peuvent être appliqués plus tôt que les herbicides phenoxides.

Des études ont démontré que si les herbicides phenoxides sont appliqués au moment voulu on pouvait obtenir des rendements supérieurs à ceux obtenus dans les champs traités en temps "normal".

Normalement, il n'y a que 8 à 10% des terres a blé qui sont traitées avec des herbicides. It serait opportun de mettre au point un programme pour augmenter de façon considérable le nombre d'hectares traités.

Original: Anglais

17

EXPERIMENTATION ET DEMONSTRATION DANS LE DOMAINE DU DESHERBAGE CHIMIQUE EN TUNISIE

A. Sellami

En Tunisie, les mauvaises herbes constituent actuellement les ennemis les plus dangeureux des céréales; en effet, si les parasites (insectes et maladies) inféodés a cette culture n'apparaissent que de temps à autre, à la faveur de certaines conditions d'ordre climatique en particulier, les mauvaises herbes sont toujours présentes dans les céréales sur lesquelles elles exercent une forte concurrence. Dans de nombreux cas, elles constituent le plus grand obstacle à l'augmentation de la production diminuant parfois les rendements de plus que 50%.

Pour résoudre ce problème des mauvaises herbes, la solution ultime consiste à employer des techniques culturales qui éliminent les infestations et parmi ces techniques, l'emploi des herbicides s'avère parfois nécessaire.

En Tunisie comme ailleurs, le travail du sol constitue la principale méthode de lutte contre les mauvaises herbes; cependant, très souvent, on se trouve dans l'obligation de recourir à la lutte chimique. En effet, en présence d'infestations qui n'ont pas pu être éliminées par des façons culturales, le recours aux herbicides continue à offrir une possibilité d'accroître le rendement des cultures tout en réduisant les réinfestations par les graines des mauvaises herbes.

Or, pour certains, l'utilisation des herbicides revient chère tout en comportant parfois un risque de phytoxicité et d'échec dans la lutte contre les mauvaises herbes surtout que leur emploi nécessite un haut degré de précision.

It est donc nécessaire:

1) D'évaluer les pertes provoquées par les mauvaises herbes.

2) D'accroître l'efficacité des désherbants.

3) De réduire au minimum les pertes découlant de la toxicité des herbicides.

Ce sont là, les objectifs de notre expérimentation poursuivie ces dernières années par la Division Technique de l'Office des Céréales (Ex-Projet Blé) en collaboration avec l'INRAT, la Division de la Défense des Cultures et la Ferme Fretissa de l'Office de l'Elevage.

Depuis 1970, la Section Expérimentation de l'Ex-Projet Blé installe, chaque année, une série d'essais et de démonstrations dans les différentes régions céréalières du nord du pays.

1970-71	11
1971-72	16
1972-73	21
1973-74	33
1974-75	45

Plusieurs types d'essais ont été réalisés. Nous aurons l'occasion de voir quelques uns au cours des tournées sur le terrain. Les principaux traitements utilisés sont indiqués sur le tableau No.

Chaque année, notre programme consiste:

- d'une part, à entreprendre des démonstrations des techniques améliorées pour la préparation du sol et l'emploi des herbicides.

- d'autre part, à poursuivre une expérimentation ayant pour but le rassemblement de nouvelles informations permettant d'améliorer les recommandations déjà formulées.

Toutes ces parcelles de démonstration et d'expérimentation sont installées chez les agriculteurs eux-mêmes. Grâce à cette recherche appliquée, nous avons pu approfondir le problème des mauvaises herbes et identifier un certain nombre de facteurs ayant une influence sur les rendements.

Facteurs ayant une influence sur les pertes occasionnées par les mauvaises herbes

Ces pertes varient suivant la variété de blé semée, la pluviométrie, les espèces de mauvaises herbes et la densité des infestations.

a) La variété de blé semée influe sur les pertes causées par les mauvaises herbes. Un développement précoce vigoureux, un bon tallage et une paille haute tendent à réduire les pertes dues aux mauvaises herbes. Les variétés "résistantes" aux mauvaises herbes sont:

Tableau No. I. Les principaux traitements utilisés.

Nom du produit commercial	Matière active et %	Dosage		Stade de la céréale
		M.A. en kg/ha	P.C./ha	
2,4-D	LV Ester 46	0,6	1,3 l	6½ f à ½ n
Certrol H	Ioxynil 12 (ester) + MCPP 36 (ester)	0,42 + 1,26	3,5 l	4½ f
Suffix	Benzoylpropethyl 20	1,20	6,0 l	6 f
Suffix, 2,4-D	Benzoylp. 20 + 2,4-D ester 46	1,20 + 0,60	6,0 + 1,3 l	6f, 7f
Suffix + MCPP	Benzoylp. 20 + MCPP ester 59	1,20 + 1,75	6,0 + 1,75 l	6f
Suffix + MCPA	Benzoylp. 20 + MCPA (Sel de K)40	1,20 + 0,60	6,0 + 1,5 l	6f
Dicuran	Chlortoluron 80	2,40	3,0 kg	2½ à 3f
Dosanex	Metoxuron 80	3,20	4,0 kg	2½ à 3f
Dicuran + Tok	Chlort. 80 + Nitrophène 50	1,60 + 1,00	2,0 + 2,0 kg	2½ à 3f
Dosanex + Tok	Metox. 80 + Nitrophène 50	2,40 + 1,00	3,0 + 2,0 kg	2½ à 3f

- parmi les BT: Soltane, Ariana 66 et Florence Aurore

- parmi les BD: Bedri, INRAT 69 et les variétés traditionnelles

Les variétés sur lesquelles la concurrence des adventices est plus marquée sont:

- pour les BT: Dougga, Carthage et Inia 66

- pour les BD: Amel, Maghrebi.

b) La pluviométrie: Ici, en Tunisie, la quantité et surtout la distribution de la pluviométrie ont une influence directe sur les rendements, l'efficacité des herbicides, la densité des infestations et les pertes de rendement occasionées par la concurrence des mauvaises herbes. C'est le facteur limitant. En effet, là où l'eau est suffisante pour assurer les besoins aussi bien du blé que des mauvaises herbes tout au long de la période de végétation, le gain en rendement résultant de l'opération de désherbage est faible. Par contre, si la pluviométrie est insuffisante, provoquant un manque d'eau grave par suite de l'extraction de l'eau par les plantes adventices, le gain en rendement résultant de l'action du désherbage est considérable.

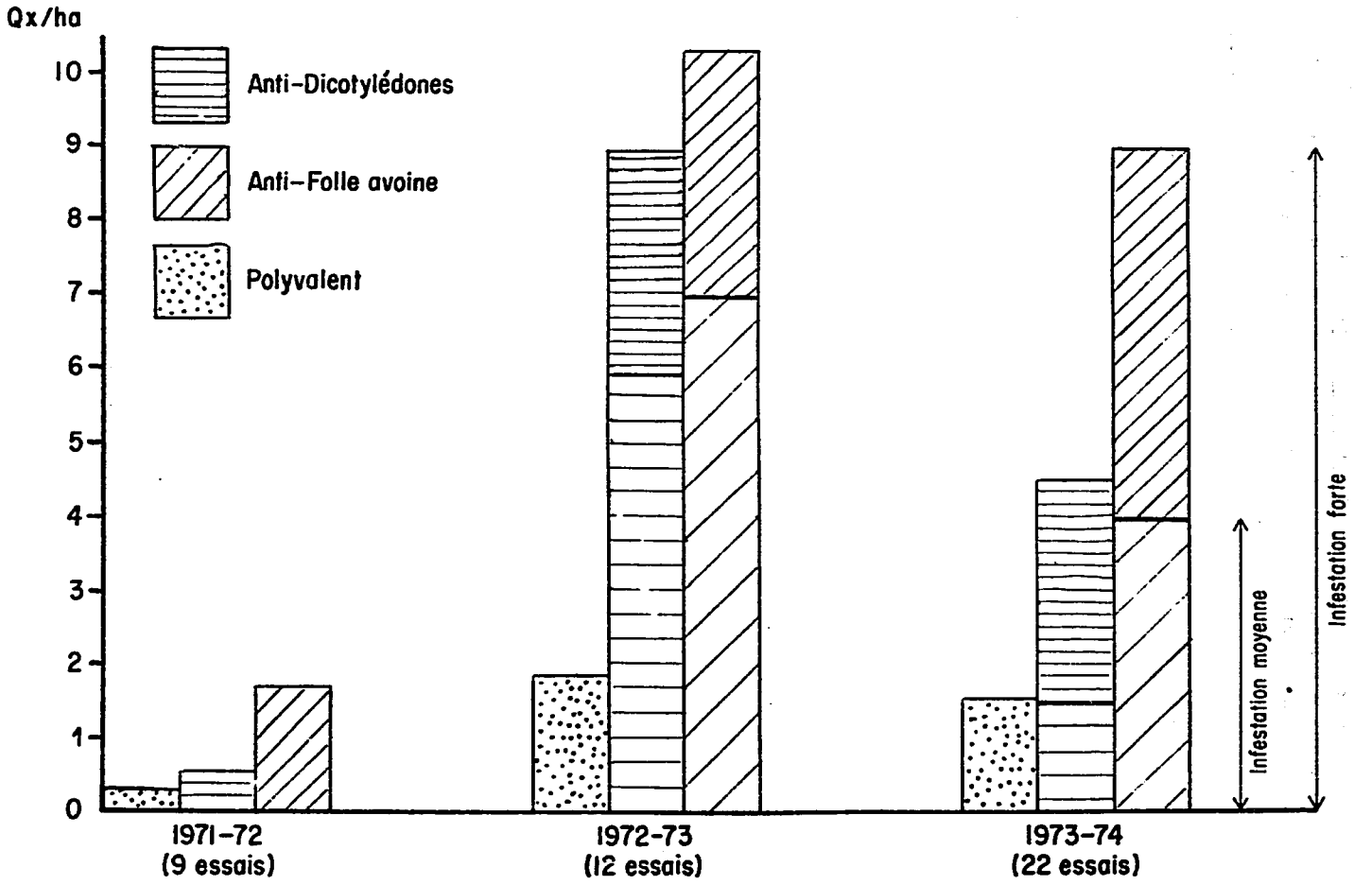
Les résultats de ces trois dernières années montrent l'influence de ce facteur "eau", voir graphique No. I.

En 1971-72 on n'enregistrait pratiquement pas de baisse de rendement due à la concurrence de la folle avoine, ni des Dicotylédones. Une répartition presque parfaite des précipitations a fourni une quantité d'eau amplement suffisante aussi bien pour les mauvaises herbes que pour le blé pendant toute la durée du cycle de croissance, y compris le stade laiteux.

En 1972-73, la concurrence de la folle avoine a provoqué une baisse importante des rendements, alors que la plupart des infestations par les Dicotylédones n'ont pratiquement pas eu d'effet. Des précipitations abondantes ont eu lieu entre le début du mois de janvier et le 18 avril. Après cette date, pratiquement, il n'y a pas eu de pluie et on assiste à une forte insuffissance d'humidité au cours du stade laiteux.

En 1973-74 et juste au début de la campagne, les réserves d'humidité restaient suffisantes pour assurer une bonne levée du blé. Puis le mois de janvier était sec. La pluviométrie continuait à être au-dessous de la moyenne pendant le reste de la saison. Dans ces conditions, une bonne preparation du sol, ainsi que la vigueur du blé ont permis de surmonter les Dicotylédones dans le nombreux essais. Là, l'emploi d'herbicides anti-Dicotylédones n'a entrainé que des augmentations très faibles du rendement. Par contre, les augmentations des rendements résultant de la lutte contre les graminées étaient considérables.

Graphique No. I. L'augmention de rendment obtenu par l'emploi de trois differentes classes de herbicides pendant trois années.



c) Les espèces de mauvaises herbes influent aussi sur les pertes de rendement. Ce sont les Monocotylédones qui sont à l'origine de dégâts particulièrement importants étant donné que leur cycle végétatif et leurs besoins en eau correspondent à peu près à ceux du blé. Trois espèces de graminées adventices sont à l'origine de 75% des pertes dues aux mauvaises herbes. Il s'agit de la folle avoine (Avena sterilis), du ray grass (Lolium rigidum) et du Phalaris (P. canariensis, P. paradoxa et P. truncata). Si les Dicotylédones ne sont à l'origine que de 25% des pertes, le nombre d'espèces ayant des répercussions économiques est important. La plupart de ces Dicotylédones arrivent à maturité plus tôt que le blé d'où absence de concurrence pour l'eau au cours du stade laiteux, phase qui comporte une forte probabilité de sécheresse.

d) La densité de l'infestation influe également sur les pertes de rendement. L'augmentation moyenne de rendement obtenue dans les essais fortement infestés est plus importante que dans les autres cas. L'infestation peut être caractérisée comme forte quand le nombre dépasse 50 panicules/m^2 pour la folle avoine, 100 épis/m^2 pour le ray-grass, 80 épis/m^2 pour le Phalaris ou quand les Dicotylédones couvrent plus de 50% de la surface du sol.

Ces densités ne constituent pas les seuils qui doivent être atteints pour assurer la rentabilité d'un traitement. Dans une saison plus typique, à savoir, à hiver pluvieux, les seuils seraient à peu près: 15 panicules/m^2 pour la folle avoine, 50 épis/m^2 pour le ray-grass, 40 épis/m^2 pour le Phalaris et 40% de la surface du sol couverte par les Dicotylédones.

Efficacité des traitements chimiques dans la lutte contre les mauvaises herbes

L'efficacité des traitements dans la lutte contre les mauvaises herbes est évaluée en estimant la réduction par le traitement de la concurrence exercée par les mauvaises herbes. Avec les graminées la comparaison porte sur les nombres d'épis ou de panicules par m^2. Pour les Dicotylédones, elle porte sur la surface couverte. Une évaluation est établie pour chaque espèce dans chaque parcelle, évaluation exprimée en % de contrôle. Le tableau No.II résume l'efficacité des traitements recommandés sur 3 ans.

a) Herbicides contre les Dicotylédones

- 2,4-D: reste l'herbicide le plus efficace contre les Dicotylédones vu le grand nombre d'espèces qu'il élimine, faible contre les espèces de Fumaria.

- Certrol H: excellent sur les espèces importantes, mais le nombre d'espèces éliminées n'est pas aussi important qu'avec le 2,4-D.

Tableau No. II. Efficacité des traitements recommandés.

Espèces de mauvaises herbes	2,4-D	Cert.H	2,4-D + Suffix	Suffix	Dicuran	Dozanex	Dicuran + Tok	Dozanex + Tok
Folle-avoine (Avena stérilis)	O	O	E	E	M	M	P	P M
Ray-grass (Lolium rigidum)	O	O	O	O	E	E	E	E
Phalaris (P. truncata et paradoxa)	O	O	O	O	O	O	P	P
Calendula (C. arvensis)	E	B E	E	O	E	E	B	B
Chrisanthemum (C. coronarium)	E	E	E	O	B E	E	B E	E
Liseron (Convolvulus arvensis)	B	O	B	O	O	O	O	O
Fumeterre (Fumaria spp.)	M	E	M	O	O	M	O	M
Rapistre (Rapistrum rugosum)	E	E	E	O	E	E	M B	E
Faux-fenouille (Ridolfia segetum)	E	E	E	O	E	E	E	E

E : Excellent contrôle = 100 à 95%

B : Bon contrôle = 94 à 80 %

M : Moyen contrôle = 79 à 65%

P : Médiocre = 64 à 35%

O : pas de contrôle = 34 à 0%

b) Herbicides efficaces surtout contre les graminées

- Le Suffix est un excellent produit de lutte contre la folle avoine. Le fait de mélanger le Suffix avec des phytohormones efficaces contre les Dicotylédones entraîne une réduction de son efficacité contre la folle avoine. Cependant les mélanges Suffix + MCPP ou Suffix + MCPA sont au moins aussi efficaces contre la folle avoine qu'un traitement combiné de 2,4-D appliqué séparément au moins 12 jours avant ou après le Suffix.

- Le Dicuran et le Dosanex sont assez bons contre la folle avoine et un grand nombre d'espèces de Dicotylédones; its sont excellents contre le ray-grass même à la moitié de la dose normale.

- Le Tok est assez bon contre le Phalaris. Lorsqu'on utilise le Dicuran ou le Dosanex il est indiqué d'ajouter du Tok afin d'empêcher le problème posé par le Phalaris. L'emploi d'herbicides détruisant la folle avoine et le ray-grass sans emploi simultané d'un produit de lutte contre le Phalaris ne résoud pas le problème des Monocotylédones - il ne fait que changer l'espèce de mauvaises herbes.

Phytotoxicité due aux herbicides

Dans les conditions de croissance qui régnent en Tunisie, le blé et les mauvaises herbes sont, tous deux, plus sensibles que dans la plupart des autres régions du monde, ce qui fait qu'il faut souvent réduire les dosages courants afin d'éviter une chute importante du rendement en blé; toutefois, it faut éviter le risque d'un contrôle insuffisant.

Un autre moyen pour éviter une éventuelle phytotoxicité est l'application des traitements au moment convenable.

En ce qui concerne le 2,4-D, les blés tendres sont beaucoup plus sensibles que les blés durs. Son application au stade plein tallage ($4\frac{1}{2}$ feuilles) a provoqué l'année dernière, pour les 5 BT, une baisse moyenne de rendement de 3,3 qx/ha par rapport au témoin tandis que le rendement moyen des 4 blés durs a été de 3 qx/ha au-dessus du témoin. Par contre, l'application du 2,4-D au début du stade de la montaison n'a donné presque pas de pertes de rendement et ceci, quelle que soit la variété. Donc it est possible d'éviter les dégâts aux variétés sensibles en retardant le traitement au 2,4-D jusqu'au moment où le point végétatif atteint la surface du sol.

Pour le Suffix on n'a relevé aucun indice de perte de rendement. Pour éviter les risques de phytotoxicité, le traitement au Suffix devrait être effectué avant ou au stade de 2 noeuds de la montaison. Dans la pratique, si un traitement au Suffix est nécessaire pour éliminer la folle avoine et si la surface du sol est sèche au stade tallage du blé on peut traiter à ce stade. Mais si la surface du sol est humide it vaut mieux attendre le début de la montaison surtout si la levée de la folle avoine continue. Mais il ne faut pas dépasser le stade 2 noeuds.

D'autre part, aussi bien les symptômes que les pertes de rendement observés confirment la recommandation de ne pas traiter au Dicuran ou au Dosanex après le stade $4\frac{1}{2}$ feuilles. Inia 66 et Tobari manifestent une tendance à être plus sensibles que les autres variétés testées au traitement tardif. Ceci aurait peut-être été le résultat de leur maturité plus avancée par rapport aux autres variétés; pourtant, une troisième variété précoce, Amal (BD) n'a manifesté aucune tendance de ce genre (Vu Tableau III).

Conclusion

L'attention particulière qu'accorde actuellement l'industrie aux herbicides témoigne de l'importance économique des mauvaises herbes.

Quelle que soit la méthode employée, la destruction des mauvaises herbes (et particulièrement les Monocotylédones) est une opération rentable. On peut estimer que son prix de revient est de l'ordre de la valeur de 3 qx/ha au maximum alors que le supplément de récolte obtenu peut atteindre plusieurs quintaux. Selon les éléments recueillis à partir de 34 essais exécutés au cours des 2 années écoulées, l'élimination des Monocotylédones à l'aide du Dosanex + Tok a été 4,6 fois plus rentable que le 2,4-D. Dans les essais à fort envahissement par les Monocotylédones, it a été 6,6 fois plus rentable d'utiliser les produits de lutte contre les Monocotylédones que le 2,4-D.

J'espère vous avoir donné quelques résponses à certains problèmes qui se sont posés ici en Tunisie dans le domaine du désherbage des Céréales. Notre effort se poursuit surtout que de nouveaux problèmes apparaissent d'une année à l'autre. Au fur et à mesure que nous obtenons de nouvelles informations, nous essayons d'améliorer les recommandations déjà formulées. Le progrès réalisé dans les recherches pratiques a permis de renforcer les actions de vulgarisation et d'accélérer l'adoption des nouvelles techniques par les agriculteurs telles que l'utilisation des herbicides anti-Monocotylédones.

Tableau No. III. Influence du stade de développment au moment d'application des herbicides sur le rendement 1973-74 (Qx/Ha[1]).

Produit et stade[2]		Moyenne de 5 variétés de Blé tendre		Moyenne de 4 variétés de Blé dur	
2,4-D					
4 3/4 f	½ Nd	-3,3	+ 1,2	+ 3,0	+ 2,3
2,4-D + Suffix					
6½ f	1 Nd	+ 4,5		+ 4,3	
Suffix					
4 3/4 f	2 Nd	+ 4,0	+ 2,8	+ 4,6	+ 1,9
Dicuran					
2 2/3 f	½ Nd	+ 2,3	- 1,4	+ 0,5	0,0
Dosanex					
2 2/3 f	½ Nd	+ 2,9	- 1,2	+ 1,0	- 0,3

1/ Valeur ± en relation avec le témoin.

2/ f = feuilles, Nd = noeud.

WEED CONTROL RESEARCH AND DEMONSTRATION

A. Sellami

SUMMARY:

In Tunisia, weeds at present constitute the most serious threat to cereals. Parasites preying on these crops (insects and diseases) appear from time to time only as a result of certain conditions, especially weather patterns; however, weeds are always present in the cereal crops. These weeds inevitably result in loss of yield. The losses incurred vary depending on the variety of wheat, the weed species, the density of the infestations and the rainfall. To solve the weed problem the ultimate solution is the use of cultural techniques which eliminate the infestations and among these techniques it is sometimes necessary to use herbicides.

In Tunisia, as elsewhere, cultivation is the principle method of weed control. But in the presence of infestations which could not be eliminated by cultivation, the use of herbicides continues to offer the possibility of increasing crop yield and at the same time reducing the reinfestation of weed seeds.

Herbicides are expensive to use and carry a risk of phytotoxicity and failure to control the weeds. Also they require a high degree of precision. It is therefore necessary to: evaluate the losses caused by the weeds, improve herbicide efficiency and reduce as far as possible the losses resulting from the toxicity of the herbicides. These are the objectives of the experimentation undertaken since 1970 by the Technical Division of the Office of Cereals (ex-Wheat Project) in cooperation with INRAT (the National Agricultural Research Institute of Tunisia), the Crop Protection Division and the Fretissa Demonstration Farm which is operated by the Livestock Office.

Since 1970 the Experimentation Section of the ex-Wheat Project has established annually a series of experiments and demonstrations in the various wheat regions of the country. These experiments have led to a better knowledge of the weed problem and the identification of a number of factors which influence the value of herbicide use in Tunisia.

Our applied research objectives are as follows:

- Development of herbicide treatments for broad-leaf control which can be used in place of 2,4-D and applied either at the pre-emergence or post-emergence stages when the wheat is still young and it is still possible to enter the field.

- Develop a program to control grassy weeds by means of recently developed herbicides (these weeds cause four times more loss than broad-leaf weeds).

- Avoid the damage that can result from phytotoxicity.

On the practical level our objective is twofold:

- Develop new data in order to improve existing recommendations.

- Extension work with farmers to acquaint them with the best products and improved methods of weed control.

Original: French

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MOYENS DE LUTTE ET POLITIQUE AGRICOLE POUR LE CONTROLE DES MAUVAISES HERBES EN TUNISIE

S. Allaya

Les pertes de rendement causées par les mauvaises herbes dans les céréales sont difficiles à chiffrer car elles varient en fonction des espèces d'adventices considérées, du taux d'infestation et du rendement moyen de la céréales. Cependant de nombreux contrôles et essais, en plein champs sur plusieurs années ont pu mettre en évidence que les dégâts causés sont importants; l'expérimentation menée avec certains produits polyvalents (Chlortoluron, Metoxuron), applicables à des stades très précoces de la céréale et des produits spécifiques, s'adressant à une seule mauvaise herbe a pu nous donner una idée plus précise de ces pertes.

Le tableau ci-dessous est avancé à titre d'exemple:

Produits employés	Spectre d'action	Rendements moyens en qx/ha			OBSERVATIONS
		Traité	Témoin	Différence	
Chlortoluron (Dicuran)	(Produit (polyva- (lents.	17,2	9,3	7,9	Ces chiffres représentent le résultat moyen de 7 essais réalisés dans différentes régions, chaque essai comportant 4 répétitions.
Metoxuron (Dosanex)	((actif (contre (Mono.et (Dicotyle- (dones).	17,3	9,3	8	
Benzoyprop. Ethyl. (Suffix)	Contre la Folle Avoine uniquement.	14,5	9,3	5,2	

It apparait clairement que la part de récolte prélevée par les mauvaises herbes est importante et la lutte contre ces adventices constitue donc un facteur important qui ne peut etrê négligé dans un effort d'amélioration des rendements et d'augmentation de la production.

Conscient de cette situation, le Ministère de l'Agriculture n'a cessé d'accorder au problème du désherbage l'importance qui se doit dans la production céréalière.

Depuis 1968, un Comité National de lutte contre les mauvaises herbes a été crée au sein du Ministère de l'Agriculture. Ce Comité groupait tous les Services et Organismes, touchant à la production des céréales et avait pour mission de coordonner les efforts dans un but de promotion du secteur.

A titre de rappel les surfaces traitées chimiquement avant cette date ne dépassaient guère les 50,000 Ha. It s'agit uniquement du traitement classique au 2,4-D. Contre les monocotylédones adventices.

Trois actions principales ont été entreprises dans le cadre de ce comité:

- Vulgarisation des résultats acquis.
- Organisation des campagnes.
- Expérimentation.

VULGARISATION DES RESULTATS ACQUIS:

Tous les moyens de formation et d'information ont été exploités en vue de sensibiliser les agriculteurs au problème des mauvaises herbes.

It s'agissait surtout d'améliorer les techniques culturales afin de réduire les infestations en mauvaise herbe, de préciser les époques de traitement ainsi que les modalités.

Des brochures comportant tous les renseignements relatifs au désherbage, ont été éditées et largement diffusées auprès des agriculteurs; les moyens audio-visuels ont été également utilisés. Signalons enfin qu'un Séminaire traitant du désherbage a été organisé en Avril 1969.

ORGANISATION DES CAMPAGNES:

Toutes les mesures agronomiques appliquées ont apporté, certes, une amélioration de la situation mais n'étaient pas suffisantes pour lutter

contre les mauvaises herbes, compte tenu du degré d'infestation des terres à céréales si bien que des traitements chimiques étaient indispensables.

Dans la première phase d'application des campagnes organisées, c'est-à-dire vers les années 1967-68 et jusqu'en 1972, les produits employés étaient les phytohormones et surtout les produits à base de 2,4-D, car l'expérience n'était pas encore étendue aux autres herbicides. Ces produits sont efficaces contre la majorité des dicotylédones adventices et d'un prix de revient relativement accessible à tous les agriculteurs.

Il s'agissait donc d'étendre leur emploi à la majorité des agriculteurs de manière à couvrir plus de surfaces; là s'était posé le problème de moyens d'application, surtout en pulvérisateurs tractés, car it s'est avéré après enquête que le nombre de machines disponibles était très insuffisant.

Dès lors une mesure d'encouragement a été prise, elle consistait à faciliter l'acquisition des pulvérisateurs par l'intermédiaire de l'Office des Céréales par un paiement réparti sur trois années et sans intérêt.

Paralèllement l'utilisation de l'avion a été encouragée par la pratique des prix modérés, ne différant pas des applications terrestres mais l'emploi de l'avion suscitait encore une certaine méfiance des agriculteurs à cause des dégâts probables sur les légumineuses.

En outre des équipes spécialisées ont été chargées d'aider les utilisateurs à mettre en état de fonctionnement les appareils existants et, à régler leur débit d'utilisation.

Ces quelques mesures jointes à une vulgarisation intense ont permi une certaine augmentation des surfaces traitées. Ci-dessous les surfaces traitées depus 1972:

- 1972 : 106,000 Ha.
- 1973 : 70,000 Ha. (Diminution dûe aux intempéries).
- 1974 : 115,000 Ha.
- 1975 : Le chiffre n'est pas définitivement arrêté il serait de l'ordre de 1[illegible]0,000 Ha.

EXPERIMENTATION:

L'utilisation des phytohormones, ne résoud que partiellement le problème des dicotylédones et laisse intact le problème de lutte contre les graminées adventices dont l'insidence sur la récolte est aussi importante.

En outre elle présente l'inconvénient majeur d'une époque d'appli-

cation trop tardive, assez courte et souvent entrecoupées par des intempéries. Se limiter à leur emploi exclusif ne peut conce apporter une solution satisfaisante au problème de la lutte contre les mauvaises herbes c'est ainsi que des essais ont été entrepris par l'I.N.R.A.T., la Division Technique de l'Office des Céréales et la Division de la Défense des Cultures en vue:

- d'étendre l'époque d'application du désherbage et par conséquent de sélectionner des herbicides applicables à un stade plus jeune des céréales.

- de lutter contre les graminées adventices c'est-à-dire d'essayer l'application de graminicides.

A l'heure actuelle nous pouvons dire que ces deux aspects du désherbage ont trouvé des solutions au niveau de l'expérimentation puisque de nombreux produits ont été essayés, se sont avérés efficaces et rentables pour l'agriculteurs. Mais, au niveau de la pratique quelques difficultés persistent it s'agit de:

- L'application assez délicate des graminicides surtout; en effet les doses d'efficacité sur les adventices et des phytotoxicités du blé sont très proches l'une de l'autre ce qui implique un certain niveau technique de l'utilisateur.

- Le prix de revient relativement élevé de ces herbicides.

- La conviction des céréaliculteurs.

En ce qui concerne la première difficulté, le Ministère de l'Agriculture a intensifié les campagnes de vulgarisation, renforcé les équipes sur le terrain pour assister l'agriculteur dans les opérations d'application (réglage des appareils, doses, époque d'application etc...). Paralèllement l'utilisation par avion de ces herbicides est a l'essai et elle est prometteuse.

Un autre élément qui aidera certainement à résoudre cet aspect du problème est l'existence, à l'heure actuelle, des pulvérisateurs équipés d'ordonnateur qui garantissent un débit constant à l'hectare.

Pour ce qui est du deuxième point c'est-à-dire le prix; le Ministère de l'Agriculture a pris une mesure d'encouragement, à titre exceptionnel et pour une première application à grande échelle des nouveaux herbicides, à savoir la subvention à 50% d'une série de produits afin de contribuer à l'augmentation de la production. Les surfaces traitées avec ces produits sont estimées à 20,000 Ha pour l'année 1975.

En ce qui concerne la conviction des agriculteurs; des parcelles de démonstration ont été installées dans toutes les régions céréalières et des visites sont organisées à l'intention des agriculteurs pour les amener

à constater concrètement les résultats; ces parcelles sont souvent implantées chez les céréaliculteurs aux-mêmes. Dans ce domaine nous espérons un peu plus de compréhension de la part de nos agriculteurs qui ont toujours manifesté la bonne volonté à l'égard de tous les problème touchant à la production.

CONCLUSIONS:

Le problème du désherbage est, certes, très important mais il ne représente qu'un facteur pour l'obtention de bonnes récoltes. It doit donc être considéré comme élément dans tout le "système" de la production céréalière.

Une organisation minutieuse, à l'échelle de l'exploitation, doit être adoptée afin d'inclure le désherbage comme toute autre mesure culturale (préparation du sol - appat d'engrais - etc...). Les prévisions d'herbicides, des moyens de traitement doivent être programmés bien avant le semi de manière à intervenir à temps.

Le choix des herbicides doit être fait en fonction de la flore adventice, de la nature du terrain et des possibilités de traitement.

Tous les moyens disponibles à l'échelle de l'exploitation et des organismes spécialisés doivent être rationellement utilisés de manière à exploiter les journées favorables, compte tenu des délais relativement courts dont dispose l'agriculteur pour l'application du désherbage.

WEED CONTROL METHODS AND POLICIES IN TUNISIA

S. Allaya

SUMMARY:

Weeds at present constitute the most serious threat to the cereal crop. Observations made in farmers' fields in recent years have on many occasions shown that large losses in yield (in the order of 4 qls/ha) have occurred in fields with medium infestations of broad-leaf weeds with these fields yielding 15 qls/ha on the average. As for the grass weeds, wild oats in particular, the losses can reach the same level with medium infestations, but in the case of heavy infestations the weed competition becomes still more intense.

Weed control is therefore a very important factor in increasing cereal production.

In view of this situation the Ministry of Agriculture has unceasingly devoted its attention to the weed control problem as a key aspect of cereal production.

In 1968 a National Weed Control Committee was created within the Ministry for the purpose of intensifying this effort.

At the same time, a number of specialists in the field engaged in weed control experimentation, which has in a short period of time made it possible to develop suitable weed control methods.

At the present time, chemical weed control in cereal crops is generously encouraged in Tunisia by means of subsidies on herbicides, loans for the purchase of sprayers and the activities of the SO.NA.PRO.V. (National Crop Protection Company) which carried out air and surface treatment of crops at modest cost (1.700 D/ha). These prices are maintained by the Ministry of Agriculture which grants a subsidy to the company to balance its costs.

Finally, the extension efforts undertaken in the past several years should not go unmentioned. All means of training and education have been mobilized to make the farmers aware of the weed control problem.

Original: French

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A MODEL OF ECONOMIC ANALYSIS FOR THE USE OF HERBICIDES

A. S. Ben Zaïd

A large number of weed species are known in Northern Tunisia to be serious competitors with wheat production for the use of factor inputs, particularly moisture and fertilizers. Their effect may be interpreted by a large loss in the normal yields of wheat 1/. Hence, in the general effort to increase wheat production in Tunisia, weed control would be no less important than the genetic improvement of wheat materials or any technological advances designed to extract higher yields of wheat.

Various technological packages of herbicide treatments have been defined for such a purpose, establishing the technical feasibility of weed control. That is, a safe hypothesis may be advanced that if the prevailing conditions are known a package of herbicide treatments specifying the nature, the timing and the doses of the product may be prescribed so as to reduce to a significant extend the negative effects of weeds on wheat yields.

The problem for the individual farm remains, however, at the decision level and resides in the economics of herbicides.

On the one hand, the cost of herbicides seems to rise with new products, but, on the other hand, the effectiveness of such herbicides seems to depend on many factors. Some of those factors are mostly "predetermined" at the farm level, such as wheat variety, types of weeds, degree of infestation, seed-bed preparation and soil endowment, so that the decision maker may take them into account. However, other factors influencing the effectiveness of herbicides are not easily predictable. Those are essentially the weather conditions, and in particular, the rainfall quantity and its pattern of distribution. The problem is then how to consider weather in decision making about herbicides.

In most problems of this type the procedure has been to transform weather uncertainty into risk probabilities, which are easier to handle in decision making and for which "Game theory" offers a convenient framework.

1/ This loss may reach 50% of the yield in some conditions (see the 1973-74 Report of the Division Technique de l'Office des Céreales, "the Wheat Project").

At the farmer's disposal there are various strategies which are the different herbicide treatments including the possibility of no treatment. Once the predetermined conditions are specified, the farmer would be playing against various states of nature, which are the different types of weather conditions weighted by a given probability distribution. In this framework the farmer must know all possible outcomes, that is the net gains in wheat yield he could make from each strategy, in each state of nature.

Based on rainfall records and the observed wheat and weed growing conditions in Northern Tunisia, three periods of the year have been chosen to simplify the distribution pattern of rainfall, and for each period, the critical quantities of insufficient, enough, and too much rain have been defined 1/. The frequency distribution of the possible types of years, obtained in this way, has then been estimated over the past 73 years and over six stations selected to represent the wheat belt in Northern Tunisia.

Those frequencies are presented in percentages in Table 1 along with the various treatments. Table 2 lists the gains in quintals of yields from each treatment in each type of year. In this tabulation of outcomes, different entries are defined by the predetermined conditions. These are the type of weeds (broad leaves, wild oats, and most weeds including canary grass and ryegrass) and the degree of infestation (average and high) 2/.

Theoretically if such a tabulation could be offered to the decision maker, who knows in addition the costs of each strategy, his economic decision on whether to treat or not and what treatment to use would depend solely on his own attitude towards risk. It should be noticed, however, that the value of the decision is mostly dependent on the precision of the estimated outcomes. Actually few of outcomes have been really observed, while the others have been estimated 3/.

In general, the usefulness of the model may be improved by the following developments: (1) More experimental results should be obtained gradually to replace the estimated outcomes presented in this analysis; (2) More detailed analysis of weather records is needed to investigate the sequence of cycles and weather conditions that are critical to agricultural practices; (3) The forecasting reliability of the model may also be improved by adapting the analysis at the level of the individual stations. Table 3 illustrates different estimates of potential gains based on frequencies of "rainfall years" at the individual stations.

1/ These values also correspond with the long term average rainfall in Northern Tunisia in each of these periods.

2/ Another predetermined factor is the wheat variety. Actually, the outcomes in Table 1 are based only on results that were observed for a weed resistant variety (Soltane). However more observations should be obtained for wheat varieties that are more susceptible to weed competition.

3/ The observed basis is obtained from the experimental results of the Technical Division of the Office of Cereals over the past 4 years. Extrapolation procedures were then used to estimate the remaining outcomes.

Table 1. Relative Frequencies of Rainfall Year Types expressed as percent (1901-1973).

Stations	Year Types 1/																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	---	=--	+--	--=	=-=	+-=	--+	=-+	+-+	-=-	==-	+=-	-==	===	+==	-=+	==+	+=+	-+-	=+-	++-	-+=	=+=	++=	-++	=++	+++
Bizerte	0	1.53	0	0	1.53	3.07	0	0	1.53	0	1.53	4.61	0	6.15	0	0	4.61	3.07	4.61	23.07	7.69	0	9.23	9.23	0	10.76	7.69
Medjez El-Bab	3.50	17.54	0	0	15.78	1.75	3.50	3.50	0	0	8.77	5.26	7.01	5.26	0	5.26	7.01	1.75	3.50	3.50	0	0	1.75	0	3.50	1.75	0
Beja	0	0	0	0	0	0	1.47	1.47	0	0	4.41	1.47	1.47	7.35	0	1.47	11.76	8.45	4.41	14.70	1.47	0	9.85	7.04	5.63	9.85	5.63
Bou Salem	2.89	13.55	0	0	7.24	1.44	1.44	8.69	0	1.44	8.69	1.44	2.89	10.14	0	7.24	11.59	2.89	2.89	4.34	0	1.44	5.79	1.44	0	4.34	0
Le Kef	1.44	2.89	1.44	0	4.34	1.44	1.44	13.04	2.89	4.34	4.34	2.89	1.44	13.04	0	10.14	13.04	4.34	1.44	0	0	0	5.79	1.44	4.34	1.44	2.89
Maktar	1.40	2.81	1.40	2.81	8.45	1.40	7.04	14.08	8.45	0	2.81	1.40	5.63	2.81	0	5.63	14.08	4.22	2.81	0	0	1.40	1.40	0	7.04	1.40	1.40
Northern Region 2/	0	0	2.73	0	4.10	2.73	0	9.58	0	0	12.32	1.36	1.36	17.80	0	1.36	13.69	4.10	4.10	4.10	2.73	1.36	6.84	0	0	9.58	0

1/ To simplify rainfall distribution three periods (Early, Middle, Late) are chosen. In each period the quantity of rain may be insufficient (-), sufficient (=) or too much (+). The type of year is then defined by the observed combination of signs.
Early = Stage of wheat stand establishment, weed stand establishment and infestation potential (Sept. 1 to Nov. 30).
Middle = Wheat and grass weed vegetative cycle, total cycle of many broad leaf weeds (Dec. 1st to March 31st).
Late = Wheat and grass weed reproductive cycle (April 1st to June 30th).

2/ Based each year's rainfall average over the six Stations above.

Table 2. Potential Gains under Six Conditions for Each Type of Year (Quintals/ha).

Treatment	Weeds	Degree of Infestation	Year Types																										
			1	2	3	4	5*	6	7	8	9	10	11	12	13	14*	15	16	17	18	19*	20*	21	22	23	24	25	26	27
			---	=--	+--	--=	=-+	+-=	-=+	=-+	+-+	-=-	==-	+=-	-==	===	+=+	-=+	==+	+=+	-+-	=+-	+=-	-+=	=+=	+==	-=+	=++	+++
T1	(2,4D) Broad Leaves	Average	0.8	1.0	1.2	0.6	0.9	1.1	0.7	0.8	1.0	1.8	1.7	2.0	0.5	0.5	0.7	0.5	0.5	0.7	1.7	1.5	1.8	0.7	0.6	0.9	0.6	0.5	0.7
T2	(2,4D) Broad Leaves	High	2.4	2.5	2.7	1.3	1.6	1.9	1.3	1.5	1.8	3.1	3.0	3.2	1.0	0.9	1.1	0.9	0.8	1.0	3.4	3.0	3.7	1.1	1.0	1.2	0.9	0.8	1.0
T3	(Suffix) Wild Oats	Average	2.3	2.3	3.0	1.5	1.5	2.0	1.5	1.5	2.0	4.7	4.1	5.0	2.3	2.0	2.5	2.1	1.9	2.2	7.1	5.8	7.1	4.0	3.5	3.8	3.8	3.4	3.5
T4	(Suffix) Wild Oats	High	6.9	6.9	5.9	4.6	4.6	5.9	4.6	4.6	5.9	10.6	8.2	9.1	5.3	4.1	4.6	5.3	4.1	4.6	14.3	9.5	12.3	8.0	7.0	7.6	8.0	7.0	7.6
T5	(Dosanex + Tok) Most Weedsee	Average	5.5	6.0	7.9	4.5	5.0	6.6	4.3	4.8	6.4	6.6	6.4	9.0	3.3	3.2	4.7	3.3	3.2	4.5	9.8	8.1	11.3	5.0	4.2	5.7	4.8	4.0	5.5
T6	(Dosanex + Tok) Most Weedsee	High	10.9	13.1	17.2	9.1	10.9	14.3	8.8	10.6	14.1	14.2	13.7	15.6	7.9	7.6	8.7	7.9	7.6	8.4	17.1	12.8	17.9	8.8	6.6	9.0	8.6	6.4	8.8

* Outcomes in year types 19, 14, 20 and 5 have been actually observed in 1970-71, 1971-72, 1972-73 and 1973-74 respectively (See "Projet Blé" Annual Report 1973-74), the other values are estimated by extrapolation.

** Including ryegrass and canary grass.

Table 3. Expected Values 1/ of Potential Gains at 6 Locations in Northern Tunisia (Quintals/Ha)

Treatment 2/	Locations						
	Northern Region	Bizerte	Medjez	Beja	Bou Salem	Le Kef	Maktar
T1	0.89	1.08	0.95	0.86	0.89	0.80	0.78
T2	1.61	1.96	1.86	1.50	1.71	1.44	1.42
T3	3.02	4.24	2.73	3.54	2.78	2.56	2.33
T4	6.28	8.05	6.39	6.95	6.33	5.85	5.66
T5	5.03	6.42	5.31	5.29	5.05	4.67	4.79
T6	10.07	10.94	10.97	9.30	10.41	9.77	10.07

1/ Expected value: Product of relative frequencies (Table 1) multiplied by the corresponding potential gains (Table 2).

2/ Same as in Table 2.

UN MODELE D'ANALYSE ECONOMIQUE POUR L'EMPLOI DES HERBICIDES

A. S. Ben Zaïd

Plusieurs espèces de mauvaises herbes posent un problème de concurrence avec la production céréalière au niveau de l'utilisation des facteurs "inputs", en particulier, l'eau et les engrais - Leur effet global se traduit par une réduction importante de la production du blé dans la région du Nord de la Tunisie 1/. Ainsi, dans l'objectif national d'augmenter la production du blé, le desherbage serait une composante de l'effort général aussi justifiée que l'amélioration génétique ou la recherche de tout autre progrès technique permettant d'obtenir des rendements céréaliers plus élevés.

Sur le plan technique le desherbage est devenu possible au moyen de traitements chimiques qui spécifient la nature, la dose et les moments d'emploi pour une gamme de produits. Cette possibilité est le résultat d'un effort expérimental continu, grâce auquel les conditions d'utilisation de plusieurs herbicides et leur degré d'efficacité technique ont été déterminés.

Cependant, sur le plan économique de l'entreprise agricole, le problème reste au niveau de la décision. Faut-il ou non traiter? et pour quel manque à gagner par chaque traitement possible?

D'une part, le coût des herbicides semble s'élever avec l'apparition des produits nouveaux, mais d'autre part l'efficacité de ces produits semble varier avec plusieurs facteurs. Certains de ces facteurs sont "prédéterminés", dans le sens qu'ils peuvent être connus à temps pour en tenir compte au niveau de la décision. Ce sont par exemple, la variété du blé, l'espèce des mauvaises herbes et le degré d'infestation, ainsi que la nature du sol et son état de préparation. Cependant, d'autres facteurs pouvant influencer l'efficacité des herbicides ne sont pas pour autant prévisibles. Ce sont essentiellment les facteurs climatiques et en particulier la pluviométrie, tant par sa quantité que par sa distribution sur la saison culturale. C'est à ce niveau que la question se pose de façon plus aigue, à savoir, comment incorporer le critère climatique au niveau de la décision concernant les herbicides?

1/ Selon le rapport annuel 73-74 du Projet Blé, la réduction du rendement peut aller jusqu'à 50% dans certains cas.

Le modèle offert pour ce genre d'analyse est inspiré de la théorie des jeux, permettant de transformer la situation d'incertitude à un problème plus maniable de risque à travers un système de probabilités. Dans ce cadre, le gestionnaire dispose d'un certain nombre de stratégies représentant les différents traitements possibles et entre autres l'alternative de ne pas traiter. Le jeu est mené contre un certain nombre d'états naturels possibles affectés d'une distribution statistique déterminée.

Pour définir ces états possibles, l'année agricole a été divisée en trois périodes consécutives et pour chaque période une quantité critique de pluie a été définie come étant insuffisante, suffisante ou trop grande par rapport aux besoins conjoints de la culture du blé et du développement des herbes nuisibles. La distribution statistique des types d'années possibles, ainsi obtenus, a été estimée à partir des données pluviométriques sur les 73 dernières années et sur six stations représentant la zone céréalière du Nord de la Tunisie. (Tableau 1).

Le travail a consisté ensuite à remplir le tableau par les gains potentiels en rendement de blé pour chaque stratégie dans chaque type d'année (Tableau 2). En fait le tableau a plusieurs entrées correspondant aux différentes combinaisons de facteurs prédéterminés, en particulier, la nature de la population des herbes (3 catégories) ainsi que le degré d'infestation (moyen et élevé) 1/.

En présence d'un tel système d'information, et sachant en outre le système des prix prévalant, la décision de traiter ou non, par quel herbicide et pour quel manque à gagner ne dépendra en principe que de l'attitude individuelle vis-à-vis du risque avec lequel les agriculteurs ont toujours coexisté. Il est cependant à noter que la valeur de la décision est directement rattachée à celle des estimations utilisées dans l'analyse. En effet, les observations réelles ou expérimentales ne remplissent qu'une faible proportion du tableau global 2/.

Pour améliorer l'utilité pratique du modèle, l'effort devrait peut-être continuer dans les voies suivantes: (1) Les résultats estimés devraient être progressivement remplacés par des observations réelles; (2) Une analyse plus profonde des données pluviométriques devrait déterminer la séquence des cycles possibles et les conditions critiques relatives aux façons culturales; (3) Finalement, l'ensemble de l'analyse devrait être adapté a l'échelle des stations individuelles, voir Tableau 3.

1/ Le degré de résistance de la variété de blé devrait être encore un autre facteur prédéterminé. Cependant, le tableau a été élaboré à partir de données relatives à une variété résistante (Soltane). Il serait peut être nécessaire de compléter les données sur des variétés susceptibles.

2/ Les observations de base sont obtenues à partir des résultats du "Projet Blé" sur les 4 dernières années. Une extrapolation raisonnée a permis ensuite d'estimer les résultats non observés.

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THE ROLE OF FERTILIZERS - ESPECIALLY NITROGENOUS - IN INCREASING WORLD FOOD PRODUCTION

N. E. Borlaug

INTRODUCTION:

During the past three years, the world has suddenly awakened to the importance of food from the standpoint of its biologic, economic and political worth. Without adequate food supplies, social unrest increases, political chaos sets in, and life itself becomes precarious. Yet, all too often, political leaders underestimate the importance of agriculture.

In the long period from 1947 to 1972, large stocks of grain - in reality surpluses - accumulated in warehouses in the grain exporting countries. World production had temporarily exceeded demand. These surplus stocks kept the prices paid to farmers for grain relatively low, and resulted in stable consumer prices for food throughout the world. During this long period, the nations with surpluses often made large quantities of grain available to the food-deficit developing nations on a concessional or long-term, easy-credit basis. I am convinced that the ease with which grain could be obtained by the developing nations from these surplus stocks, whenever needed, often contributed to the neglect of the development of their agriculture. These shortsighted policies, employed by both the food exporting and food deficit developing nations, collectively contributed to the events of the past three years that have brought world civilization to the brink of wide-spread disaster from famine.

Over a long period of years during the 1950's and 1960's, cereal grain production was intentionally reduced by various devices in the grain exporting surplus countries. This was done to bring production more into balance with international market demands, while at the same time adjusting reserve stocks downward so as to reduce the economic burden on their taxpayers and economies. It was believed that a proper balance between cereal production and demand, maintaining an adequate reserve to meet any emergency, had been reached in 1971. But events of the past three years show that something was wrong with these calculations.

Cereal grain production is often used as the best index of overall world crop production. Cereal grains collectively -- wheat, rice, maize, barley, sorghum, millets, oats and rye -- are grown on about 698 million

hectares, which represent 48 percent of the world's total cultivated land area (1,457 million hectares). On a world-wide basis, cereal grains directly provide 56% of the caloric intake and 50% of the protein consumption of human diets. Indirectly, cereal grains also contribute greatly to human diets, since about 1/3 of the annual production of cereals is fed to livestock to produce meat, eggs, milk, butter and cheese. It is estimated that cereal grain production utilizes about half of all the fertilizer consumed annually.

The fact that I will use cereal grain production as an overall index of crop production, in the following discussion, does not, however, imply that root crops, legumes and pulses, sugar crops, oilseeds, vegetables, fruits and nuts are not important in food production. Rather, it is used to simplify the explanation of the magnitude of the problem of producing the food required to feed a world population of 4 billion; it is helpful to focus on cereals as the key group of commodities.

1. THE MAGNITUDE OF THE PROBLEM: PRODUCING CEREAL GRAINS TO FEED 4 BILLION PEOPLE

The cereal grain production of 1971-72 (Table 1) reached an alltime world record of 1,212 millions (1.212 billions) of metric tons. This figure is so large it means little to most of us. Perhaps we can best visualize this production as equivalent in volume to a highway built of cereal grains (calculated on the weight/volume basis of wheat) with a roadbed approximately 2 meters high and a width of 18 1/2 meters that circles the earth at the equator.

This highway, which I will designate as "Pan-Equatorial Grain Highway I" must be rebuilt each year (unlike highways built of concrete for transportation, which will last with only minor repairs for 20 to 30 years), for its equivalent in grain is completely consumed annually. Moreover, world population (which now numbers approximately 4,000 million (4 billion) and is increasing at the rate of about 2 percent annually) requires that cereal grain and other food production must be increased sufficiently each year to feed 80 million more people. However, world cereal grain demand during 1965-71 increased at the rate of 2.5 percent per year -- 0.5 percent faster than population growth -- thus indicating that cereal grain production must be increased by approximately 30 million metric tons annually in order to maintain the 1971 per capita consumption (which is still very modest) without drawing on stored reserves. Therefore, "Pan-Equatorial Grain Highway I" must be rebuilt (annually) and construction must be launched on "Pan-Equatorial Grain Highway II" with the same width and depth of grain-filled roadbed as Highway I. Over 1,000 kilometers of this new roadway must be constructed annually to maintain 1971 per capita food production and hold the line against the relentless advance of the population monster.

But crop production fluctuates from year to year because of factors beyond the control of man. In the 1972-73 crop year, adverse weather conditions (severe winter kill of wheat in the Soviet Union and eastern Europe combined with severe drought that adversely affected the production of summer crops, i.e. sorghum, millet, maize and rice across vast areas of south Asia and the Sahelian countries of Africa) resulted in a modest reduction of approximately 39 million metric tons, or only 3.2 percent below the record 1971-72 crop. Nevertheless, this modest reduction in world cereal production set in motion a sequence of events that has seriously affected world-wide food grain availability and food prices over the past three years. Large purchases of wheat and other grains by the Soviet Union to compensate for their bad 1972 harvest greatly reduced the reserve grain stocks of the U.S.A., Canada, and Australia -- which, as now judged by perfect "20/20 hind-sight vision" had been permitted to fall to a precarious level. As a result, grain and other food prices began to soar and further added to the already serious world-wide inflation. In less than a year, wheat and other grain prices more than tripled and added to the dilemma of low income people throughout the world, and especially seriously affected the economies of the developing nations.

Cereal production recovered spectacularly (despite worsening fertilizer shortages) with favorable weather in most of the world in the 1973-74 crop year (Table 1), but the increase was insufficient to significantly replenish reserve stocks. And food prices remained high, while fertilizer shortages and fertilizer prices worsened.

In 1974-75 a world-wide effort was made to increase production and rebuild reserves. The area sown to cereals was increased, but this was offset by worsening shortages of fertilizer; and by floods, droughts and early frosts. As a total effect of these negative factors, production dropped to near the 1971-72 level. Therefore, in order to feed the additional 240 million people who have been added to the world population in the past three years, it was necessary to withdraw more grain from the already limited world grain reserves. As a result, by the end of June 1975, the grain reserves will be at the lowest level since 1947 and will represent a reserve of only 7 percent of the annual world cereal consumption.

A disastrous situation has been at least temporarily circumvented during the past 8 months by an unanticipated reduction in demand for grain for feeding of livestock -- beef, swine and poultry. High prices for grain in late 1974, coupled with falling prices for meat, resulted in a sharp decline in demand for cereals for feed. This in turn resulted in diverting considerable grain (especially wheat) for human consumption. This unanticipated reduction in demand for grain temporarily salvaged a precarious situation from becoming disastrous in Bangladesh and parts of India. Nevertheless, the critical shortage of foods and resulting high prices for grain persists, and

TABLE 1. WORLD CEREAL PRODUCTION AND RESERVE STOCKS 1971-75[1]

All Cereal Grains[2]	Crop years			
	1971-72	1972-73	1973-74	1974-75[3]
	(In million of metric tons)			
1. Production (Actual)	1,212.5	1,173.9	1,279.8	1,220.3
2. Estimated projected production needed to maintain per capita consumption at the 1971-72 level without drawing on reserve stock	---	1,242.8	1,273.4	1,303.4
3. Reserve stock June 30	150.5	107.7	112.1	88.8
4. Reserve stock June 30 expressed as percentage of an estimated world consumption	12.6%	8.8%	8.8%	7.1%

[1]Source: The World Food Situation - Year End 1974 by Dale E. Hathaway, Ford Foundation, based on USDA agricultural statistics

[2]Wheat, rice, maize, sorghum, barley, millets, oats and rye.

[3]Projected through June 30, 1975

[4]Assuming 2% population growth and increase in consumption of 2.5%

cannot be corrected until reserves of grains are replenished. It is obvious that a reserve greater than that of 1971-72 must be maintained and adjusted to population growth. How it is to be handled and financed is another matter that limitations in time do not permit us to explore at this workshop.

2. FOOD PRODUCTION EXPANSION TO IMPROVE DIETS; WHILE KEEPING PACE WITH POPULATION GROWTH

From the beginning of history until the end of World War II, whenever more food was needed to meet growing demands caused by improvement in diets and population growth, the problem was solved primarily by increasing the area under cultivation. Sometimes the cultivated area could not be expanded rapidly enough to compensate for bad harvests caused by wide-spread droughts, floods, frosts, disease epidemics and insect plagues, and when this happened, famines occurred. History tells of devastating famines with monotonous regularity dating back to the time of the earliest records.

At the end of World War II, agricultural production recovered spectacularly, especially in Europe and parts of Asia. For the first time, world-wide gain in production was primarily the result of increase in yields per hectare, rather than by an expansion in cultivated area. Production increased rapidly while the area cultivated to cereals declined. This was a change from the traditional methods of increasing food production. The increases in yields per hectare were attributable to the wide-spread application of improved technology; i.e. the use of higher yielding varieties, the use of more chemical fertilizer, better cultural practices and better control of weeds, insects and diseases. The increase in yield resulting from improvements in technology can be illustrated by the change in corn yields in the U.S.A. where the average national yield increased from 2.55 metric tons per hectare (40 bushels/acre) in the early 1950's to 5.62 metric tons per hectare (90 bushels/acre) by 1972. The wide-spread application of new technology in many developed countries of the world in the period from 1949 to 1971 resulted in similar rapid increases in food production. It resulted in the production of surpluses with resulting cheap food in most countries of the world;and, as I have already mentioned, this in turn discouraged agricultural improvement in many of the developing nations. Now that the food reserves have been depleted because of inclement weather in two of the last three crop years (further complicated by a rapidly increasing demand for food caused by exploding population growth during the past two decades) what is to be done to increase food production fast enough to meet the growing demand so as to avoid disastrous famines?

As mentioned above, it is necessary to increase cereal production at the rate of a minimum of 30 million additional metric tons per year in order to maintain per capita grain production at the 1971-72 level. This can be done

by expanding the area cultivated to cereals, by increasing the yields on the area currently being cultivated, or by a combination of the two approaches. If the increase in production were to be achieved exclusively by increasing the area sown to cereals it would (using the current world-wide average grain yield for all cereals of 1826 kilos per hectare) require increasing the area sown to cereals by 16,430,000 hectares annually. Similarly, the area sown to other essential crops would need to be increased proportionately. This immediately indicates that this approach is not feasible, since most of the densely populated food deficit countries of the world have little or no additional good new land that can be brought under cultivation. If they attempt to expand the area sown to cereals, other necessary crops will simply be displaced from cultivation in most cases. For these countries, the only feasible solution is to increase crop yields on the area now under cultivation and perhaps slowly expand the area under irrigation where this is feasible.

There are only a few countries in the world that can still expand greatly the area under cultivation. In this category are a number of central African countries in the tropical and subtropical rainfall areas, and here development is difficult, costly, and slow. Generally there are also severe health problems that must be solved before these areas can be successfully opened to agriculture. Brazil is another area where it is still possible to open vast areas for agriculture. But most of these virgin areas have infertile soils, which have been highly leached of nutrients in the geologic past. To open them to cultivation requires vast capital investments in roads, railroads and fertilizer factories, etc. and it will require many years to make them productive.

It is therefore clear that most of the increase in cereal and other food production in the next two decades must come mainly from increasing yields on the areas now under cultivation, and especially, in the developing nations where crop yields are currently generally very low.

Such an attempt requires an integrated approach. It will require the development and wide-spread application of improved technology combined with wise economic policy that will encourage farmers to adopt the new technology and thereby increase food production.

All of you at this Third Regional Wheat Workshop are playing vital roles in one or more aspects of this task. Some of you are developing high yielding, fertilizer-responsive crop varieties. Others are engaged in seed multiplication programs, still others in agronomic and/or fertility research, and some of you are involved in developing better cropping systems as they relate to both crop and animal production. And finally, others are involved in developing economic information which will lead to more realistic agricultural economic policies. The world needs your very best collective efforts if we are to expand food production fast enough to avert disaster. At the same time, others, struggling on a different front, strive to slow population growth so as to provide the possibility for a decent humane life for all who are born into this world. The question of how many should be born into this world, and what is a manageable rate of population growth, are beyond the scope of this Workshop.

3. THE IMPORTANCE OF FERTILIZER IN INCREASING CROP YIELDS AND PRODUCTION

Soil infertility is the factor most limiting food production throughout the cultivated areas of the world. Much of this land has been cultivated for decades or even centuries in a "mining type of agriculture": essential plant nutrients have been extracted from the soil in the process of repeated harvesting of crops without the replacement of essential nutrients to the soil. As a result, most of the cultivated land area of the world is now deficient in one or more of the essential plant nutrients. Nitrogen deficiency is almost universal, while phosphorus and potash deficiencies also are very wide-spread. Calcium, magnesium, and sulfur are deficient in some soils, whereas one or more of the essential minor elements sometimes limit yields in others. The usual manner of correcting these nutrient deficiencies, and thereby increasing crop yields, is through the application of the right kind and proper dosage of fertilizer. (This is not meant to ignore the important use of legumes to increase soil nitrogen in rotations with cereals).

The wide-spread and judicious use of chemical fertilizer has, perhaps, contributed more than any other single factor to increasing crop yields and production since the end of World War II. The annual world consumption of fertilizer for the five year period, 1949-1953(expressed in metric tons of plant nutrients) was: 4,541,000 (N), 6,051,400 (P_2O_5) and 4,815,800 (K_2O). By 1970-71, the consumption had climbed to 32,589,300 (N), 20,642,300 (P_2O_5) and 17,693,400 (K_2O) (metric nutrient tons). Total combined world consumption of these three nutrients thus climbed from 15,408,200 to 70,925,000 metric tons in the 22 year period. The expanding use of chemical fertilizers to increase food production continues dramatically, as is indicated in Table 2. Dr. Raymond Ewell (Professor of Chemical Engineering State University of New York, Buffalo) estimates that the world consumpriton of N - P - K will reach 94.1 million metric nutrient tons by 1975-76, and will increase again to 123.6 million tons by 1980-81.

3.a Unpredictable prices and supplies

The task of expanding world food production fast enough to rebuild grain stocks during the past three years has been fraught with frustrations. Although unfavorable weather has adversely affected crop production in two of the past three years, the shortage and high prices of fertilizer also have greatly contributed to the dilemma.

The chemical fertilizer industry of the world over the past twenty five years can be characterized as a "boom to bust to boom" type of business. Fertilizer shortages with high prices for products have been followed by overproduction and a crash in product prices. Nitrogen fertilizer production

capacity was over-expanded in the first half of the 1960's as a result of the euphoria that evolved from a breakthrough in a new, cheaper process of ammonia manufacture. A glut of nitrogenous fertilizer production followed, prices plummeted, and old plants with inefficient production technology were forced out of business. Disenchantment followed, and investments in new factories to expand fertilizer production lagged behind rapidly expanding consumption for a number of years. It was during this period of over-production of fertilizer (with the resultant low prices in the late 1960's and early 1970's) that the developing nations; i.e. India, Pakistan, the People's Republic of China, Mexico, Brazil, etc., began to rapidly increase their consumption of nitrogenous fertilizers and of phosphorus. While world fertilizer consumption was increasing at an annual rate of 9 percent per year in the period from the early 1960's to 1971, production capacity was being expanded at only about 6 percent annually. As a result, reserve stocks were being depleted at an accelerated rate and production began to fall farther behind demand. The first signs of impending serious shortages of nitrogenous fertilizer became evident in late 1972, when early delivery of fertilizer purchases was no longer possible. Urea prices increased by 25 percent from July 1972 to July 1973. The demand for fertilizer was further accentuated by the poor grain crop of 1972-73, which resulted in a large increase in grain prices. Scarcity of fertilizer worsened and prices began to rise more steeply, exploding upward with the drastic increase in petroleum prices in late 1973. The drastic changes in both nitrogenous and phosphatic fertilizer prices are shown in Table 3 and Figure 1. The price of anhydrous ammonia rose from $29 per metric ton in July 1972 to $300 per ton by July 1974. Urea prices in the same period rose from $45 per metric ton to $300 per ton. Both have increased again in recent weeks. All other nitrogenous fertilizer prices have increased proportionately with increases in ammonia prices.

3.b The Magnitude and Nature of the Nitrogenous Fertilizer Shortage

The availability of adequate supplies of nitrogenous fertilizers at reasonable prices will be one of the decisive factors in determining whether food production can be expanded fast enough to stay ahead of growing demands for food in the next five years.

Nitrogenous fertilizers can be produced from electrolysis of water, from natural nitrate deposits (i.e. Chile nitrate and guano), or by stripping hydrogen from a hydrocarbon fossil fuel and reacting it with nitrogen from the air.

The fixation of nitrogen by electrolysis of water requires large inputs of cheap electric energy, generally from hydro-electric sources. Only two plants are currently producing nitrogenous fertilizer by this process:

Table 2. WORLD FERTILIZER CONSUMPTION

Nutrient	Year			
	1971-72	1972-73	1975-76*	1980-8:
	Millions of Metric Nutrient Tons			
N	33.7	36.1	47.0	65.0
P_2O_5	20.9	22.6	25.5	31.7
K_2O	17.5	18.7	21.6	26.9
Total N+P+K	72.1	77.4	94.1	123.6

*Projected consumption

Source: World Plan of Action for Fertilizer Industry by Raymond Ewell, UNIDO Conference on Fertilizer, Lima, Peru, March 1975

the plants at Aswan Dam in Egypt and at Mangal, India. The total production of nitrogenous fertilizers from natural deposits such as Chile nitrate or guano is very small and can contribute little toward solving the current world-wide shortage of nitrogenous fertilizer. Ammonia can be made by using any one of the fossil fuels as a hydrocarbon source from which hydrogen is stripped and combined with nitrogen from the air in reactors operating at high temperatures and pressures. The process has high energy input requirements. All solid nitrogen fertilizers are made from anhydrous ammonia.

Natural gas is the best, most economical, and most widely used raw material and energy source used for the production of ammonia. Nevertheless, naphtha, gasoline, fuel oil, crude oil and coal can all be successfully used as raw materials, even though plants employing these raw materials are more expensive to build and to operate than are those based on gas, as is indicated in Table 4.

The present total world nitrogen production capacity for both industrial and fertilizer use is estimated to be about 72 million metric tons. Of this total, approximately 41 million nutrient metric tons of nitrogen are currently available annually for fertilizer use (Table 5). This represents approximately 57 percent of the theoretical total world nitrogen production capacity. Nevertheless, there is currently a world-wide shortage of nitrogenous fertilizer and prices are 6-fold to 8-fold higher than they were three years ago (Table 3 and Figure 1). In part, this horrendous increase in price of nitrogenous fertilizers is attributable to the increases in prices for petroleum and gas. Nevertheless, a disproportionately large part of the high prices is caused by scarcity of supply and competition for the inadequate supplies that are available.

The nitrogenous fertilizer industry is at present rapidly expanding production capacity in an attempt to overcome these shortages. At a recent U.N.I.D.O. Fertilizer Conference in Lima, Peru, Dr. Raymond Ewell reported that 137 ammonia plants, mostly large,are now under construction or in the final stages of planning. They range in size from 500 to 1,500 ton per day capacity, with most being of 1,000 ton per day capacity. It now takes 3 to 4 years after construction begins before new ammonia plants come on-steam. Consequently, nitrogen fertilizer will likely remain in short supply at least until 1980, according to Ewell.

Ewell figures that the ammonia, urea and phosphoric acid plants now under construction represent an investment of $20 billion. More than half of these plants are being built in the developing countries; i.e. India, Indonesia, the People's Republic of China, etc. Many new nitrogenous fertilizer factories also are being installed in the Soviet Union, eastern European countries, Venezuela and Mexico. Plans for large expansion of ammonia production in Canada have recently been cancelled. Western European coun-

Table 3. CHANGES IN FERTILIZER PRICES FROM JULY 1972 TO APRIL 1975

	U.S. Dollars per Metric Ton of Product						
	GTSP[1]	DAP[2]	MAP[3]	Urea[4]	NH[5]	Phosphate Rock[6]	
July 1972						FOB Morocco	FOB Florida
FOB USA Gulf Port	73.00	92.00	95.00	45.00	29.00	12.00	7.00
Freight	6.00	6.00	6.00	6.00	7.00	---	--
CIF Buenos Aires	79.00	98.00	101.00	51.00	36.00	---	--
July 1973							
FOB USA Gulf Port	80.00	100.00	103.00	56.00	35.00	14.00	10.00
Freight	10.00	10.00	10.00	10.00	12.00	---	---
CIF Buenos Aires	90.00	110.00	113.00	66.00	47.00	42.00	25.00
July 1974							
FOB USA Gulf Port	285.00	325.00	325.00	300.00	300.00	63.00	48.00
Freight	40.00	40.00	40.00	40.00	42.00	---	---
CIF Buenos Aires	325.00	365.00	365.00	340.00	342.00	---	---
January 1975	--	--	--	--	--	68.00	48.00
April 1975							
FOB USA Gulf Port	310.00*	340.00*	360.00*	350.00*	360.00*	68.00	48.00
Freight	40.00	40.00	40.00	40.00	42.00	---	---
CIF Buenos Aires	350.00	380.00	400.00	390.00	402.00	---	---

[1]Granular triple superphosphate-(46%P_2O_5), [2]Diammonium phosphate-(21-54-0), [3]Monammonium phosphate-(11-48-0), [4]Urea-(46% N), [5]Anhydrous ammonia-(82% N), [6]Exportable grade phosphate rock.

* Estimated prices for April 1, 1975.

by Norman E. Borlaug, CIMMYT, February 1975.

Figure 1

PRICES OF FERTILIZER FOB US GULF PORTS
US DOLLARS PER METRIC TON OF PRODUCT
1972–1975

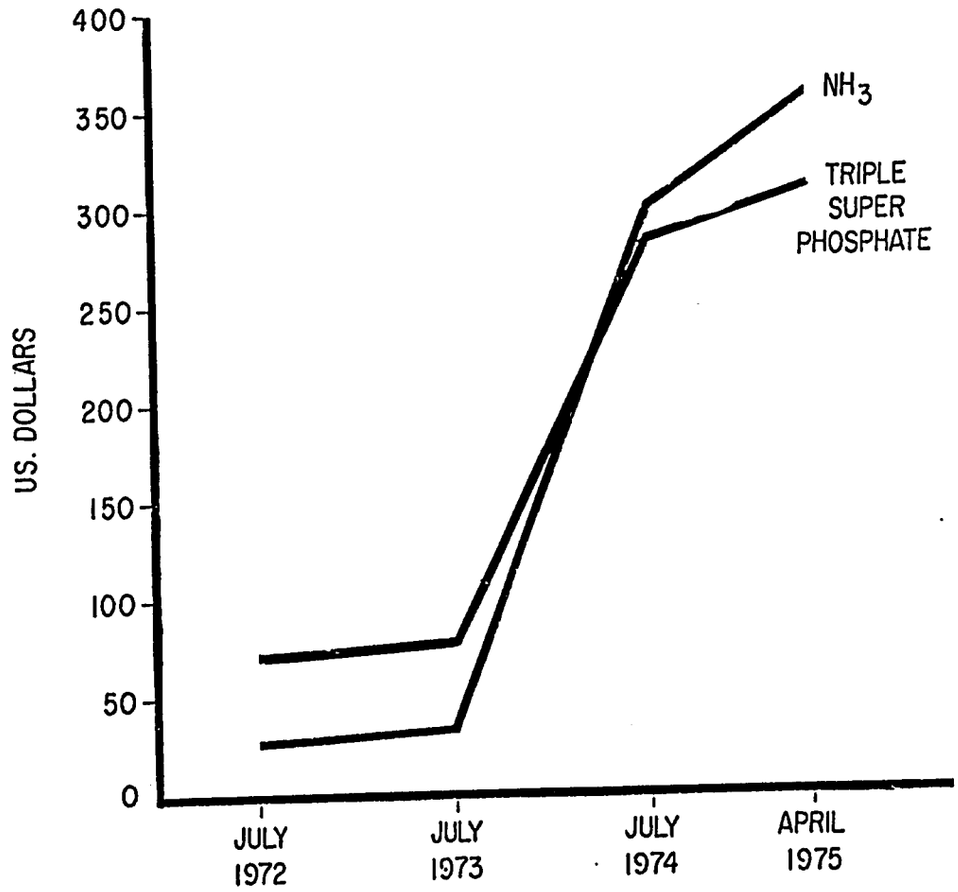

Table 4. CAPITAL REQUIRED FOR INSTALLATION OF A 1000 METRIC TON PER DAY ANHYDROUS AMMONIA PLANT AND FOR UNIT TO CONVERT THE 1000 TON PER DAY AMMONIA PRODUCTION TO UREA

Raw material source	Cost of Factor Units		Total Cost Ammonia + Urea Unit
	Ammonia Unit	Urea Unit	
	In Millions of U.S. Dollars		
Natural Gas	$50-90	$40-60	$90-150
Naphtha	$55-95	$40-60	$95-155
Fuel Oil	$65-100	$40-60	$105-160
Coal	$85-140	$40-60	$125-200

Source: Dr. Raymond Ewell, UNIDO Conference on Fertilizer, Lima, Peru, March, 1975.

tries, Japan and the U.S.A., which formerly were leaders in nitrogenous fertilizer production, are at present doing little to expand production capacity -- because of the scarcity of gas and the precariousness of the supply of petroleum.

3.c World Shortages Spur China's Fertilizer Production

The People's Republic of China is one of the countries that is currently investing very heavily in the expansion of its nitrogenous fertilizer industry. Before 1960, virtually no nitrogenous chemical fertilizer was used in China, and the only source of nitrogen for agriculture was composted organic wastes, human, animal and plant. In the 1960's, the Chinese government began to build a large number of small factories producing ammonia and ammonium bicarbonate from coal. There are estimated to be about 800 of these small plants in operation at present; the production ranges from 2,000 to 50,000 metric tons of ammonia annually. Despite the installation of this large number of small ammonia plants, demand for nitrogenous fertilizer has increased rapidly and has outgrown supply. Consequently, in the period from 1969 to 1974, the People's Republic of China had become the world's largest importer of nitrogenous fertilizer. It is estimated that, in 1974, about one-third (33%) of the nitrogen used in crop production was derived from chemical nitrogen; moreover, its use is increasing rapidly.

When the world price of petroleum crude oil increased greatly in late 197 and adversely affected nitrogenous fertilizer production in Japan (one of the principal suppliers of urea for China) the government of the People's Republic of China took action. Within only a few weeks time, the Chinese revolutionized their production of ammonia and solid forms of nitrogenous fertilizers. Currently, twelve, 1000-ton-per-day ammonia plants are under construction, employing the most modern technology. This development clearly indicates their recognition that much more chemical fertilizer must be used to produce the food for a population of 900 million. Moreover, it clearly indicates the decision of the Chinese government to invest huge sums in fertilizer production capacity. In addition to the direct cost of installing these factories, the government obviously has committed itself to tremendous investments in development of gas and petroleum fields, pipelines, warehousing and transport systems.

The enormous investments by the People's Republic of China in modern chemical nitrogen fertilizer factories should destroy the myth that "organic farming" alone can be the solution to our fertilizer needs for solving the world's food production problems -- as some idealistic, but confused, organic gardening advocates would have us believe. China has always been singled out by the organic farming enthusiasts as the model country that has

Table 5. WORLD PRODUCTION CAPACITY FOR NITROGEN, NITROGEN POTENTIALLY AVAILABLE FOR FERTILIZER AND ESTIMATED WORLD DEMAND FOR NITROGEN AS FERTILIZER

Year	World Total Nitrogen Production Capacity *	World Potential Nitrogen Supply for Fertilizer	Estimated World Demand for Nitrogen as Fertilizer
	Millions of Metric Tons of Nitrogen		
1974	67.1	38.2	39.2 (-1.01)**
1975	72.1	40.9	42.0 (-1.1)
1976	77.2	43.6	44.8 (-1.2)
1980	96.7	56.3	56.9 (-0.6)

* Discrepancies between production capacity and nitrogen as fertilizer availability result from:

(1) 15-20% of world nitrogen production capacity if for non-fertilizer uses.

(2) Plants world wide operate at 75-85% of rated plant capac

(3) 5-10% loss of nitrogen occurs in converting NH_3 to urea other solid fertilizers.

** Figures in parenthesis ( ) indicate estimated deficit.

Source: Dr. Raymond Ewell, UNIDO Conference on Fertilizer, Lima, Peru, March 1975.

solved its fertilizer and food production problems through the use of decomposed human, animal and plant wastes as fertilizers.

My comment above does not imply that decomposed organic wastes are not used effectively and skillfully in Chinese agriculture. Indeed, there is much that we can learn from them about utilizing such wastes, and at the same time help to reduce pollution of the environment. However, the magnitude of nitrogen fertilizer needs is such that the use of decomposed organic wastes can be only a useful adjunct or supplement to the extensive use of chemical fertilizers, if we are to restore fertility to the huge areas devoted to agriculture throughout the world.

Moreover, it should be pointed out that the widespread and skillful use of composted organic wastes as effective fertilizers in China is tied directly to their culture; to practices that have evolved over centuries. It is estimated that China currently produces 250 million swine annually, more than 4 times the number produced in the U.S.A. This vast number of hogs is produced largely on fermented plant parts and wastes unusuable directly as human food, and with a minimum of grain for feed. For the most part these hogs are produced by individual families. They receive the piglets, at weaning time, from state hog-breeding farms, and raise them to marketable age. These hogs are a chief source of income for farm families and provide large quantities of meat for the nation. Moreover, since this huge number of hogs is almost exclusively confined to pens, all of the manure is recovered for inclusion in the compost piles with human and plant waste. Thus, hog production indirectly plays a vital role in maintaining soil fertility. In China, virtually all of the animal waste (primarily hog) is used as fertilizer, rather than as fuel for cooking of food, as is the case with cattle dung in the Indian sub-continent. This is made possible because the government has made coal available as fuel, at the village level.

Another factor that makes both human and animal waste an effective constituent in organic composts in China (and it could become so in India where other sources of fuel exist) is that 80 to 85 percent of the population lives in rural areas where the waste is directly collected daily without entering a central sewage system. In western Europe or the U.S.A. 85 to 95 percent of the total population is urban or non-rural and all human waste enters central sewage systems where it is contamined with industrial wastes. The transport costs of returning these vast amounts of sewage to the land far removed from the cites poses a serious problem. Moreover, the sewage from most largecities often contains large quantities of one or more heavy metals; i.e. mercury, lead, zinc, copper, etc. After a number of years of fertilization with sewage, a build-up of these elements may occur which is toxic to crops and/or may pose human health problems from consuming plant products produced on this land.

Admittedly, in the western world -- and especially in the U.S.A., where enormous numbers of cattle are fattened in large feed lots -- huge amounts of animal wastes have accumulated that would be valuable as fertilizer if returned to the soil. As these wastes accumulate they often are unpleasant pollutants of the air and sometimes of surface water. Again the main problem involved in utilizing these wastes as fertilizer is that enormous quantities are accumulated in a few places. Since they are voluminous and have low levels of nutrient nitrogen, phosphorus and potash, the labor and transportation costs of returning them to the farms far removed from the feed lot locations have been, up to the present, both an obstacle to utilizing this waste effectively, and to cutting down on their polluting effects.

Since this Workshop also deals with the use of leguminous forage crops used in rotations with cereals, I would be remiss to not mention the importance of this indirect method of providing part (or all, depending upon rainfall) of the nitrogen needed for the subsequent cereal crop.

Other biological nitrogen-fixing possibilities include a number of non-nodule forming nitrogen fixing bacteria that grow in the rhizosphere of certain plants. The amount of nitrogen that is fixed by these organisms is, however, very small and of little significance in increasing crop yields. Within the past two years, Dr. Johanna Dobereiner in Brazil has called attention to the symbiosis of an intercellular non-nodule nitrogen-fixing bacterium. Spirellum loboferum, with certain tropical grasses.

Despite these interesting discoveries, there is no reason to believe, at present, that within the foreseeable future - if ever - such organisms will be able to supply significant amounts of the nitrogen requirements for non-leguminous crops. Hence, for the future, we will need to continue to rely largely on the use of chemical nitrogenous fertilizers and crop rotations involving legumes and, to the extent possible, the use of organic fertilizers as the sources of nitrogen for our crop plants.

4. WORLD NEEDS FOR CHEMICAL FERTILIZER EXPANSION

Despite the large expansion currently underway in the chemical fertilizer industry, as referred to above, it is likely that the current shortage of nitrogenous fertilizer will persist at least until 1980. The amount of capital, great as it is, that is now being invested in new fertilizer production facilities is, according to Ewell, inadequate to meet the production goals. There is a reluctance in many countries to invest in new production capacity because of a number of uncertainties, including high prices and unreliability of sources of gas or petroleum raw materials, and fears of over-expansion and the subsequent collapse of the price for fertilizer as occurred in the mid-1960's. Moreover, in recent years there has been considerable over-sophisticated "academic smog" being vented by food production theorists and activist environmentalists which has beclouded the issues and perhaps disenchanted potential investors.

A few years ago, when the DDT hysteria began to wane, a new environmental crusade got under way. This new crusade seemed to be based largely on the principle that "blue water was more beautiful than green", and that the use of both nitrogenous and phosphatic fertilizers were greatly contributing to the eutrophication of streams, rivers, and lakes. After public hearings, lawsuits and many pages of copy in the popular press, proof of the general validity of the charges was not established, so once again the crusaders' interest waned and the activists retired to search for a newer and better cause.

The energy crisis has brought new food production theorists into the limelight. Their ideas have added both confusion and disenchantment to those considering investing capital in expansion of the fertilizer industry. This small group of food production theorists insisted that nitrogenous fertilizer production -- derived from "scarce fossil fuels" -- cannot be justifiably used to produce food. (Presumably, it is more valuable for use in the second or third family car). It is their contention that new crop varieties must be developed by plant breeders which would have the ability to produce high yields of grain in wornout soils, without the "wasteful" use of nitrogenous fertilizer. To these utopians, one can only reply that such wheat varieties will be produced by plant breeders about six months after these crusaders produce a race of Homo sapiens that require no food to live a normal, fruitful, enjoyable life.

It should be self-evident that a thoughtful informed person should not become very concerned about employing natural gas to produce nitrogenous fertilizers that are needed to increase food production; as long as one sees the enormous quantities of natural gas that are being flared and wasted at petroleum well-heads and refineries throughout the world.

There seems to be no accurate estimate of the magnitude of this world-wide gas wastage. According to a recent report published in The Daily Star of Beirut, it was estimated that approximately 6,000,000,000 (6 billion) cubic feet of gas is being flared from petroleum well-head and refineries in Saudi Arabia each day. It requires approximately 36,000,000 (36 millions) cubic feet of gas per day to energize and provide the feed-stock for a 1,000 metric ton per day anhydrous ammonia plant. Consequently, each day gas sufficient to provide the energy and feed-stock for 167 anhydrous ammonia plants of 1,000 metric ton per day production capacity is being flared and wasted. Each 1,000 metric ton per day anhydrous ammonia plant operating at rated capacity over a 330 day/year will produce approximately 324,200 metric tons of ammonia, or an equivalent of 275,000 nutrient tons of nitrogen. Therefore, the gas currently being flared -- if utilized as feed-stock and energy source in the aforementioned 167 one thousand metric ton/day (1,000 mt/day) anhydrous ammonia plants -- would produce approximately 45 million metric nutrient tons of nitrogen per year. It is estimated that the total world consumption of nutrient nitrogen utilized as fertilizer in 1975 will be approximately

41 million metric tons (Table 5). Therefore, the amount of natural gas being flared in just one country, Saudi Arabia, is sufficient to produce the entire nitrogenous fertilizer needs of the world in 1975, were it utilized rather than wasted. When one reflects on the vast quantities of gas now being flared and wasted in many countries, including the Arab Emirates, Algeria, Bolivia, Ecuador, Chile, Gabon, Indonesia, Iran, Iraq, Kuwait, Lybia, Nigeria, Peru, Romania, Soviet Union, Mexico, Venezuela, etc., there seems to be little reason to restrict the use of natural gas for the production of nitrogenous fertilizer at this time.

How much additional nitrogenous fertilizer production capacity must be installed each year in order to correct the present deficit and maintain the rhythm of expansion needed to produce the required annual increases in food production?

It is difficult to predict with any reasonable degree of certainty the number of 1,000 metric ton per day anhydrous ammonia factories that must be installed each year in order to meet both the world's growing needs for industrial nitrogen requirements and for fertilizer. This difficulty in part indicates why the nitrogenous fertilizer industry goes through periods of overproduction followed by shortages -- a "boom to bust" economic cycle. Table 5 indicates some of the many discrepancies and vagaries that are involved in planning new nitrogen production facilities to meet anticipated world needs.

Although the 1975 calculated world production capacity for nitrogen is 72 million metric tons, of which about 80 percent is believed to be devoted to satisfying fertilizer requirements and 20 percent industrial needs, only about 41 million tons were available for fertilizer. The large discrepancies between the calculated available nitrogen production capacity and nitrogen available for use in fertilizer and industry is the composite effect of many factors contributing toward factories operating at much less than rated capacity, among which are: poor factory design, inadequate maintainance, and poor management. Although a few factories operate at more than 100% of calculated capacity, many, especially in the developing nations, are operating at only 60 to 70 percent of calculated capacity. Moreover, losses of 5 to 10 percent of nitrogen occurs in converting anhydrous ammonia to urea and other products. Added to these difficulties in estimating the production output of installed factory capacities are the vagaries of expanding fertilizer demand on a worldwide basis. Nitrogenous fertilizer requirements and application varies widely from crop to crop within the same country, depending on the climate (especially moisture) and the soil type involved, and also widely from country to country on the same crops, depending upon the stage of evolution or intensification of the agriculture.

While recognizing full well the errors involved in estimating expanding nitrogen needs, it may none the less be useful to indicate the general magnitude of expanding needs.

Dr. Raymond Ewell uses a rule of thumb to estimate the needed expansion of ammonia production capacity. He states that for each additional 6 million people, one additional 1,000 ton per day anhydrous ammonia plant must be installed, as well as its corresponding urea plant. This means that to provide the nitrogenous fertilizer that is needed to produce the additional food required by the 80 million people who are added to the world population each year, 13 new 1,000 ton per day anhydrous ammonia plants, with a rated total capacity to produce 3.5 million tons of N, must be installed annually. This, however, assumes that all of the new ammonia plants would be used exclusively for the production of fertilizer, that they all would produce up to their rated capacity and that there would be no loss in conversion to urea or in transport and storage. However, Table 5 indicates that about 20 percent of the world nitrogen production is employed in non-fertilizer used. Moreover, world-wide nitrogen production only reaches 75 percent of rated plant capacity and another 10 percent loss is encountered in converting ammonia to solid fertilizer and in storage and transport. Considering these discrepancies, it is quite possible that a more realistic figure would be to increase the total production capacity by approximately twenty (20) additional 1,000 metric ton per day ammonia plants each year. This figure of needed expansion seems to be conservative, if one considers both the fertilizer and industrial needs based on the calculations indicated below.

Needed expansion of fertilizer production capacity may also be considered from the crop requirement point of view. If one calculates the expanded fertilizer production capacity needed to produce an additional 30 million metric tons of cereal grain (assuming 1 kilo of nitrogen will produce an additional 10 kilos of grain), an additional 3 million nutrient metric tons of nitrogen, 1.5 million tons of P_2O_5 and 1.0 million tons of K_2O will be required annually. Considering the additional production capacity required for non-fertilizer uses; that required to compensate for production lower than rated capacity; and losses in conversion and storage, an additional eighteen (18) 1,000 ton per day ammonia plants will be required to produce the nitrogen fertilizer needed to produce the additional 30 million tons of grain each year. Since, however, only about 60 percent of the nitrogenous fertilizer consumed is used to produce cereals, and the remainder is applied on cotton, sugar cane, sugar beets, potatoes, yams, vegetables, fruits, nuts and other crops, about thirty (30) 1,000 ton per day ammonia factories must be added yearly so as to assure the corresponding necessary nitrogen increase for both non-agricultural and fertilizer uses (on both non-cereal and cereal crops). This assumes that all of the increased production of both cereal and non-cereal crops would result from the increased use of fertilizer, which is, of course, unrealistic. Since improvements in cultural practices (that is, better land preparation and moisture utilization, use of high yielding varieties, better control of weeds, diseases and pests) can be expected to collectively contribute about 40 percent toward the increase in crop yields, annually, this benefit can be expected to offset the 40 percent of the fertilizer used on non-cereal crops.

Consequently, the estimated need for adding 18 new 1,000 ton a day anhydrous ammonia plants annually appears to be more realistic. This estimate is also in reasonably good general agreement with the "rule of thumb" used by Raymond Ewell, a recognized world authority on fertilizer production and needs, which states that the addition of each six million more people to the world population requires the addition of one new 1,000-ton-a-day anhydrous ammonia plant each year.

Dr. Ewell recently indicated that a capital investment of $100 billion dollars must be made in the ten-year period from 1975-1985 in fertilizer plants, raw materials, operating costs, transport and other infrastructures for the fertilizer industry, if we are to meet the food production goals. Since it costs from $100 to $200 million to build a 1,000 ton per day anhydrous ammonia plant and its appropriate urea conversion plant (Table 4), these cost estimates appear to be conservative. Ewell estimates that the capital investments in expanded fertilizer production capacity will be running at a rate of $7 billion annually in 1975, and must increase to $10 billion by 1980, and to 13 billion annually by 1985.

Although at first glance this seems to be a huge sum to invest in fertilizer production, it is very modest compared to the more than $240 billion that the world is presently spending on "defense" and armaments.

4.a The Phosphate Fertilizer Problem

Not only have nitrogenous fertilizers been in short supply with resultant disastrous increases in prices, but phosphate rock and phosphatic fertilizer production also began to lag behind demand in 1972. In part, the shortage of phosphate rock production in Florida in the U.S.A. was caused by legal action suits brought by activists in the environmental movement against the phosphate rock producers, which delayed opening of new mines. This blockage of expanded production of phosphate rock in the U.S.A. was not relaxed until food prices began to soar and farm groups brought political pressures to increase phosphate fertilizer production. Almost simultaneously with the big increase in crude oil prices in November 1973, Moroccan phosphate rock prices were increased greatly (Table 5). Since Morocco is the world's largest exporter of phosphate rock, this sets the pattern for both phosphate rock prices and (indirectly) to a large degree, for all other phosphatic fertilizers. Moroccan phosphate rock prices increased from $12 per metric ton in July 1972, to $63 in July 1974 and to $68 by January 1975. Triple super phosphate increased from $73 per ton in July 1972 to $285 per ton in July 1974, and diammonium phosphate from $92 to $325 per metric ton in the same period.

In all probability, the prices of phosphate rock and phosphate fertilizers in general will soon begin to ease. Currently there are 67 new phosphoric acid plants under construction in the world. New phosphate rock

mines are being opened in a number of countries. Some experts predict that by late 1975 or early 1976 adequate supplies of phosphate fertilizer will become available to meet demands and begin to ease pressures on the market. The shortage of potash fertilizers during the past three years has been much less of a problem in expanding world food production than has been the case with either nitrogenous or phosphate fertilizers. Already the expansion of production of potash, especially in Canada is easing pressures on the market.

It must be emphasized that the horrendous increase in prices of nitrogenous and phosphoric fertilizers (even when they are available) in the developing nations -- where the prices of food grains are maintained at an artificially low level, often only half or even one-third of the price on the international market -- have been a disincentive to fertilizer use by farmers and hence have indirectly restricted cereal production during the past two years. How much longer the price of nitrogenous and phosphatic fertilizer prices can be maintained at these unreasonable levels in the face of growing farmer resistance remains to be seen.

I would be less than frank with you if I did not express my deep concern about exploding world population growth. In the three days since our Workshop opened, approximately 660,000 more people have been added to the world that must be fed, clothed, provided opportunities for education, medical care, and for employment. There are now approximately 4,500 more people on earth, than when I began speaking about 30 minutes ago. I ask you how much longer can the world continue to provide an opportunity for a decent life for all who are born into this world if this rate continues? It cannot continue to do so much longer!

Author's note - August 5, 1975

As a result of farmer resistance to the exaggerated prices for both nitrogenous and phosphatic fertilizers, demand (especially in the food-deficit developing nations, where grain prices were controlled at 1/3 to 1/2 of international price levels) dropped sharply in the period from January to June. As a result, anhydrous ammonia which was selling at $360 dollars per metric ton on April 1, 1975 had fallen to $175 by August 1, 1975. Similarly, diammonium phosphate that was selling at $340 dollars per metric ton on April 1, 1975 had plummeted to $175 per ton by August 1st. In retrospect, it has become evident recently that (in addition to a real shortage of production of both nitrogenous and phosphatic fertilizer during the past year and a half, which drove the prices higher) speculators were also operating in the market and also contributed to driving the prices to such a horrendously high level that farmer resistance and shrinking demand finally broke the spiraling prices.

Now that this spiral has been broken, there is likely to be further downward adjustments in all fertilizer prices during late 1975 and 1976.

LE ROLE DES ENGRAIS, PARTICULIEREMENT DES ENGRAIS AZOTES, DANS L'AUGMENTATION DE LA PRODUCTION DES DENREES ALIMENTAIRES

N.E. Borlaug

RESUME:

La baisse rapide dans des réserves de céréales et la hausse des prix des produits alimentaires pendant les trois dernières années a mis fin à un état de contentement politique concernant la capacité mondiale de production et d'entretien des stocks de vivres. Avant la Seconde Grande Guerre Mondiale, le problème de comment augmenter la production de vivres a été resolu en premier lieu par l'augmentation de la superficie en culture. Toutefois, pendant les prochaines décennies, l'augmentation de production des céréales et d'autres vivres doit être principalement le résultat d'une augmentation de rendements sur les superficies déjà en culture, particulièrement dans les pays en voie de développement où de faibles rendements font la règle aujourd'hui.

Le facteur le plus limitant à la production de vivres est l'infertilité des sols. Depuis la Deuxième Grande Guerre, l'emploi judicieux des engrais chimiques a contribué, plus qu'aucun autre élément, à l'augmentation des rendements et de la production.

Il y a eu une surproduction des engrais azotés au début des années '60, suite à une percée technologique qui a permis une production d'ammoniaque à bon marche, ce qui a causé une réduction dans le prix du produit et, parallèlement, une réduction des investissements pour la construction des usines de fabrication.

La première indication d'une pénurie d'azote s'est manifesté vers la fin de 1972, lorsqu'il est devenu impossible de commander l'engrais azoté avec livraison contractée en avance de la saison. Les prix se sont montés! Le prix d'ammoniaque anhydre a passé de $US 29 la tonne en Juillet, 1972, à $US 300 la tonne en Juillet, 1974. Pendant la même période, le prix d'urée a passé de $US 45 à $US 300 la tonne.

A présent, l'industrie des engrais est en pleine expansion; néanmois, grace à la forte demande pour l'énergie, son prix élevé aussi bien que les hauts frais d'investissement, la pénurie d'engrais azoté durera jusqu'à 1980

au moins. Dans la production de cet engrais, l'insuffisance des ressources terrestres n'est pas un facteur limitant car le processus le plus efficace est de séparer l'hydrogène du gaz naturel et de le recombiner avec l'azote atmosphérique. Selon les reportages, la quantité de gaz naturel flamboyée chaque année aux raffineries et aux environs des puits de pétrole, est suffisant pour satisfaire aux besoins mondiaux en engrais azoté jusqu'à la fin du siècle.

Dans les cinq années prochaines, la disponibilité d'engrais azoté à des prix raisonnables sera un des facteurs déterminants dans la course entre l'explosion des besoins alimentaires et l'effort d'expansion de production de vivres.

Original: Anglais

21

THE STRATEGY OF ESTABLISHING A CROP ROTATION PROGRAMME USING ANNUAL FORAGE LEGUMES

J.B. Doolette

The concept, important principles, benefits and the feasibility of the land-use system developed in southern Australia in which a free-seeding, self-regenerating, annual forage legume is grown in rotation with cereal crops has been described previously (1, 2).

This paper discusses some important considerations for the introduction of the system to a country where it is intended to replace the existing rotation.

Choosing a new crop rotation

Experiments designed to compare possible crop rotations are long-term and complicated. In comparing a simple 2-year rotation with a 3-year rotation and assuming each to have been established in 3 successive years to minimise the effect of climate in the year of establishment and to speed up comparisons, the useful wheat yield data would be generated in the 9th, 10th and 11th years of the experiment. It is not unusual to have analyses deferred until 25-30 years after commencement in more complicated comparisons. The disadvantages of these time delays are obvious when there is need to find a superior rotation to replace a lowly productive or damaging system.

Often the "best bet" approach is preferable. This entails a careful appraisal of the environment, the constraints imposed by the environment and management facilities, and the production goals, and then looking to another region of the world of similar environment, constraints and goals and where improved systems have been established.

In these respects Tunisia and other parts of North Africa resemble southern (temperate) Australia so that a land-use system based on wheat in rotation with an annual forage legume is likely to be suitable.

The levels of soil nitrogen are low as evidenced by the yield responses obtained to added nitrogen. Wilhelmi (3) reported 82 experiments

over four years and stated that responses have been very pronounced in most of the trials even in dry years.

Year	Mean Yield Increases from Added Nitrogen	%age Increase
1969-70	7.1 qls/ha	26%
1970-71	10.3 qls/ha	37%
1971-72	11.3 qls/ha	33%

In the same report Wilhelmi states that organic matter values taken from soil samples in the wheat areas normally range between 1-2 percent. It should be expected that soils of these types in regular cropping patterns would have values in the order of 2-3 percent.

The wheat growing region of Tunisia has soils variable in respect to type, depth and texture and rarely have the capacity to sustain continuous cropping.

Tunisia has a rainfall pattern the main feature of which is its variability -- variable not only in respect to the annual incidence but also in respect to the onset and length of the growing season and the occurrence of stress periods.

In all these constraints the Tunisian wheat regions resemble those of temperate Australia. More importantly, the production goals of cereal grain and livestock products which are the prime income sources are the same.

Whereas the broad principles of a crop rotation programme are dictated by technical considerations and directed towards maintaining soil productivity, the final decisions are invariably based on financial considerations. The land-use system in which cereal crops are interspersed with periods of pasture composed predominately of annual forage legumes is capable of maintaining soil productivity for the cereal crops and supporting livestock enterprises in a flexible manner.

All these considerations made it reasonable to assume that the system would be economically sound for Tunisia as well as being technically feasible.

Variety of legume and its interaction with the location

The key factor in the system is the legume -- the free-seeding, self-regenerating, annual forage legume.

The system has been developed in mediterranean climates and the subterranean clover and medicago varieties used are typical mediterranean annuals. They germinate with the autumn rains, grow under favourable conditions until seed is set in the spring or early summer and survive the dry summer months as seed. The success of a variety depends not only on the vigour of the winter/spring growth but also on its ability to produce a large quantity of seed so that in regeneration dense seedling populations exert competitive pressures. The seed must have a protective mechanism against germination until growing conditions are favourable. Some sort of dormancy mechanism will allow the species to survive adverse conditions and germinate at the correct time. In the neutral to alkaline soils of Tunisia's wheat growing regions (pH 7.5-8.0) the annual species of the genus Medicago grow strongly and the development of the system is based on this material. The system can be constructed, under different soil conditions, using varieties of Trifolium subterraneum or indeed other annual forage legumes, but this discussion will use the consideration relating to Medicago.

An important issue is the necessity of establishing the system using a variety which responds best to the environment. As well as varieties commercialised elsewhere there is a wide range of indigenous material occurring in Tunisia. Heyn (4) reviewed the world distribution of the genus Medicago which occurs from Europe to Central Asia, in North Africa and in Asia Minor. It is suggested that the annual species are mostly confined to areas bordering the Mediterranean Sea and nearby regions. Much of the material in North Africa has been collected and in some instances some of them have already been chosen for multiplication for commercial purposes. There is little doubt that suitable native material is available for most of the micro-environments where the system is envisaged. A good deal of work is necessary however to establish how a newly developed strain is going to react to an environment. Early selection based on agronomic characters and yield performance in rows or micro-swards can sometimes be misleading. The effects of such factors as seed size, seedling populations, drought tolerance or competition in mixed swards have received little attention from agronomists mainly because in the areas where most study has been done and at the time when study was most active there was an absence of a suitable range of material. In North Africa there is a wide range of material and it is widely distributed, so that new plantings will have to compete from the beginning.

Development of commercial varieties from indigenous material should be a strong part of a country programme and should be encouraged, but because of the length of time needed to establish the true performance of potential lines particularly from an ecological standpoint, an alternative approach should be sought initially.

Taking these considerations into account it is strongly recommended that programmes be launched uring commercial varieties of known performance and wide adaptation, or, if a dense population of natural material exists in situ, managing this.

It is not always possible to predict what influence the native material will have on the sown sward. In the year of establishment it has been noted in Tunisia that the sown material mostly dominates the legume fraction of the pasture. In the sward that regenerates after the first wheat crop there is a likelihood of it being invaded by a large population of native material which has been encouraged by the shallow cultivation, superphosphate and other management treatments. Broadly the goal is to ensure a dense population of plants which fix nitrogen and meet the requirements for success described above.

The Tunisian programme was launched using two introduced varieties whose performance is well known and whose wide adaptation is established.

The variety Jemalong belongs to the group of barrel madics (Medicago truncatula) of which there are four well known commercial varieties, viz. Hannaford, Jemalong, Cyprus and Borung. Jemalong variety is adapted to a Mediterranean-type climate with greater than 250 mm annual rainfall of predominately winter incidence. Flowering occurs approximately 3 ½ months after germination. It is best suited to medium - textured, neutral to alkaline soils with a high lime content and of medium fertility. It is unsuitable for heavy textured soils. It cannot withstand waterlogging but is moderately tolerant of high salinity. It displays good tolerance to drought stress. Seed yields in lower rainfall areas in good seasons may be in the order of 300 kgs/ha.

The variety Harbinger is a strand medic belonging to the species Medicago littoralis. It is winter growing with the same general adaptation as the barrel medics. It is earlier flowering than Jemalong with the seed ripening some 15-20 days earlier. It has considerably higher herbage yields in the winter. It grows well on soils suitable for barrel medics and in addition grows well on sandy alkaline soils where barrel medics do not perform well. It is extremely sensitive to waterlogging. Harbinger's high winter production, early maturation and ability to set seed satisfactorily make it suitable for low rainfall districts with short growing seasons.

The two varieties of known wide adaptation were chosen as the basis of the commercial establishment programme in Tunisia and the results to the present have justified the choice.

The importance of seed coat impermeability

In the description of a successful variety reference is made to the need to have some sort of dormancy mechanism to allow the species to survive adverse conditions and germinate at the correct time. It is required that once established the legume regenerate spontaneously either in successive years or after cropping. This requires that the seed produced survive

the long, hot, dry summer periods and the cropping phases and that the irregular occurrence of the opening of the winter season and out of season rains does not induce germination that cannot be sustained and hence causes pasture failure.

Both embryo dormancy and impermeability of the seed coat are listed as characteristics of importance, but Quinlivan (5) establishes that the latter is the principle mechanism regulating germination of annual legumes over a number of years.

Impermeability prevents water movement through the seed coat. The mechanism is referred to as "hardseededness" and the seeds concerned are referred to as "impermeable seeds" or more commonly "hard seeds".

Seed coat impermeability, which is due to the development of a continuous suberin deposition in the seed coat, develops as seeds ripen and lose moisture in equilibrium with the relative humidity of the ambient air. It has been shown that the actual proportion of hard seeds depends on the stage of development of the seed when drying starts. Seeds maturing under moisture stress display less hard seeds than those maturing under conditions of adequate moisture. Hence there is an important influence of seasonal conditions in the spring. There is no evidence associating hardseededness with plant nutrients.

In field situations the daily alternating temperature cycle is the major cause of softening.

Annual medics are capable of carrying through a much higher proportion of impermeable seeds than other annual legumes and this ability to retain a relatively high proportion of the total seed crop as hard seed for one year at least is important in climates such as these and in fitting a situation of alternate year cropping.

Early study of the hard seed function is essential.

In Tunisia the pattern of hard seed percentage has been different from that anticipated. Whereas it would be anticipated that hard seed percentages should range from 85-95% for first year seed, in fact the limited data so far collected ranges between 55 and 70% for Harbinger at the lower rainfall sites and 65-85% for Jemalong at wetter sites. These levels remain satisfactory and regenerations after cropping have generally been satisfactory.

The subject warrants urgent study in Tunisia and should be an important early activity in any country programme perhaps in variety x location studies as well as commercial demonstrations.

Nitrogen and Nodules

The legume has the ability to fix atmospheric nitrogen through its symbiotic relationship with rhizobia bacteria, and the nitrogen fixation assumes that inoculation and nodulation with rhizobia is satisfactory.

The scientific appreciation of this symbiosis began in 1889 with the observations of two German scientists, Hellriegel and Wilfarth that the legumes' nodules made the host independent of other nitrogen. A year later Beyerinch isolated the bacterium Rhizobium. In the 85 years since then there has been a slow but steady increase in the understanding of how the nodule develops, the barriers to this development and subsequent function and how much nitrogen can be fixed.

From the practical standpoint it was important in Tunisia at the beginning of the programme to evaluate the situation. Firstly, it was assumed from visual examination that adequate rhizobia of one or more strains was present because the indigenous medics appeared to be effectively nodulated. Secondly, the soil conditions which affect inoculation and function such as low pH and mineral deficiencies such as molybdenum, cobalt, calcium were not apparent.

Early variety trials with Jemalong, Harbinger and Cyprus which have low rhizobia specifity, Paragosa which has a narrow specificity and Clare variety of subterranean clover were planted with and without inoculum. These and many subsequent commercial plantings led to the conclusion that Jemalong, Harbinger and Cyprus could be planted with safety whenever native material could be found in the near vicinity.

It is keenly appreciated that the local strains may be less effective than specially developed strains, but it is also keenly appreciated that the varieties Jemalong and Harbinger for which a suitable strain is available commercially may not remain the dominant varieties, that developing strains for new cultivars takes time, the introduced strains will have to compete with existing bacteria in the same way as introduced varieties will have strong competition from existing varieties.

Thus in the long term detailed rhizobial research and development could prove lucrative and it ought to be initiated relatively early in the programme, but in launching a programme the subject may best be treated as early as the local situation will allow.

Importance of Phosphorus

The annual legumes subterranean clover and medicago species are sensitive to phosphorus deficiency and appear more responsive to application of phosphorus than wheat, probably because of their freedom from

dependence on an outside nitrogen supply. A great deal more work has been carried out on the effect of phosphorus on subterranean clover than medics, but the general principles can be assumed to apply.

Apart from the question of correcting a deficiency of phosphorus to produce healthy plants, there are several important issues. Nitrogen accretion is related to phosphate supply. The production of the legume in the sward is affected by a number of factors, but an estimated mean value of annual build-up is 60-70 kgs N/ha which represents in the order of 3-4 kgs N/kg P_2O_5. Many workers have tried to separate the response to currently applied phosphate from the response to residual phosphate. In summarising some of these it seems that the reaction products of water-soluble phosphate are available to the plants on neutral to alkaline soils at least in the short term.

There is quite frequently a response to the initial application of phosphate which is lasting and may be due to the competitive effect of a denser initial stand and better yield of seed. These factors can have a long-term effect.

A third point relates to the effect of time of application of phosphate on botanical composition and this is particularly important in the legume which is regenerating spontaneously. There is a difference between phosphate applied before the germinating rain than after. When applied before, the legume is stimulated ahead of the grass and this is important in maintaining legume dominance and competing with grassy weeds.

Early Programme Goals

Based on the assumption that in Tunisia the system would work from a technical standpoint, that it was socially possible and that it supported the main production goals at least in the 350-500 mm rainfall region, certain programme objectives were established.

(1) The first was to adapt the Australian model to fit the Tunisian situation. To do this several simple and important questions had to be answered. These largely centre around points discussed above. The important additional point concerned the frequency of cropping particularly in the initial stages. Whilst it is clear that the system functions best on a 1:1 medic, crop basis and after seed supples in the soil and soil fertility build-up more intensive cropping can occur, often in establishment it is wise to have an initial period of 2 or 3 years pasture. This in fact can allow the build-up of seed quantities and soil fertility quickly. Here in Tunisia it appeared to be prudent to maintain the 1:1 frequency from the beginning. This frequency of cropping was the established pattern and a lessening would reduce income and make acceptance more difficult. Also, there did not appear to exist the facility for

heavy grazing or cutting in years subsequent to establishment and it was likely that stimulated weed populations particularly grassy weeds would use up accumulated nitrogen and affect the next crop.

Therefore, the aim became one of cropping after one year of medic only, however successful it might have been, and if necessary adding some fertiliser nitrogen.

(2) The second objective was to give some understanding of the principles and practical considerations to scientists and technicians of the country and sensitise the farmers to the possibilities and implications of this system. Although the plants which are the keystone of the whole system come from this region and have undoubtedly contributed to its agricultural production in the past, the major scientific and production development has occurred elsewhere. Hence it was not unreasonable that there was a very limited understanding before the programme began.

(3) It was important to establish the likelihood of success as early as possible in respect to two main considerations. In the first of these, the question was simply to determine whether within a relatively few cycles of the rotation the yields of wheat could match those obtained in the fallow system using all the recommended production practices of seedbed preparation and fertiliser. Equally as tangible is the need to measure the stability of the system. Would the legume regenerate after the crop? This is not only a question of seed quantity and hardseededness but also a managerial issue of whether it would be allowed to regenerate and establish.

(4) The fourth objective of the early programme was to point up and address as many of the management and technical problems which may limit adoption or function. The areas in which they lay but not the actual problem could be foreshadowed. These areas concerned things such as likely insect attack, grazing management or cutting strategy to limit weed growth and facilitate subsequent seed-bed preparation, and phosphate fertiliser placement.

(5) Develop the basis for more detailed agronomic and economic research within the appropriate institutions.

To achieve these objectives, a series of experiments were laid down at several sites and a large number of demonstrations were established. At the same time, 500 hectares of medicago was established in various size commercial areas in each of two successive years.

The early data and observations referred to in the Tunisian programme were derived from these experiments, demonstrations and commercial areas.

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L'INITIATION DE PROGRAMMES D'ASSOLEMENTS A BASE DE LEGUMINEUSES FOURRAGERES ANNUELLES

J.B. Doolette

RESUME:

L'expérimentation dans le domaine des assolements est une entreprise de longue haleine, et les décisions finales sont inévitablement fortement influencées par une situation économique en constante mutation. Il est préférable par conséquent de choisir un assolement à peu près valable, que de s'éterniser à trouver un assolement parfait, ce qui signifie choisir un assolement qui a déjà fait ses preuves dans une région présentant plus ou moins les mêmes conditions du milieu, limitations et objectifs en ce qui concerne la production agricole. A ce niveau il y a de fortes ressemblances entre la Tunisie et certaines autres régions en Afrique du Nord, d'une part, et le Sud de l'Australie de l'autre; il est donc fort possible que l'établissement d'un système d'utilisation du sol basé sur la culture du blé en rotation avec des prairies de légumineuses fourragères annuelles serait praticable.

Les données existantes indiquent que les réserves limitées d'azote dans le sol et l'insuffisance de matières organiques ainsi que certains problèmes ayant trait à la structure du sol qui ont été observés en Tunisie peuvent être imputés en partie à la pratique qui consiste à laisser les champs en jachère dans le but de minéraliser l'azote à partir de matières organiques, pratique qui ne réussit que rarement à assurer la constitution de réserves d'humidité. Les principales activités sont de loin la culture du blé et l'élevage, et au moins dans la zone pluviométrique de 350 à 500 mm, il n'existe guère d'autres alternatives. Des variétés de légumineuses fourragères adéquates sont disponibles, et un grand nombre de variétés locales spontanées garantit la possibilité de mettre au point des variétés qui seront adaptées à la plupart des micro-environnements. Les difficultés qui se présentent quant à la culture de ces variétés sont minimes.

Il est nécessaire d'avoir une idée assez précise du modèle englobant l'ensemble des activités, et à cet effet il faut dès les premiers temps procéder à une évaluation de la performance de différentes variétés et des relations qui pourraient exister entre cette performance et la localité, ainsi qu'une étude des problèmes de levée, de l'accumulation d'éléments nutritifs, des relations avec les rhizobia, des caractéristiques du tégument de la graine et de l'amélioration de la fertilité du sol.

Les objectifs visés par un programme au stade du démarrage sont multiples; il faut simultanément trouver les réponses à certaines questions de façon à rendre possible l'adoption du modèle, sensibiliser aussi bien les agriculteurs que les chercheurs à un système tout à fait nouveau et leur apprendre les techniques d'exploitation, estimer quelles sont les chances de réussite, préparer le terrain pour des recherches tant sur le plan scientifique qu'économique et développer certains aspects commerciaux tels que la production de semences.

Les difficultés qui se posent dans les premiers temps sont plutôt dans le domaine de l'exploitation qu'un manque de données et dans la nécessité d'assurer une continuité dans les sites d'expérimentation et dans le personnel.

Original: Anglais

22

EARLY MANAGEMENT ISSUES IN ESTABLISHING WHEAT-FORAGE LEGUME ROTATIONS

D.A. Saunders

The system of wheat fallow, using deep ploughing, much of it poorly timed, has led to poor structure of many soils in North Africa through depletion of organic matter.

It is found that where deep ploughing has not been continuously practiced (e.g. roadsides or shallow soils), many ecotypes of Medicago can be found. This indicates that the annual species of the genus are well adapted to the environment but not to the farming system being practiced.

The introduction of the Medicago-cereal rotation does not merely mean the replacement of fallow by legume pasture. Rather, it entails the introduction of a fully integrated system, involving a reduction of tillage depth (with a change of tillage equipment), the replacement of fallow by Medicago and the introduction of greater precision of livestock management.

The benefits which will accrue from this involve an increase in available forage, an increase in soil nitrogen of about 60 kg/ha/annum, increased organic matter with its associated benefits in soil structure and erosion control and some measure of weed control, directly by plant competition and by judicious grazing of the swards. Tillage costs will also be reduced and because of more rapid ground coverage, tillage should be better timed.

Important Technical Aspects of the Medicago-Cereal Rotation

Possibly the most important factor influencing the Medicago-cereal rotation system is that of seedcoat impermeability to water (hard-seededness).

The degree of hardseededness is influenced by genotype but environmental factors are also important. Slow maturation enhances the deposition of impermeable substances, moisture stress interrupts it. The conditions in North Africa during the period of seed maturation are not expected to favor the formation of very hard seeds.

Hardseededness is broken down in the field by diurnal temperature fluctuations, causing contraction and expansion of the seed, finally leading to a parting of the cells of the strophiole or possibly to rupture of the seedcoat. These temperatures at the soil surface in Southern Australia are about 50-60°C by day and 10-15°C by night. Other factors will be involved such as the effect of frosts and chemical action after incorporation into the soil.

There are differences due to genotype in the rate of hardseed breakdown. For example, four months after maturation under South Australian conditions, nearly 45% of Paragosa (M. rugosa) is permeable compared with only about 3% for Cyprus (M. truncatula) (Mathison 1972).

The rate of hardseed breakdown is important in the regeneration reliability. Mathison suggests that an ideal cultivar should have about 20-30% breakdown by mid-October (in North Africa) but not much before this. Thus with a cultivar such as Paragosa, it is possible to lose a very high percentage of permeable seed with light falls of rain in a so-called "false break" to a season, i.e. where rain falls and is followed by a prolonged dry period during which the small plants are killed.

In addition to this factor, some species show very significant reactions to falls of rain in summer and early autumn. For example, Boyce and Saunders (1971) demonstrated that following summer rainfall, Paragosa germinates a far greater percentage of permeable seed than Jemalong or Harbinger. These differences are related to the rapidity of water uptake by the seeds. These are amongst the reasons for the wide adaptability and success of some cultivars (e.g. cultivars of M. truncatula, M. littoralis). Of course, many other factors are also involved such as the rapidity of root growth, forage production, competitive and seed producing ability.

After one year of a well-adapted cultivar, one can expect a yield of seed on the soil of up to 1000 kg/ha, depending on management and seasonal conditions. During the following season, in the course of preparation of the soil for the cereal crop, this seed (in pods) will be incorporated into the soil. It is essential, therefore, that soil workings should not be too deep (less than 10 cm in most instances). If buried too deep, the seedlings will never emerge--maximum hypocotyl length is related to seed size (Black 1956).

Under South Australian conditions, it can be expected that between 10% (M. truncatula C.V. "Jemalong") and 50% (Paragosa) of the seed produced in year one will germinate in year two, the cropping year. In this context it becomes a weed and is normally eliminated in the cultivation or general broadleaf herbicide program. This assumes an early germination of all permeable seed.

During the summer after the wheat crop, it is essential that the stubbles are grazed or cut and removed so that they do not act as a tempera-

ture insulator for the soil surface. Thus temperature fluctuations will be wide and good hardseed breakdown can occur.

Practical Aspects of Establishing the Medicago-Cereal Rotation

A. Choice of Cultivars

Cultivars from southern Australia have been used in the region. In general terms, cultivars of M. truncatula, M. littoralis and M. scutellata are adapted to the areas of lower elevation.

In Tunisia Jemalong has shown wide adaptation, although it performs best in the 400-500 mm rainfall areas. Harbinger is better adapted to lighter soils and lower rainfalls. Snail has shown good forage and seed yields over much of North Africa. However, it has been an unreliable variety in Australia due to inconsistent hardseed breakdown and loss of seed in "false breaks".

For the long term, it is necessary to develop local cultivars, especially for the colder regions of high altitude.

B. Soil Preparation and Sowing Methods

Although dense Medicago pastures are an aid to weed control by competition and through grazing management, they are not the full answer. Rather, fields must be managed to have as low a weed population as possible before sowing Medicago.

The seedbed required for s small seeded species requires greater attention to fineness of tilth and consolidation than for the larger cereal grains. There are relationships between soil particle size and seed size in germination rapidity and resistance to drought after germination due to seed-soil contact (Carter and Saunders 1970).

How this seedbed is achieved, i.e. a firm base with 1-2 cm of finely worked soil on top is not important. However, the use of Australian-type scarifiers provides a rapid and economic method. More passes with harrows are required than is customary in the North African region.

Consolidated, flat seedbeds are required so that depth of seeding can be regulated. Very flat seedbeds are also required where seed production is contemplated.

Carter (1975) suggests that seed should be sown dry early in autumn. He suggests a shallow scarification of the soil surface (1-3 cm), dropping the seed and fertilizer onto the surface followed by a harrowing.

Where the equipment is available, this method is being used in the region. However, dry sowing involves risks -- a germinating rain may occur and then be followed by prolonged dry weather which kills the seedlings.

In a situation where seed is extremely expensive, it would seem more prudent to wait a little longer, where local weather conditions permit, until after the first major rain, to sow Medicago onto a properly prepared seedbed. By this means also, the weed population will be initially reduced. However, one cannot sow too late or production is lost.

In much of North Africa, it has been customary to apply phosphate in advance of sowing, before the final working, and then applying the seed in another pass. This practice is inefficient both in terms of labour time and fertilizer efficiency. Fertilizer must be placed in close proximity to the Medicago seeds.

In the absence of combined fertilizer and seed drills, it is suggested that an ideal method of sowing is by mixing the seed and superphosphate and applying this mixture through a fertilizer dropper. However, care should be taken not to leave seed and fertilizer mixed for long periods of time. This operation (on a well prepared seedbed) would then be followed by a passage of harrows or a roller, but not a smooth roller.

The "crosskill" roller has been shown useful because it creates an irregularly indented surface which reduces erosion, trapping water and thus obtaining greater infiltration. Of course it also breaks down the remaining large soil clods.

Seeding rates should be in the range of 10-12 kg/ha. The use of high seeding rates may be required in some situations for competition with weedy species or to provide more winter forage.

It is possible that cover crops (light seedings of oats or barley with the Medicago may be useful for creating a more favorable micro-climate in the colder areas in the region.

Rudd (1972) showed that dry matter production increased with increasing rate of phosphorus application. Carter (1974) suggested there should be a relationship of 3-4 kg N/kg P_2O_5 applied to Medicago. In any event, he estimates there should be a net gain of soil nitrogen in the region of 60 kg N/hectare with fertilizer rates between 25-50 kg P_2O_5/ha.

Nodulation of the Medicago should not be a problem in the region due to the presence of many local ecotypes, indicating the presence of Rhizobia bacteria. Localized problems could exist. However, Paragosa, because it has a specific rhizobial requirement, should benefit from inoculation. "Clare" (Trifolium subterraneum) will require inoculation.

Where a seed production stand is being established, it may be useful to use herbicides for gramineous weed control. Trifluralin has given excellent control of these species without affecting establishment of Medicago.

C. Grazing Management

During the initial year of establishment, the overriding objective is to obtain maximum seedset to ensure good regeneration in year three. Thus the amount of grazing is not to be considered important in that year.

However, grazing is important as a management tool for weed control. Sheep should be introduced onto the pasture late winter-early spring. They will preferentially graze the gramineous species and reduce seeding of these. However, the usefulness of grazing as a management tool is reduced later in spring when Bromus and Hordeum species begin to head. It is then necessary to cut these above the Medicago before maturity -- a rotary slasher has been found ideal for this operation.

The aim of grazing during the first year should be to leave the Medicago fairly short (about 6-8 cm) at flowering when the grazing should be stopped.

Some grazing during the first summer is possible only if it is regulated so that large amounts of pods are not ingested. There are some studies (e.g. Vercoe and Pearce 1960) which show that only 3-8% of seed ingested, passes through the animal intact, although these investigations might not accurately reflect the field situation. Thus, some guideline is required. The best farmers in southern Australia stop grazing when the faeces of sheep contain seed or seed remains in the first year.

Grazing, well controlled, is required to reduce the amount of dry residue during summer. If not removed, this creates problems in seedbed preparation for the wheat crop and will also cause some reduction in available nitrogen early in the wheat growing cycle.

As indicated by Rudd (1972), phosphate should be applied each year. He found superior Medicago growth resulted from applications each year over that obtained in a system where all the phosphate was applied in the cropping year.

In conclusion, there is no doubt that this system is suitable for large areas of this region using imported cultivars. The most urgent research requirement is for the selection of cold tolerant, winter-vigorous local ecotypes.

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TECHNIQUES D'EXPLOITATION DANS LES PREMIERS STADES DE L'INTRODUCTION D'ASSOLEMENTS A BASE DE BLE ET DE LEGUMINEUSES FOURRAGERES

D.A. Saunders

RESUME:

Dans cette région les assolements basés sur le blé et les légumineuses fourragères annuelles sont supérieurs sur de grandes surfaces tant sur le plan économique qu'agricole au système traditionnel de blé-jachère. Les avantages comprennent la fixation symbiotique d'azote sous une forme utilisable par le blé, la production de quantités plus importantes de fourrage de bonne qualité pour l'alimentation du bétail (fourrage utilisé soit comme matière verte ou séchée) et l'amélioration de la structure de la couche arable du sol par le moyen de l'apport de matières organiques.

Les premières recherches réalisées dans la région ont porté sur des sols neutres ou alcalins, et par conséquent l'accent sera mis dans la présente communication sur les espèces annuelles de medicago.

La rotation se propage d'elle-même grâce à l'imperméabilité à l'eau des semences de medicago. Au stade de la maturation les semences sont imperméables à l'eau à pratiquement 100%, mais après un certain délai - qui dépend de l'espèce, du climat et des techniques d'exploitation - l'imperméabilité se trouve diminuée de façon à ce qu'une partie des semences contenues dans le sol soit suffisante pour assurer la régénération spontanée de la prairie.

L'introduction d'un tel système dans une région nécessite quelques modifications radicales des techniques traditionnelles d'exploitation.

Premièrement les façons culturales ne doivent pas dépasser 8 à 10 cm de profondeur de manière à ce que les semences de l'espèce légumineuse restent près de la surface du sol. Cette technique comporte plusieurs avantages, à savoir: les matières organiques sont concentrées sur un petit volume ce qui améliore rapidement la structure de la couche arable et diminue les risques d'érosion. Les moyens nécessaires pour réaliser les façons culturales sont moins importants, ce qui permet de réaliser des économies sur ce plan. En plus, avec des façons culturales superficielles le sol est vite débarrassé des graines de mauvaises herbes, ce qui constitue un avantage économique supplémentaire.

Deuxièmement, le lit de semences pour la légumineuse annuelle fourragère doit être préparé de façon plus soignée. En effet, les techniques de préparation du sol employées dans la culture du blé ne suffisent pas puisque ces techniques ont généralement pour résultat de laisser la surface du sol pleine de mottes, irrégulière et peu tassée. Ceci rend presque impossible le semis à la profondeur précise qui est nécessaire pour la levée satisfaisante des espèces à petites graines.

Troisièemement, le pacage doit être contrôlé de façon plus précise, au moins dans les premières années, puisqu'il constitue un facteur très important en ce qui concerne la quantité des semences formées et, par conséquent, la régénération spontanée de la prairie, et c'est cette capacité de régénération qui détermine en dernier lieu la réussite ou l'échec du système.

Original: Anglais

23

THE TUNISIAN EXPERIENCE WITH THE ROTATION OF CEREALS AND ANNUAL FORAGE LEGUMES

M.L. Mouaffak

NOTE: This paper is represented only by Summaries in French and in English.

On the basis of the assumption that the Australian system of rotation of wheat with annual forage legumes can be adapted in Tunisia due to the similarity in the climatic conditions of Tunisia and South Australia and the need to improve cereal and livestock production techniques, Tunisian activities in this field were commeced at the beginning of the 1971-72 crop season.

It seemed wise to adopt this hypothesis because if it were necessary to prove it, a considerable time would elapse before it would be possible to initiate the program and especially since the area concerned is the area in which the rainfall varies from 350-500 mm where the present practice of fallow is favorable neither for the cereal crop nor for husbandry.

Therefore, in order to assure rapid adoption it was first necessary to find the answers to certain questions concerning the behavior and potential of the introduced varieties of medicago, their phosphate requirements, their ability to regerminate and the quantity of organic nitrogen which is sufficient to allow the suspension of nitrogen fertilizer applications.

For this purpose a series of experiments (rotation, varieties, fertilization) and demonstrations of the system has been established at a number of sites in the area concerned. The enthusiasm on the part of farmers generated by the novelty of the system and the extension efforts based on the early results obtained in the experiments and demonstrations have made it possible, already in the second year of the program, to begin substituting medicago in the place of the fallow on an area covering 500 ha.

Through the high quality and sustained support given to the farmers by well-trained technicians, it was possible to expand the 500 ha to 1000 ha in 1973-74 and 3000 ha for this season.

It goes without saying that the successful establishment of the medicago is largely dependent on proper seed-bed preparation and seeding.

Thus, the expansion of the system, although on only a modest scale up to the present, makes it possible to simultaneously evaluate the experimental results, sensitize the farmers, provide further experience for the technicians, define research questions and prepare the development of other aspects such as the commercial aspects for the production of seed.

Nevertheless, the early results cannot be considered to be conclusive; they do however show a positive trend in that the system has led to a great volume of forage material and an increase in the productivity of the wheat.

There remain other problems to solve concerning the management of the crop:

The evaluation and possibly the improvement of the local cultivars since the varieties thus far chosen are not adapted over the entire zone concerned.

Management techniques.

Crop frequency once the desired level of fertility is attained.

Original: French

L'EXPERIENCE TUNISIENNE DANS LE DOMAINE DE L'ASSOLEMENT CEREALES/LEGUMINEUSES FOURRAGERES ANNUELLES

M.L. Mouaffak

RESUME:

Partant de l'hypothèse que le système australien d'assolement blé/légumineuse fourragère annuelle peut être adapté en Tunisie en raison de la similitude des conditions climatiques Tunisiennes à celles de l'Australie du sud et de la nécessité d'améliorer les techniques de production de céréales et celles de l'élevage, l'expérience tunisienne dans ce domaine a démarré au début de la campagne agricole 1971-72.

Il a paru avantageux d'adopter cette hypothèse car s'il fallait le démontrer un temps considérable s'écoulerait avant de démarrer le programme surtout qu'il s'adresse à une zone pluviométrique de 350 à 500 mm où la pratique actuelle de la jachère n'est favorable ni à la production céréaliere ni à la production animale.

Aussi pour assurer rapidement l'opération, a-t-il fallu d'abord trouver les réponses à certaines questions relatives au comportement et aux potentialités des variétés introduites de médicago, à leurs exigences en engrais phosphatés, à leur faculté de régénération et à la quantité suffisante d'azote organique permettant la suspension des apports d'engrais azotés.

A ce sujet une série d'expériences (rotation, variétés, fertilisation) et de démonstrations du système a été installée dans différents sites de la zone intéressée. L'enthousiasme des agriculteurs créé par la nouveauté du système et l'effort de vulgarisation à partir des premiers résultats obtenus dans les essais et les démonstrations ont permis dès la deuxième année d'amorcer la substitution de la jachère par la médicago sur une superficie de 500 ha.

L'encadrement judicieux et continu de ces 500 ha par un personnel préalablement initié a pu étendre cette superficie à 1000 ha en 73-74 et 3000 ha pour la présente campagne.

Il va sans dire que la réussite de l'installation de la médicago tient de beaucoup à la bonne préparation du lit de semences et à l'exécution du semis.

Ainsi, l'extension du système, quoique modeste jusque là, permet simultanément d'apprécier les résultats obtenus au niveau de l'expérimentation, de sensibiliser les agriculteurs, de renforcer l'expérience des techniciens, de poser des questions à la recherche, et de préparer le développement d'autres aspects tels que commerciaux pour la production de semences.

Toutefois, les premiers résultats ne permettent guère de se prononcer mais dévoilent une tendance positive caractérisée par une production fourragère importante et une amélioration de la productivité du blé.

Il resterait cependant d'autres problèmes à résoudre touchant à l'exploitation de la médicago.

- L'évaluation et l'amélioration éventuelle des cultivateurs locaux car les variétés retenues ne s'adaptent pas à toute la zone intéressée.

- Aux techniques culturales.

- La fréquence des cultures une fois le niveau de fertilité atteint.

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THE RELEVANCE OF THE CEREAL-PASTURE LEGUME ROTATION IN THE MIDDLE EAST AND THE NORTH AFRICAN REGION

D.M. Leeuwrik

Introduction

The maintenance of soil productivity by crop rotations is an old practice in mixed farming. While crops are selected for economic reasons and to fulfill human and animal nutrition needs, crop rotations are selected in such a way as to accumulate plant nutrients in the soil and to improve - or at least maintain - the physical condition of the soil for cultivation and plant growth. A livestock enterprise is often integrated with the cropping system.

The recognition of the value of legumes in crop rotations is likewise very old even though the knowledge that their beneficial effect is due largely to a build-up of nitrogen in the root material, which is subsequently released to the soil, is comparatively recent. Before fertilizers came to be extensively used, the accumulation of plant nutrients was the most important consideration in crop rotations. Now, the use of fertilizer has provided more flexibility in rotational practices because crop yields are not limited by the natural fertility of the land and its management. In addition, increased use of power and mechanization have provided opportunities for more precise and timely operations. Even so, rotations are still an important part of crop management because each crop is affected by the preceding crop, and soil management, just as it will affect succeeding crops. The crop production process must be planned in a long-term perspective; one cannot regard each crop in isolation.

Dryland farming contains a large element of risk because of the great variability in weather conditions. Rainfall, in particular, is extremely variable and unreliable both in amount and distribution, leading to wide fluctuations in crop production. Under these conditions, farmers tend to keep to proven practices and rotations, not necessarily for maximum yields but to obtain an assured minimum yield and to maintain a measure of yield stability. Introducing new rotations, crops or practices may lead to failure. Not only that, subsequent crops may also be affected and the production cycle upset for a number of years. Farmers cannot afford to take unnecessary risks.

Considerable scope exists in the region for improvement of dry farming practices which would lead to increased production. There is evidence that the introduction of a pasture rotation could raise cereal crop yields as well as support greater livestock numbers. More extensive research is needed in crop-pasture-livestock systems and the capital requirements of changing to such a rotation need to be established. Rapid adoption is only likely if subsistence needs of farmers are assured and risk is low and if, in addition, the benefits of the change are obtained in a relatively short time. This paper examines the relevance and broad implications of introducing a pasture rotation in the low to medium rainfall cereal growing areas of the region.

The use of pasture in crop rotations

Cereal crops exhaust the soil by reducing nutrient content. Depletion of nutrients and frequent cultivation also result in loss of soil structure. Utilization of a pasture phase in the rotation is a well established practice to restore the physical condition and fertility of the soil and to maintain soil productivity. This practice forms the basis of ley* systems of farming. Soil fertility accumulates under the ley and is subsequently utilized by cropping. The length of the ley depends on how productive it is and how soon it restores fertility through dry matter production and nitrogen fixation by leguminous plants in the sward.**

In intensive systems, nitrogen can be applied as fertilizer to stimulate dry matter production and returned to the soil in dung and urine of grazing animals. Most leys, however, contain a proportion of volunteer or sown legumes. The nitrogen which is fixed accumulates in the root material, and is therefore mostly in the organic form. Mineralization of organic nitrogen depends on factors including temperature, mineral nutrient status, pH, rhizosphere activity and so on. The C/N ratio of the root material influences the release of nitrogen from the organic matter for use by growing plants. If the C/N ratio is high, as for instance in a grass dominant ley, the nitrogen availability may be reduced.

It is particularly the increased soil nitrogen that results in improved crop production. Experiments have shown that, in a humid, temperate environment, sowing wheat after a white clover ley can lead to yield increases of approximately 1 ton/ha, provided that phosphorus and potassium are adequate (table 1). Under the same conditions it has been shown that an average three-year ley adds to the soil in roots and stubble about 5-6 tons of dry organic matter. This is equivalent to about 25-30 tons of farm yard manure and the physical condition of the soil is considerably improved.

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* Arable land used temporarily for pasture.

** Sod or grassland cover.

Wheter or not the improved physical condition of the soil results in increased yields of subsequent crops is difficult to prove. However, there is no doubt that the workability of the soil is much improved. This leads to indirect advantages of lower draft requirements for cultural operations and, depending on soil type, weather and timely management, fewer cultivations. Moisture infiltration rates and soil moisture holding capacity may also be improved and erosion hazards lessened.

The success of ley-systems based on annual self-regenerating pasture legumes in semi-arid temperate and mediterranean types of climate, such as found in Southern Australia, also has been well documented (8, 11). It has led to improvement of soil fertility, crop yields and sheep production over large areas of the Australian wheat belt. Moreover, it has provided a stable farming system under conditions of limited and unreliable rainfall. The use of pasture legumes in the rotation combined with the application of phosphoric fertilizers has been responsible for an estimated 60 to 70% of the total increase in cereal yields in Australia. The remaining increase is accounted for by the use of new varieties and improved cultural methods. Much of the increase in improved pastures has occurred in high rainfall zones. However, in low rainfall areas also, extensive spread of annual medic and clover pastures has had considerable impact on the productive potentials for these areas. A good ley will fix from 50 to 100 kg N per ha per year in the upper 15 cm of soil. When the sward is plowed in, this nitrogen is released over a period in easily available form for subsequent utilization by crops. Increased production and quality of dry matter from improved pastures also has raised animal production.

The ley system based on annual pasture legumes is, in fact, ideal for the integration of cereal cropping with livestock production. The marked similarity of climate and soil found in Southern Australia and parts of the Middle East and North African regions suggest that a ley-system of farming would increase and stabilize production in the latter regions. Annual legume species successfully used in Australia actually originated from this region and occur widely. Investigations in several countries in the region have shown that productive legume pastures can be established (1, 2). The application of phosphate frequently results in impressive volunteer legume pasture (1).

More work, however, is needed to accurately estimate the effect of ley on yield of subsequent crops under various conditions of soil, rainfall and management in the region. Preliminary results indicate that cereal yields are generally higher after medic than after fallow. On the basis of Australian experience, initial increases in yield are unlikely to be spectacular because of other limiting factors, mainly moisture and management. However, the build-up of fertility is a continuous process over time and yields should continue to rise over a number of ley-crop cycles. Only after several cycles will the true impact of the system on yield and stability become evident. Even so, yield increases of 30% or more could be expected in the early stages under satisfactory management. Success of the system will depend on the effective integra-

tion of livestock with arable farming, since the longevity and productivity of annually regenerating pastures is highly dependent on grazing management.

Climate and soils in the region in relation to annual legume pastures

Climate in the cereal growing areas of the region, varies from semiarid to continental. Winters are wet and mild while summers are dry and hot. Rainfall varies, but, in general, is low and unreliable and fluctuates widely from year to year in amount, intensity and distribution. Evapotranspiration rates tend to be high because of a high percentage of sunshine and high average temperatures. The bulk of the rain falls, however, during the winter and early spring when evapotranspiration rates are lowest. For this reason, reasonable yields can be obtained with winter cereals even though total amount of precipitation is low. Most of the dryland winter cereals are grown in the range from 250-500 mm rainfall. Differences in elevation and proximity to sea coasts cause considerable changes in local temperatures and rainfall. Thus, although over much of the region moisture, rather than temperature, limits the growing season, there are also considerable areas where temperature is an equally or more limiting factor, notably in Iran and Turkey. A description of climatic conditions as found in upland and plateau areas has been given in a previous paper, using Iran as an illustration (12).

It has been suggested that the impact of annual pasture legumes in a cereal rotation will be greatest in the 350-500 mm rainfall zone. Possibilities for conditions of lower rainfall are more limited, and under higher rainfall annual cropping and other alternatives must also be considered. Since the annual pasture legumes are shallow rooting, they tend to be less drought resistant than cereals and need more frequent rain. The annual legumes in use today are not particularly cold hardy but a lot of scope appears to exist for selection for cold resistance amongst naturally occurring species. With present cultivars, the lower limit of temperature tolerance is reached when the average monthly minimum temperature is around 2°C. At Horsham and Roseworthy in Southern Australia, in the heart of the wheat-sheep farming areas, the average minimum monthly temperatures during the coldest month are 3.6°C and 5.8°C respectively. In much of the North African and Middle East region temperatures will not be limiting to the growth of known cultivars of pasture legumes, and there are large areas with rain between 350-500 mm where the introduction of a ley system is climatically feasible. At higher elevations, as for instance in Iran and Turkey, with their extensive, cold high-plateau and upland areas of up to 2000 m, the use of the system in its present form will be limited because of temperature restrictions (12).

As would be expected, soils vary tremendously over such a large region; in many instances, detailed information is still lacking. There are, however, some broad generalizations that can be made. In the drier areas, towards the desert, soils are sierozems grading into desert sands and lithosols. Reddish brown soils are predominant in the 250-250 mm zone where most of the dryland wheat is grown. Black and grey-brown rendzinas

are also common, as are rendzina-terra rossa complexes on lower slopes of hills. Good, deep soils of alluvial or colluvial origin are found in the valleys. Soils are generally calcareous throughout the region. Many have a high silt or clay content and, at least in the dryland regions, organic matter and consequently nitrogen content is extremely low. Phosphorus is also deficient, but generally not as limiting as nitrogen. The heavy texture of many of the soils presents some management problems. They may set hard with deep cracks when dry, and become sticky when wet. Soil crusts may be formed leading to limited soil moisture intake, excessive run-off and erosion. Shallow soils, with limited moisture storing capacity, are also widespread.

Generally, soils of the region pose no special problem to the establishment of productive swards of annual pasture legumes, although there may be localized problems. Because of their alkaline nature and heavy texture they are more suited to species of medicago than trifolium. In low rainfall areas, shallow soils with limited moisture holding capacity reduce chances of satisfactory plant growth, particularly of shallow-rooted pasture plants. Similarly, the presence of calcium carbonate or other impervious layers in the soil profile, which occur over substantial areas, may have a detrimental effect on plant establishment and growth. Problems of impeded drainage and salinity, not uncommon in local situations, can, to some extent, be overcome by using species and cultivars tolerant to those conditions (9). However, more extensive measures of land reclamation may prove necessary.

Roughness of land surface and stoniness also present difficulties in parts of the region in the year of pasture establishment. Pasture legumes are small-seeded and need a reasonably well-prepared, firm seedbed for satisfactory establishment. Depth of seeding is extremely important. Machinery and equipment presently used or available in the region is, for the most part, unsatisfactory or inadequate for proper and timely land preparation and precision sowing. Construction is not sufficiently rugged to deal with the heavy soils, rough landsurfaces and rocky conditions. Depreciation of machinery is therefore high and breakdowns are frequent. It is difficult to keep equipment in proper adjustment and working order. Carter (9) has suggested that some of the machinery designed for Australian conditions may be more suitable than that presently used. Particularly, the "stump-jump" principle should be incorporated in machinery designs, wheels should be large and clearances wide. There should also be a concerted effort to train operators in the proper maintenance, adjustment and operation of their equipment.

Another problem, not so much of soils but of soil management, is the wide-spread practice of deep plowing. The success of a ley system based on self-regenerating annual legume species depends on the presence of adequate numbers of seed pods, of different ages, in the surface soil. When phosphorus is adequate and moisture and temperature allow, seeds in these pods germinate resulting in natural regeneration of the pasture. A degree of dormancy and hard-seededness prevent all seeds germinating at once, thus providing a built-in safeguard against losing the pasture under adverse condi-

tions. The effect of deep plowing is to turn down the pods to a depth where it is impossible for seed to germinate or seedlings to emerge. The opportunity for self-regeneration of the pasture is thus effectively eliminated. It is for this reason that naturally occurring species are mostly found at roadsides and in undisturbed ground rather than in plowed fields.

The purpose of deep plowing is probably to obtain a measure of weed control and to overcome some of the structural defects of a soil cultivated continuously for many years (9). With present technology, its effectiveness and necessity is doubtful. Recent research in Lebanon shows no advantages from deep plowing over shallow cultivation. In addition, it is a practice which is expensive and extremely wasteful of power. For the successful introduction of a ley farming system it is imperative that a system of shallow cultivation be adopted. A series of progressively shallower cultivations will provide a weedfree, firm seedbed for germination of crops and pasture alike. It will also ensure that a sufficient quantity of legume seeds remain in the upper 15 cm of soil.

The relevance of the rotation to the region

To a greater or lesser extent over the entire region, cropping for many years has depleted soil fertility, destroyed soil structure and exposed the land to dangers of erosion. Increased availability and use of power has spread exploitive farming. Deterioration of soils and productivity is continuing today in many cases. In other areas, yields have stabilized at low levels but fluctuate widely between seasons.

The use of the tractor is also having its effect on livestock production. Arable farming is encroaching on marginal land that should only be used for pastoral purposes. Less land is available for grazing and, since there has not been a proportional decrease in livestock numbers, most natural grazing land is seriously overstocked. The quantity and quality of natural grazing is deteriorating rapidly and the range supports less livestock now than before. The concern is therefore not only with crop production but with that of livestock as well. Grazing pressure on the range should be reduced. Possibilities for increased livestock production only exist in farming areas.

It has been estimated that some 40 million ha in the region lie idle in fallow. The relevance of the legume rotation to the region lies in the possibility of turning some of these idle hectares into productive soil fertility restoring pastures, using shallow-rooting legumes, which make use of winter and spring rains and can be plowed in before moisture in the soil profile is entirely depleted.

In general terms, the advantages are obvious. Use would be made of unproductive fallow lands. Soil organic matter and structure would be improved leading to better soil workability, lower draught requirements, less

cultivations, better erosion control and conservation, and utilization of moisture; a well-managed pasture would assist in better weed control and is also useful in preventing the build-up of pests and diseases, particularly nematodes and rootrots; soil fertility would be restored and maintained, resulting in higher crop yields. In addition, more and better quality feed would be available for livestock and the possibility of vertical or horizontal integration of livestock enterprises with arable farming would be enhanced. In other words, a productive and balanced system of ley-farming would protect soil resources and provide an opportunity of increasing livestock as well as crop production.

The benefits of the rotation

To put the advantages in more precise, quantitative terms is difficult. It requires careful study and analysis of the resources and agrarian structure in the dryland areas of countries in the region. Until these detailed studies can be made, the following approach is used in this paper in order to arrive at a first approximation of the areas involved. First, it was assumed that the area of greatest impact would be within the zone of approximately 350-500 mm rainfall with a lower limit temperature restriction of about 2°C average monthly temperature in the coldest month. Since the latter restriction cuts out large areas in Turkey and Iran, it was decided to delete these countries from the study and to concentrate on Jordan, Syria, Lebanon, Morocco, Algeria and Tunisia. Iraq was excluded because of insufficient information. However, the remarks in this paper would apply to large areas in this country.

Next, a detailed country study was made of Jordan, from which reasonably complete statistics and information on dry farming practices were available, to estimate the annually cropped and fallowed land. A percentage was calculated representing fallow lands as a proportion of winter cropped area in the 350-500 mm zone. This percentage was then multiplied with the total dryland area under winter crops reported by different countries. This, it was felt, would give a reasonable estimate of the most favorable areas for introduction of the rotation, even though it would err a little towards the high side because marginal and high rainfall areas would be included.

The extrapolation of results from Jordan to other countries is reasonably valid for Syria and Lebanon, and, to a lesser extent, for North African countries because of the similarity of climatic conditions, soils and farming practices. For instance, if the data for Jordan are compared with those of Algeria, as representative of the North African region, (tables 2, 3, 4 and 5) it can be seen that most of the land in both countries is classed as arid (less than 200 mm) or marginal 200-350 mm). In Jordan, 97 percent of the land receives less than 350 mm rain, whereas in Algeria 92 percent receives less than 300 mm. In Jordan, 2 percent of the land lies in the 350-500 mm zone. This corresponds roughly with 5 percent in the 300-500 mm zone in Algeria.

Of the total land surface, Algeria has 3 percent in the 500 mm zone and above, against Jordan's 1 percent. Total annual crops and fallow constitute 3 and 2 percent respectively in Jordan. In Algeria, corresponding figures are half of this: 1.5 and 1.0 percent. The proportion of the cropped lands to fallow is, however, the same in both countries (3:2). Thus, there appears to be broad similarity between the two countries in distribution of lands according to rainfall and the relationship of crop to fallow.

In Jordan, 76 percent of all field crops are grown in the marginal and semi-arid zones (200-500 mm). Examining the composition of fallow more closely, it can be seen that about 97 percent of all fallow lands are in the arid and marginal areas below 350 mm; only 2 percent are found in the 350-500 mm zone (table 5). Moreover, fallow in the 350-500 mm zone expressed as a percentage of cropped land is only 32 percent. Even in the marginal zone this value does not exceed 63 percent (table 5). The reason for this is that growers in the semi-arid zone, and in the higher rainfall range of the marginal zone, do not adhere to a strict wheat-fallow rotation (or, more appropriately, a wheat-volunteer weed pasture rotation, since bare fallow is not widely practiced) (table 2). In the higher rainfall areas, and in the better rainfall years, farmers crop annually and a rotation of wheat/barley-lentils - summer crops is widely followed. Summer crops, such as tomatoes and melons, are grown on the deeper soils when rain is adequate. In a study conducted in 1972 in Karak, a typical dryland area in the 300-400 mm rainfall zone, it was found that 67 percent of the total cultivated area was sown to wheat or barley, while 33 percent was under legumes, vegetables, maize, millets, tobacco or fallow. A breakdown of the 33 percent showed approximately 20% fallow and 13% legumes and summer crops.

Results such as these suggest that a figure of 30 percent of the total area of dryland winter crops (in this case dryland wheat, barley and lentils), would represent a reasonable approximation of the areas where the legume rotation would be of most immediate importance. Areas thus calculated for a number of countries in the region are shown in table 6. The estimate for the combined areas in Lebanon, Jordan, Syria, Tunisia, Algeria and Morocco is about 3,000,000 ha. This estimate is thought to represent those areas where the rotation could be introduced with a minimum of adaptive work and with maximum results. It is not suggested here that the pasture rotation could not and would not spread more widely to both lower and higher rainfall areas, particularly when a larger range of locally adaptive cultivars becomes available and ley management techniques have been adapted to local conditions. In an excellent study, for instance, Carter (9) has estimated that in the dryland growing areas of Algeria, 2,500,000 ha of fallow land could be converted to pasture, which is substantially more than the 791,000 ha. estimated here. Carter's figure probably includes a substantial area of marginal land with rainfall below 250 mm, as well as fallow lands in high rainfall and irrigated areas, since the total area of fallow lands listed in Algerian national statistics is only 2,707,000 ha. However, the potentials in these regions are not as

clear-cut and the spread of sown pastures is likely to be slow. Nevertheless, the figure quoted in the Algerian study serves to drive home the opportunities and the considerable benefits to be derived from the rotation.

Using some of the assumptions made by Carter* (9), table 6 shows that 3,000,000 ha of legume pasture in the region would add about 174,000 tons of N to the soil. This is especially significant because of the present shortages and high prices of nitrogen fertilizers, which are likely to continue for some time. Moreover, the use of inorganic nitrogen in drylands with low and variable rainfall is not always economic and carries a considerable amount of risk. The 174,000 tons of additional N would represent a 119% increase in nitrogen use on the basis of 1970/71 consumption (most of which is not used on cereals) (table 7). It would give a considerable boost to the nitrogen economy of all the countries under discussion, except Lebanon. What this could mean in terms of increased crop production is shown in table 6. Assuming a 1:10 average nitrogen to grain conversion ratio, and taking the average production over 1966/70 as a base, the combined increase of 1,740,000 tons of cereals is 24 percent of the total production. In individual countries the increases may be much higher. For example, in Jordan and Tunisia they are of the order of 30 and 40 percent, respectively.

The effect on livestock production is shown in table 8. For the six countries under discussion it is estimated that an additional 11,600,000 tons of high quality dry matter would be produced for stockfeed. With a moderately high degree of pasture management, the use of crop residues and other supplementary feedstuffs, as well as adequate fodder conservation, this quantity of feed would be able to maintain an equal number of sheep. In approximate numbers, this would mean that in Morocco it should be possible to carry an extra 4.5 million sheep on fallow lands; in Algeria 3.2 million; in Syria 2.1 million; in Tunisia 1.4 million; while in Jordan additional feed produced should be sufficient for 330,000 sheep. Table 9 gives details of the actual and projected sheep and mutton production in the various countries, as estimated by F.A.O. The projections correspond well with the opportunities for higher production afforded by the legume rotation in dry-farming areas. In all, a percentage increase of 26 percent in terms of numbers of livestock could be expected.

Important prerequisites to the introduction of the rotation

Achievement of the potentials presented in the above paragraphs is dependent on a number of factors, but more especially on the availability of seed and phosphate fertilizer. These two inputs are essential to the rapid spread and establishment of legume pastures. Most of the countries of the

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* On the basis of available information Carter estimated that a ley pasture would fix an average of 60 kg N per ha per year, and produce an average additional 4,000 kg of dry matter (high quality stock feed). He estimated that, with proper management, 1 ton dry matter would maintain 1 breeding ewe equivalent for one year.

region do not have a highly developed seed industry. Since the techniques required to produce high quality seed of medicago and trifolium species are rather sophisticated, a considerable effort will be needed to develop an efficient seed production organization at an early stage. Carter (9) has estimated that in Algeria it would take 10 years to seed the entire estimated area if an annual seed production program was carried out on 10,000 ha. If Australian cultivars proved to be generally adapted to the region it would, of course, be possible to import seed from that country. However, local seed production and processing capacity should be built up at the same time.

Similarly, the use of phosphorus is essential for the establishment and growth of legumes. In many soils of the region the availability of this nutrient is low to medium. Present use of phosphorus fertilizer is shown in table 10. The application of fertilizer to winter pastures will be a completely new concept and, at first, may be difficult to accept for many farmers. An average application of 25 kg P_2O_5 per ha on 3 million ha of pasture would require the additional use of 75,000 tons P_2O_5. Since the total consumption in 1970-71 was 157,000 tons, the additional phosphorus required for annual pastures alone would therefore amount to almost 50% of the total consumption of P_2O_5. Cereals and other crops would benefit equally from the increased and more widespread application of phosphorus. It is evident, therefore, that a drastic increase in the use of phosphoric fertilizers is a pre-requisite to increased crop and livestock production in the region. The region is fortunate in being highly endowed with rock phosphate deposits (table 11). The supply to farmers of adequate amounts of reasonably priced phosphoric fertilizers (together with an education campaign) should therefore pose no problem in the long run. Combined with the use of legumes this will ensure that the fertility and productivity of farmlands will be maintained at optimum levels.

Utilization of pasture rotation in livestock production

Full benefit from the extra feed will not be derived unless certain changes are made in traditional animal management methods. Animal husbandry skills encountered in the region vary a great deal, as does the extent to which modern methods are practiced in flock management. Some degree of mating control is usually practiced, but it is still common to see animals of different sex and ages run together indiscriminantly. Ewes are rarely culled before mating and old ewes are frequently fattened and sold only after they have failed to lamb. Lambing percentages are low and mortality is high owing to the high incidence of parasites and disease, as well as the poor level of nutrition. Offtake rates are low and fluctuate with the availability of feed. Main sales occur in late spring when the animals are fat and feed supplies are diminishing. In winter, most sheep are fed supplementary hay or grain which is generally purchased from farmers in higher rainfall areas, since there is little or no scope for fodder conservation in the rangelands. Nevertheless, sheep are subjected to large bodyweight fluctuations during the year according to the availability of feed. This has a detrimental effect on production as well

as reproductive rates. A better and more constant plane of nutrition is essential for efficient, high level production. There is, therefore, considerable scope for improving management practices to make the animal production process more efficient and to take advantage of the extra feed produced.

Concluding Remarks

The broad estimates given in this paper of the feasibility and benefits of a ley system of farming for dryfarming areas of the region are impressive. No doubt, the figures can be questioned and, as more detailed studies are made and knowledge increases, inaccuracies will surface. At this time, however, these estimates serve not only to draw attention to the great productive potential of the system but also to point to the steps to be taken - and to put these steps within a reasonable timeframe - for this potential to be achieved. However, national level averages do not mean much to individual farmers, particularly those who farm areas where climate is variable and unreliable, yields low and uncertain, risks high and incomes low. The questions, therefore, are: is a system of integrated crop-livestock production compatible with the farm structure and organization as found in the region; will it be acceptable; and what will be the benefits for individual producers?

Results from Australia show that increases in the productive capacity of single farms are, in many cases, spectacular. Comprehensive schemes for whole farm improvement including pasture improvement, erosion control, fodder conservation and proper rotations have led to trebling of crop yields while simultaneously doubling stock carrying capacity. Incomes are not only higher but also more stable since assets and risks are spread over crop and livestock enterprises. But farm structure in Australia is entirely different from that found in this region, as table 12 shows. The average Australian wheat-sheep grower farms a total of about 1,000 ha, crops about 200 ha annually, and runs a flock of some 2,000 sheep. His operation is capital-intensive and highly mechanized. The output per unit of labor is high.

In this region, holdings are predominantly small, fragmented and often patterned in such a way that improvement in mechanization, drainage, erosion control, etc. are impracticable. Access to inputs is often limited. The majority of farmers are still at, or little above, subsistance level. Crop and livestock production have been traditionally separated. Yet, although this separation has often been stressed as a limitation, the Turkomans in Iran, traditionally pastoralists, have adopted settled agriculture to a considerable extent, and there are other examples. Some of the socioeconomic implications of introducing an integrated crop-livestock system under such conditions were dealt within an earlier paper (12). At least in the short term, it seems clear that changes will have to be acceptable in the existing patterns

of production. Such changes will therefore have to be compatible with the needs of producers within largely subsistence agricultural and pastoral economies. A different strategy will be needed for the lesser number of market-oriented producers with larger holdings who, nonetheless, may represent quite a large proportion of the area in question. The most rapid progress could probably be made with the latter group.

Comparatively little is yet known about existing production systems, farmers values, needs and motives. If knowledge of existing farming systems is incomplete, even less is known about the animal producer. Like in the farming areas, the average operational unit or size of flock owned per household appears to be small. There appears to be a skew in the distribution of ownership with, in many cases, the largest number of animals being owned by a small proportion of the total households. Apparently the number of men in the household unit has an important bearing on flock size since most of the work is done by men. Many flocks are too small even for subsistence, in which case owners work for larger operators as shepherds and, where possible, carry on some subsistence cropping.

To plan a more effective integration of livestock enterprises with arable farming, a more accurate and complete picture of occupation and utilization of range and marginal croplands is needed. Ownership and migration patterns of flocks should be established, for these could have an important bearing on the manner in which animal and crop production could most effectively be integrated. Some migration will be necessary to utilize rangeland feed but a large number of animals could and should be "settled" in arable areas. The best way to achieve this should be carefully established taking into account the present organizational structure. It is possible that cooperatives or other corporate organizations could perhaps assist in regulating grazing and feed supplies, as well as marketing crop and livestock products. Inasmuch as crop and livestock production are carried out as separate enterprises, such organizations could act as a sort of management or bridging unit for vertical integration of crop and livestock enterprises involving separate or multiple ownership. This may speed up integration in the initial phases of establishing the system. One would expect horizontal integration to gradually evolve in later stages.

To ensure rapid progress in the adoption and spread of the system, there is a great need to step up activities in the region at all levels. At present, there are only about five scientists working with country programs at the international level. In national programs, only a handful of scientists are concerned with aspects of the problem, and a few have received specialized training. The Arid Lands Agricultural Development (ALAD) Program has recently made a modest start to study existing farming systems in order to provide the background information necessary for planning change. Scientists, administrators and policymakers alike need to know more about farm operations and the decision-making process at the farmers' level. It will take time, money, trained manpower and a systematic, well-planned approach to translate the broad potentials presented in this paper into reality.

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Table 1. Yield of Winter Wheat After Pasture (cwt. per acre)

White clover sown alone	36.2
Perennial ryegrass and white clover	32.7
Perennial ryegrass only	26.7

Source: T. E. Williams, The value of leys in crop rotation.

Table 2. Land use in dryfarming areas in different rainfall zones in East Jordan.

Zone	Total area ha	Field crops ha	Vegetables ha	Fallow ha	Orchards ha	Forest ha	Grazing & uncultivated land. ha	Irrigated ha
Arid (200)	3,456,900	59,632	-	60,768	-	-	8,316,253	20,247
Marginal(200-350)	536,400	198,547	7,884	124,566	2,429	6,035	211,764	12,175
Semi-arid (350-500)	135,900	10,621	10,963	3,391	19,096	21,375	68,014	2,440
Semi-humid(500-800)	98,900	8,000	2,553	2,775	6,175	12,580	65,898	909
Total:	9,255,100	276,800	21,400	191,500	27,700	40,000	8,661,929	35,771

Source: Ministry of Agriculture, Jordan.

Report on agricultural zoning, 1974.

Table 3. Some Comparative Agricultural Statistics

	Algeria	South Australia
Total Area (ha)	237,556,000	98,400,000
Distribution of Land By Rainfall		
600 mm	5,081,000 1/	1,082,000
500-600 mm	1,756,000	2,165,000
400-500 mm	4,588,000	4,488,000
300-400 mm	7,558,000	3,051,000
300 mm	218,623,000	87,674,000
Land Used for Agriculture (ha) 1971/72	42,449,000	65,146,000
Cereals for grain (ha)	3,228,000 2/	2,041,000
Other annual crops 3/ (ha)	313,000	181,000
Fallow (ha)	2,707,000	402,000
Vineyards (ha)	300,000	39,000
Orchards & Vegetables (ha)	252,000	27,000
Pasture (ha)	35,000	3,194,000
Rangeland (ha)	34,345,000 4/	59,272,000
Unproductive farm lands (ha)	1,289,000	tr
Superphosphate Used (Means 1966/67-1971/72)		
Crop (tonnes P_2O_5)	31,360	60,968
Pastures (tonnes P_2O_5)	tr	59,444
Cereal Production (Means 1961-72)		
Wheat harvested (ha)	2,035,200	1,165,600
Wheat yield (kg/ha)	624	1,139
Barley harvested (ha)	728,900	561,000
Barley yield (kg/ha)	610	1,131
Livestock (Mean head 1970-72)		
Sheep	8,357,000	18,961,000
Cattle	864,000	1,239,000

1/ Includes 1,335,000 ha with slope 25%
2/ Includes c. 1 million ha in marginal steppe
3/ Includes cereals for hay and green storage crops
4/ Includes c. 20 million ha of steppe

Source: Carter, E.D. 1975. The potential for increasing cereal and livestock production in Algeria.

Table 4. Distribution of land in different rainfall zones in East Jordan

Zone	Area (ha)	%
Arid	8,456,900	91.4
Marginal	563.400	6.1
Semi arid	135,900	1.5
Semi humid	98,900	1.0
Total:	9,255,100	100.0

Source: The Natural Research Authority
The Ministry of Agriculture 3-year Agric. Devt. Plan 1973-1975, Amman 1972.

Table 5. Distribution of fallow land in different rainfall zones in East Jordan.

Zones	Area (ha)	%
Arid	60,768	31.7
Marginal	124,566	65.0
Semi arid	4,391	1.8
Semi humid	2,775	1.5
Total:	191,500	100.0

Fallow as % of Cropland

Arid	102 %
Marginal	63 %
Semi arid	32 %

Table 6. Estimates of present fallow lands to be brought under annual legume pastures and estimated benefits in terms of N added and additional crop yield

Country	Land under dryland wheat, barley and lentils (ave. 1966/70) '000 ha.	Estimates of fallow to be sown to pasture. '000 ha.	Nitrogen added to soil by legume pasture* tons	Additional cereals production** tons	Average production of wheat plus barley 1966-70**** tons	Percentage increase in cereal production over 1966-70 average. %
Jordan	277***	83	4,980	49,800	152,000	32.8
Syria	1,787	536	32,160	321,600	1,200,000	26.8
Lebanon	62	19	1,			
Morocco	3,746	1,124	67,440	674,400	3,615,000	18.7
Algeria	2,635	791	47,460	474,600	1,647,000	28.8
Tunisia	1,140	342	20,520	205,200	472,000	43.4
Total:	9.647	2,895	173,700	1,737,000	7,151,000	24.3

* It is assumed that nitrogen is added at an average of 60 kg N per ha per year.

** An average 10:1 conversion ratio of grain to nitrogen is assumed. The actual production depends on management and other factors and is likely to be somewhat less.

*** Calculated from FAO Production Yearbook. Corresponds well with same statistics from other sources, see table 2.

**** Includes production from high rainfall and marginal areas. Particularly if proportion of crops grown in marginal areas is high, this may lead to overestimation of the percentage increases.

Table 7. Consumption of nitrogenous fertilizers in selected countries of the region in 1970-71 and potential amount of nitrogen added by legume pastures (tons of N)

Country	Total consumption. tons of N	Consumption per ha. cultivated land kg of N/ha	Total estimated nitrogen fixed by legume pastures tons of N	Added N as percentage of total '70/71 consumption
Jordan	800	0.6	4,980	622
Syria	26,000	4.4	32,160	124
Lebanon	19,000	60.1	1,140	6
Morocco	28,000	4.8	67,440	177
Algeria	40,000	5.9	47,460	119
Tunisia	15,500	3.4	20,520	132
Total	146,500		173,700	119

Source:of nitrogenous fertilizer consumption data: FAO Production Yearbook.

Table 8. Estimates of potential areas of annual legume pasture, additional drymatter produced and additional stock carrying capacity

Country	Fallow lands sown to pasture '000ha	Additional* dry matter produced '000tons	Additional** sheep carried '000head
Jordan	83	332	332
Syria	536	2,144	2,144
Lebanon	19	76	76
Morocco	1,124	4,496	4,496
Algeria	791	3,164	3,164
Tunisia	342	1,368	1,368
Total:	2,895	11,580	11,580

* Assumes an average annual additional production of 4,000 kg D.M./ha. (9).

** Assumes that, with proper management, 1 ton D.M. will maintain 1 ewe equivalent for a year (9).

Table 9. Mutton and Lamb - Numbers of livestock, offtake, carcass weight and production 1970 and projections for 1980

Country	1970				1980			
	Livestock Nos.	Offtake	Carcass weight	Production	Livestock Nos.	Offtake	Carcass weight	Production
	'000 head	'000 head	kg	'000 ton	'000 head	'000 head	kg.	'000 ton
Jordan	2,171	868	13	11	3,536	1,414	14	20
Syria	7,357	3,090	14	43	11,757	4,938	14	69
Morocco	20,504	6,251	12	75	23,796	7,615	14	110
Algeria	9,360	3,744	15	56	11,298	4,971	17	84
Tunisia	5,555	1,666	15	25	6,275	1,883	16	34
Total:	44,997				56,662			

Source: Agricultural Commodity Projection, 1970-1980, FAO.

Table 10. Consumption of phosphate fertilizers in selected countries of the region in 1970-71

Country	Total consumption tons of P_2O_5	Consumption per ha. cultivated land. kgs. of P_2O_5
Jordan	1,400	1.1
Syria	12,500	2.1
Lebanon	18,000	57.0
Morocco	44,500	5.6
Algeria	52,600	7.8
Tunisia	28,000	6.2
Total:	157,000	

Source: FAO Production Yearbook

Table 11. World reserves of phosphate rock

(Containing at least 25% P_2O_5)

Country	Millions of metric tons
Morocco	21,000
U.S.A.	13,526
U.S.S.R.	7,568
Tunisia	2,000
Egypt (approx.)	1,200
Algeria	1,000
Brasil	572
Pacific and Indian Ocean Islands	182
Others* (mainly W. Africa)	670
Total:	47,738

* Jordan also is not an insignificant producer of phosphates.

Source: The Arab Economist, December 1974.

L'APPLICABILITE DE L'ASSOLEMENT A BASE DE CEREALES ET DE PRAIRIES DE LEGUMINEUSES DANS LES PAYS DU MOYEN-ORIENT ET DE L'AFRIQUE DU NORD

D.M. Leeuwrik

RESUME:

On utilise les prairies de légumineuses dans les rotations pour restaurer et maintenir la fertilité et la productivité du sol. En australie l'installation de prairies de légumineuses annuelles à régénération spontanée en rotation avec des céréales a eu pour résultat la restauration de la fertilité du sol et l'augmentation de la production tant végétale qu'animale. Le résultat est un système d'exploitation où la production végétale et animale sont parfaitement intégrées.

Les similitudes du climat permettent d'espérer qu'il sera possible d'augmenter et de stabiliser de cette façon la production végétale et animale au Moyen-Orient et en Afrique du Nord.

De façon générale les sols dans cette région sont peu fertiles et lourds mais ne posent pas de problèmes spéciaux pour l'établissement et la croissance des variétés de légumineuses actuellement disponibles. Les sols sont pour la plupart calcaires et par là plus adaptés aux espèces de medicago. Les régions qui conviennent le mieux pour l'adoption d'un tel système sont supposées être celles qui se trouvent dans la zone où la pluviométrie se situe entre 350 et 500 mm et où la température mensuelle moyenne minima n'est pas inférieure à 2°C pendant les mois le plus froids.

Dans le pays où sur de grandes étendues la température ne constitue pas un facteur limitatif, à savoir, la Jordanie, la Syrie, le Liban, le Maroc, l'Algérie et la Tunisie, on estime qu'il serait possible de créer des prairies sur une superficie actuellement en jachère équivalente à environ un tiers de la superficie semée en céréales annuellement, à savoir 3,000,000 ha. L'azote accumulé par les prairies serait suffisant pour assurer la production de 1,740,000 tonnes de céréales supplémentaires ce qui équivaudrait à 24% de la production annuelle des dernières années. Dans quelques pays, la possibilité existe même d'augmenter la production de 40%. En plus, 11,600,000 tonnes supplémentaires de matières sèches seraient produites annuellement, ce qui, avec une exploitation correcte, assurerait l'alimentation d'un nombre égal d'ovins (équivalents en brebis), une augmentation de 26% par rapport aux nombres actuels. L'approvisionnement en semences et en

engrais phosphatés est nécessaire pour l'adoption rapide des prairies artificielles à base de légumineuses. Il faudrait également modifier les techniques employées dans le domaine de l'élevage de façon à tirer profit du fourrage supplémentaire produit. Une connaissance approfondie des techniques actuellement employées dans la production végétale et animale est une condition essentielle pour la réussite d'un système intégré englobant ces deux aspects.

Original: Anglais

25

IMPORTANCE OF AUSTRALIAN TECHNOLOGY FOR NORTH AFRICAN AND MIDDLE EAST COUNTRIES

A. Hafiz

After having visited Australia for one month, I prepared a detailed report which is now being distributed to conference participants.

This publication is "Report on a visit to Australia" by A. Hafiz, FAO, Near East Regional Office, Cairo, December 1974.

The main points of the report are the following:

1. As North-African and Middle-East countries have with Australia (above all Southern and Western Australia) much similarity in climate, soil, vegetation and crops, it may be possible to use the Australian technology to improve the agricultural production of these countries.

2. There is a great possibility of increasing the production not only of the cereals but also of the livestock in the cereal areas by replacing the fallow with Medicago sp. which reestablishes itself following wheat by means of hard seed. This practice will increase the quantity of nitrogen in the soil by about 60 kg/ha, which represents a value of millions of dollars per year. It will also increase the organic matter level in the soil and as a result improve the soil texture. This system may reduce weeds due to the competition with Medicago, double cereal yield and furnish additional green fodder of good quality, forage and dry feed for millions of sheep every year.

However, to reach this goal we must force ourselves to make considerable multidisciplinary efforts in the fields of research and production.

3. To achieve these objectives, the following suggestions have been made:

a) To start testing and multiplying Medicago cultivars (as well as indigenous species), to use phosphates in the cereal areas and to avoid deep tillage.

b) To increase exchanges of material including cereals, grain and forage legumes, oil crops, etc. and to develop closer and more productive contacts with Australian scientists.

c) To send scientists to Australia in order to obtain doctorates in the relevant subjects.

d) To conduct a one year training course for a period of five years concerning agricultural methods practiced in dry areas of Australia.

The steps required to carry out these suggestions are now being undertaken.

IMPORTANCE DE LA TECHNOLOGIE AUSTRALIENNE POUR LES PAYS D'AFRIQUE DU NORD ET DU MOYEN-ORIENT

A. Hafiz

RESUME:

Après avoir visité l'Australie pendant un mois, j'ai préparé un rapport détaillé qui circule actuellement parmi les participants à la Conférence[1/]. Les points principaux de ce rapport sont les suivants:

1. Etant donné que les pays d'Afrique du Nord et du Moyen-Orient ont avec l'Australie (surtout l'Australie du Sud et de l'Ouest) plusieurs points communs come le climat, le sol, la végétation, les cultures, il est possible, avec de grandes chances de succès, d'utiliser de façon adéquate la technologie australienne pour améliorer la production agricole de ces pays.

2. Il existe indéniablement une grande possibilité d'augmenter la production non seulement des cultures céréalières mais aussi du bétail dans les zones céréalières en remplaçant les jachères par du Medicago spp. qui se reproduit lui-même annuellement. Cette méthode augmentera la quantité de nitrogène dans le sol d'environ 60 kg/ha, ce qui représente des millions de dollars par an; elle aura également pour conséquence une augmentation du niveau des matières organiques dans le sol et par là une amélioration de la texture du sol, un contrôle des mauvaises herbes par la compétition avec le Medicago et le pâturage, un rendement de céréales multiplié au moins par deux et une augmentation de pâturages verts de bonne qualité et de grande variété, du foin et (dry feed) pour des millions de moutons de plus chaque année. Cependant, il faut, pour arriver à ce résultat s'astreindre à des efforts de nature multi-disciplinaire considérables à la fois dans le domaine de la recherche mais aussi dans le domaine de la production.

1/ A. Hafiz, Report on a visit to Australia FAO Near East Regional Office, Cairo, Dec. 1974 (42 pages).

3. Pour atteindre ces objectifs on a fait les suggestions suivantes:

a) Commencer (ou continuer) à tester le Medicago spp. (y compris l'accumulation d'espèces indigènes et leur multiplication), utiliser des phosphates dans les régions céréalières en les combinant avec la pratique des labours superficiels.

b) Améliorer les échanges de matériel végétal concernant les céréales, les légumineuses, les légumineuses fourragères, les graines à huile, etc... en développant des contacts plus étroits et plus productifs avec les chercheurs australiens.

c) Envoyer des chercheurs en Australie pour obtenir des doctorats dans ces disciplines connexes.

d) Développer des programmes de formation sur les méthodes d'agriculture pratiquées dans les régions sèches d'Australie d'une durée d'une année et sur une période de 5 ans.

Les actions nécessaires sont actuellement mises au point pour appliquer les suggestions ci-dessus mentionnées.

Original: Anglais

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COMBINED DISCUSSION IN RESPONSE TO ALL PRESENTATIONS ON WHEAT - FORAGE LEGUME ROTATIONS

Comment: The problem of deciding which is the most profitable rotation system is very difficult to assess and requires long term experimentation. In these rotation studies, traditionally grown legumes such as common vetch should be considered along with the Australian cultivars.

Australian methods must be modified to fit the conditions in the region. Priorities should be set before selecting the best systems for each region, i.e. priority for grain production or for forage production. In the first case, the best rotation would be one which produces the maximum quantity of grain over a given period. Therefore, systems of continuous wheat or barley should be considered.

Comment: Medicago presents a number of problems, i.e. sensitivity to cold and frost, regeneration, and soil preparation after harvest of the cereals. Therefore it may be wise to evaluate vetch because of its wide range of adaptation. Research should include search for useful biotypes and their nutritional and agronomic adaptation. In Morocco, vetch is considered a weed and standards should be set for number of seed permitted in certified seed of cereals.

Comment: The basic idea of the system is to improve productivity of the soil by placing a leguminous crop in rotation with cereals. Depending on rainfall, soil depth, physical properties and fertility, we can choose either grain or forage legumes. The value of a forage legume depends on the presence of livestock for its utilization.

The success of the Australian system is based on scientific selection, and development under their own environmental conditions. In order to utilize the system in this region it is extremely valuable to follow their methods and use their cultivars in the beginning. At the same time there is need to select and evaluate local species and ecotypes. There are many promising genera in addition to Medicago and Trifolium, i.e. Vicia, Lathyrus, Onobrychis,

Hedysarum, Scorpiurus, etc. Collaboration with botany departments may be very productive.

Question: How much nitrogen is accumulated and what is the relationship between innoculation and amount of nitrogen accumulated?

Answer: Mr. Doolette's results indicate nitrogen accretion in the region of 60-70 kg/ha. This indicates good nodulation.

However, the variety Paragosa has been found to nodulate only slowly and would benefit from innoculation. "Clare" sub-clover requires innoculation. Some local ecotypes collected on the coastal plain in Algeria have not nodulated when grown in a colder region.

Comment: Work on Rhizobium culture is very important. In some of the countries like Oman, United Arab Emirates and South Yemen a lot of alfalfa is being grown and there is no nodule formation with the result that the farmers have to apply nitrogen. If the seed had been innoculated the crop should not need addition of nitrogen but should accumulate nitrogen and enrich the soil.

Question: What is the best depth of seeding for medicago?

Answer: Considering the many depths of planting studies the best depth is $1\frac{1}{2}$ - 2 cms.

Question: Is it necessary to limit tillage depth to 8 to 10 cm?

Answer: Growers who have tilled to a greater depth have not obtained good regeneration.

Question: If an adequate first-year yield could be achieved, why not re-seed medicago whenever it is needed in the rotation? This would avoid limiting tillage depth and permit normal soil preparation for wheat.

Answer: The production of forage is dependent on population density. Thus, if you sow medicago at 10 kg/ha you get a certain amount of forage. Assume a seed production of 1,000 kg/ha in the 3rd year, with a breakdown of hard seed of 10%, you will get a population derived from 100 kg/ha of seed. It stands to reason that you will get higher forage production.

Question: In Tunisia (1) what are the yields of wheat after fallow compared with yields of wheat after the first year of medicago? (2) What is, the production of green material the first year compared with following years of regeneration? (3) What seed yields have been harvested?

Answer: (1) With the same fertilizer application and the same wheat variety, the yield of wheat has been higher after first-year medicago than after fallow, providing the medicago field was disced at least once before sowing wheat.

(2) The first-year yields of green matter, and of course of dry matter, are less than those of second-year medicago.

(3) Our first seed harvesting operation will start with the present crop.

Question: There is much similarity between Australia and North Africa but there are also differences and all problems are not resolved, therefore, should we not proceed with caution?

Answer: The price of wheat is high and much potential forage production is wasted in the fallow year. There is a real need for the system to be successful. There are solutions, but not magic solutions; for instance, the Australian cultivars came from North Africa, but they are not successful over 700 meters. However, there are native species growing at elevations much higher than 700 meters which may solve this problem. The crucial question is, how long will it take to solve the problems and put the system into full use.

Comment: Seed supply also influences the time it will take to develop this program of rotation. If we are to seed 2,000,000 hectares with Australian cultivars in Algeria within the next 10 years, this is 200,000 hectares per year. This represents a total seed demand of 20,000 tons of seed at a cost of $36,000,000 at present figures. Where will the seed come from? Perhaps medicago acreage should also be increased by developing existing endemic medicagos by phosphate fertilization and shallow tillage. Research should be conducted to study this possibility. In the 300-400 mm region it may be possible to establish half the needed area by this method.

Comment: No doubt Australian experience will have to be modified and adjusted to the local conditions available in each country and this will require research. This does not mean that we should do nothing until research is completed. We should make use of all the experience which is available and proceed as rapidly as possible.

FT-1

FIELD TRIPS

Weed Control

Afternoon of April 29, 1975

1. Farm of Mr. Ben Amar at Cebala Ben Amar.

Excellent weed control in the wheat fields was observed and Mr. Ben Amar discussed problems and progress. At this farm near the coast, rainfall is relatively high and herbicides must be used to control the grassy weeds. In contrast, on his farm near Pont du Fahs where rainfall is less and drainage is better good weed control can usually be obtained by cultural practices only. Three specific problems of herbicide application were pointed out: (1) the necessity of agitation for wettable powders, (2) the importance of accuracy of dosage applied, (3) the difficulty of controlling the pathway through the field when using ground application equipment.

2. Farm of Hadj Moktar Ben Mustapha at Utique.

Conferees saw a variety demonstration trial in which wild oats and canary grass had been controlled with a mixture of Dosanex plus TOK (at 3 kg/ha and 2 kg/ha respectively), a herbicide demonstration trial with 10 treatments which are recommended for various weed problems, and a canary grass control trial. Treatments were 4 dosages of TOK mixed with Dicuran and with Dosanex and a spray volume comparison of 100 vs. 400 liters per hectare.

3. U.C.P. (cooperative) Side Ali El H. at Mornaghia.

At this site 22 promising herbicide treatments were being evaluated under conditions of very high infestation of both wild oats and broad leaf weeds. A number of treatments were nearly weed free. Two replications of this trial had been over-sprayed with 2,4-D by air and suppression of wild oats as a result of this application was evident.

Editor's note: Without 2,4-D over-spray yield of the non treated plots was 16.1 qx/ha and of the best herbicide treatment, 39.4 qx/ha (Dosanex + TOK). With 2,4-D over-spray yield of the otherwise non treated plots was 22.2 qx/ha and of the best herbicide treatment, 39.0 qx/ha (also Dosanex + TOK).

Afternoon of May 1, 1975
(one stop during the Rotation Field Trip)

4. U.C.P. (cooperative) Amel, Pont du Fahs.

Under a different set of weed conditions the same weed control program was seen as at Utique with the addition of an herbicide phytotoxicity trial. Strips of 7 different herbicide treatments had been applied across plots of 11 wheat varieties. The purpose of this type of trial is to ascertain if the recommended herbicide treatments are safe to use on the varieties being grown in Tunisia.

Durum Wheat and Seed Production

All day, April 30, 1975

1. INROT Wheat Breeding Station, Beja.

This fertile, well managed experiment station is the major cereal breeding site in Tunisia. Crossing blocks, segregating populations, International nurseries, yield trials and seed increase plots, were seen and discussed.

2. Farm of Mr. Ben Chiboub, Bou Salem.

Cereal seed production procedures of the farm were discussed as well as the total farm operation which includes many other enterprises. By appropriate tillage, hand weeding and rotation practices Mr. Ben Chiboub achieves excellent weed control without recourse to herbicides. His frank discussion of all aspects of his business and operations was greatly appreciated.

3. CCSPS seed processing plant, Beja.

Cleaning and storage facilities were seen and the seed production, handling and distribution systems were discussed.

Grain-Forage Legume Rotation Program

Afternoon of May 1, 1975

1. Farm of Mr. Fethi Bouchoucha at Smindja.

This is one of the 3 major experimentation sites of the Medicago program (the other two are St. Cyprien and Le Krib). Here conferees saw a rotation experiment designed to determine the number of wheat-medicago cycles

necessary to reach a level of wheat production similar to that of the wheat-fallow system plus nitrogen fertilizer. The wheat after the second year of Medicago was clearly superior to the wheat after the first year of Medicago. Other work at this site included an evaluation of Medicago cultivars. Harbenger is superior on this particular sandy soil and the wheat following this variety was clearly higher yielding.

2. UCP Drijet (cooperative) at Bordj El Amri.

A commercial field of Medicago (Jemalong) in the first year, having been planted the previous November, demonstrated the case of establishing the legume on these shallow calcareous soils. Also evident was the high forage production (approximately 5000 kg of dry matter/ha) as well as good seed production even after a limited amount of grazing.

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SUB-COMMITTEE REPORT: SEED PRODUCTION

M. Turkmani

In the course of the session on seed production two reports were presented, one by Mr. Douglas and the other by Mr. Kouki. The first subject was needs and development of the seed industry in the region and the second was wheat seed production and regulation in Tunisia.

Mr. Douglas emphasized the importance of the multiplication program which is the link between research on new varieties and their production in the field. He described and illustrated the different links of the chain which makes up the seed industry. Then he discussed the "FAO Seed Review 1971-72" which contains information on the seed situation in many countries of the region. He praised the large effort and progress which has been made since 1971-72 but pointed out that there is still much to be accomplished. Additional efforts are needed, especially the development of cooperation among the national seed industry programs of the entire region.

In order to achieve the objective of furnishing large numbers of growers the maximum amount of high quality seed of the best existing varieties the following will be necessary:

1. Coordination between the different elements of the industry.
2. Solid support of the Government.
3. Utilization of the best varieties which already exist.
4. The capacity to multiply them rapidly.
5. Reasonable and effective management of the seed organizations.
6. Efficient channels of commercial distribution.
7. Sufficient capital.
8. Qualified and motivated personnel.

It was emphasized that the seed industry in each of the concerned countries should be thoroughly examined in order to determine and overcome the weak points. It was pointed out that considerable advantage would result from uniform regulations and procedures in all countries of the region. Also of great advantage is a free exchange of information and cooperation in the development of trained personnel. Many other ideas were presented for strengthening the seed industry through regional cooperation.

In contrast to the treatment of Mr. Douglas of the seed industry within the whole region, Mr. Kouki treated the Tunisian experience. He outlined the early history of the organization and regulation of cereal seed multiplication. He then told of development of new legislation and recent government actions to assist the seed industry in meeting the increasing needs of the country for quality seeds.

Legislation was drafted to govern the organization and the regulation of seed production and marketing for all categories of seeds including cereals, vegetables, forage crops and trees. Procedures and techniques adopted were those of the International Seed Testing Association. This legislation also accomplished:

1. Formation of a National Seed Committee.
2. Construction of a seed quality laboratory.
3. Creation of a pool of technical personnel, etc.

The Ministry of Agriculture decided to start testing the proposed standards before their official adoption; therefore, it was possible for Mr. Kouki to present the results of 2 years of experience with these new rules. If the proposed legislation had been in force in 1973-74 approximately 24.5% of the seed lots would have been rejected. After studying the reasons for the failures to meet the standards an appropriate course of action was recommended.

Before a new variety can be registered, it must be tested for 4 years in 2 different types of trials in order to establish its performance, purity and characteristics.

In regard to certification and control of distribution of seed, these two functions may be carried out by either one or two organizations. If the program is small the two tasks can be carried out by a single organization. However, if the program is large two organizations are preferable.

In conclusion, the seed industry is a complex chain of operations and sufficient attention should be placed on each element in order that no part creates a bottleneck.

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SUB-COMMITTEE REPORT: CROP ROTATION

D.M. Leeuwrik

Yields of cereals grown in the dryland areas of the Middle East and the North African regions are low and fluctuate widely with annual rainfall which is unrealiable in amount, distribution and intensity. Soils are generally of medium to heavy texture and, after many years of cultivation, are low in organic matter and have poor structure. Water infiltration rates and soil moisture storage capacity are frequently low and, with present farming practices, weeds are a problem during the cropping phase. Soil fertility levels are generally low and little fertilizer is used on field crops. In many instances yields are so low that the use of nitrogen, at present high prices, may not be economic.

It is postulated that the introduction of a cereal - forage legume - animal production system could lead to increased soil productivity and higher, more stable levels of both crop and animal production in low to medium rainfall areas. In lower, more marginal areas the alternative would be a clean fallow system in order to conserve sufficient moisture for crop growth, whereas in higher rainfall areas annual crop sequences may be economically desirable. There is a need to describe more fully, and quantify as much as possible, agro-ecological areas of the region in terms of climate, soil and productive capacity and to conduct comparative studies in order to identify the appropriate and more productive farming system for particular regions. To be able to do this, more needs to be known also about existing farming practices and production systems.

Work conducted to date in this Mediterranean region, characterized by winter rainfall and a long, hot, dry summer, indicates that the use of an annual, self-regenerating pasture legume in rotation with cereals may provide a solid base for a productive, integrated crop animal production system for the 350-500 mm rainfall zone if average temperatures during the coldest month of the year do not go below 2°C.

It is recognized that the adoption of such a system should be only advocated on the basis of adequate information generated by sound research. However, the generation of reliable data from dryfarming research is a slow process which takes many years. In the interest of saving time, therefore, the

careful appraisal and adaptation of information available elsewhere may speed up the process of adoption. This forms the basis of the so-called "best bet" approach used in Tunisia. Using this approach, large-scale demonstrations and verification trials have been conducted with Australian cultivars of Medicago on farmer's fields in order to test and demonstrate the feasibility of the system and to identify research needs. Several areas needing more detailed research can now be identified after it has been demonstrated that productive annual legume pastures can be established:

Selection of Adapted Genera, Species and Cultivars of Legumes for Different Agro-Ecological Regions.

The greatest need is to identify a productive legume resistant to low temperatures and adapted to high elevation. The search for superior germplasm should not be restricted to Medicago but should include Vicia and other forage and grain legumes. It would be desirable to set up a regional nursery network for testing superior lines of different legumes over a wide range of conditions and to ensure that the material is widely available. Selection criteria would include forage and seed yield, cold tolerance, disease resistance, seed coat impermeability, etc.

2. Management Studies.

a) Seed dormancy and hardseededness.

This is the most important factor in self-regeneration of the pasture phase. It is genotypically controlled, but environment and also management greatly influence it. Knowledge of this factor in different cultivars under conditions experienced in various agro-climatic parts of the region is very scanty. In view of its importance in determining the persistence of the pasture it is recommended that extensive investigations be undertaken.

b) Pasture management studies should be undertaken to determine the effect of various management systems, including fertilization, grazing, cutting, tillage, use of selective herbicides, etc. on forage and seed yield, longevity of the pasture, regeneration, pasture composition, weed population and spectrum during the crop as well as the pasture phase, and yield of subsequent crops.

c) Pasture utilization practices should be developed to make maximum use of the dry matter produced. Investigations should include determination of optimum stocking rates, grazing systems, fodder conservation, animal management and production.

d) Agronomic and soil management.

Localized problems in crop and soil management should be identified and overcome.

e) Rhizobium studies.

3. Socio-economic issues.

   a) Farm structure and size
   b) Separation of enterprises
   c) Infrastructure needs.
   d) Cost of production

4. Some of the requirements to establish the system.

   a) Phosphate
   b) Seed

5. Training of personnel and development of national programs.

6. Collaboration between country programs and international organizations.

In summary, a wheat-forage legume rotation system has great potential in this region for increasing and stabilizing production of both grain and meat. However, in order to achieve this potential, considerable technical and material inputs must be made.

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SUB-COMMITTEE REPORT: WEED CONTROL

T. Lyons

Weed problems are universal in wheat production and as yield potential increases, weed damage potential increases proportionally. In the survey reported by Mr. Nelson, loss of production as a result of weed competition was approximately 5,000,000 tons in 13 North African and Middle Eastern countries.

Mr. Nelson pointed out that 2,4-D would control the most damaging weed in about 1/2 of the countries reporting. This is fortunate because 2,4-D is inexpensive, effective and well accepted by growers. Also there is a greater backlog of use-experience with 24-D than with any other herbicide. This information is of great value but does not necessarily guarantee favorable results. Growth patterns are different in different countries as well as in different localities of the same country. Therefore, responses to herbicides differ and modification of the standard recommendations may be needed in order to obtain full value of herbicide use.

Developments in Turkey and Tunisia provide an example of the need to modify herbicide recommendations as a result of different growing conditions. Mr. Tezel reported that on the Anatolian plateau of Turkey the most profitable time to apply 2,4-D is the three-leaf stage. In Tunisia, because of damage to wheat at earlier stages, the proper time to apply 2,4-D on bread wheat is after the growing point reaches the surface. Usually by this time seven leaves have fully developed. The important lesson is that in Turkey, trials show that application date should be moved ahead, but in Tunisia, trials show that application date for bread wheat should be delayed.

Am I saying, "Don't use 2,4-D because it is too complicated?" Of course not. I stand with Dr. Hafiz, "Never mind the complications, full speed ahead!" My advice is, "Use 2,4-D or any other improved practice, as long as you measure the results and modify the techniques if necessary.

A grand institute for research is not essential for immediate progress in the field. Even one engineer with material and moral support can make amazing contributions. Simple experiments are often the most valuable. For

instance, trials to determine the most profitable dosage or the most profitable time of application are very easy. Trials to determine if the herbicide treatments damage wheat are easy, if a weed-free site can be found.

In Tunisia it has been necessary to carry out considerable applied research in order to improve the results of herbicides. Mr. Sellami described the purpose of the trials of the Technical Division of the Office of Cereals, the methods used and some of the results. The experimentation was carried out on farms and most trials were designed for extension demonstrations as well as for developing information.

You have seen the weed control progress in the wheat fields of our Tunisia. Perhaps Mr. Alaya best explained the reasons for this accomplishment, teamwork among all agencies concerned with weed control. This cooperation was fostered by an early start on the weed problem and in recent years there has been a coordinating committee. The total National effort on weed control includes research, applied research and extension, regulation, government supported application by ground and air, subsidies and financing. Even the supplying companies are allies -- they know a great deal about using the materials they supply.

Let us return to results reported by Mr. Sellami because they may have implications for other countries. On farms sampled by our experimentation, yield loss from grass weeds has been 4 to 6 times greater than from broad-leaf weeds. The pattern we see is increasing importance of grass weeds relative to broad-leaf weeds with improvement in farming practices, moisture conditions and soil fertility. In countries with similar conditions this may mean that agronomists should plan ahead for grass weed control, even though 2,4-D is giving satisfactory results at the moment. Herbicide use as well as other changes in farming practices may result in very rapid shifts in weed problems.

Another result reported by Mr. Sellami is the extreme influence of the season's fainfall pattern on loss of yield due to weeds. In these trials the yield loss was related to increased water stress as a result of weed competition, especially during the grain filling period. In seasons with favorable rainfall amount and distribution very little moisture stress develops, therefore, yield increase as a result of weed control is small. In other seasons, severe moisture stress develops and large yield increases result from weed control.

Without accurate long range weather forecasting, how do we cope with this extreme influence of the weather in our planning and decision making? Dr. Ben Zaïd presented a method which utilizes the 73 year record of rainfall in Tunisia. If the kinds of "rainfall years" are described in a way that relates to the agronomic outcome, the frequency of the different kinds of years estimates the probability of the different outcomes. In this study the outcomes estimated were the amounts of yield loss due to weeds. Adjustment to change in

farming methods and conditions is automatic if each years' trial data and experience are used to test and modify the scheme. This approach may be applied to disease and insect outbreaks, farming systems, management practices, etc. More use of climatic data is needed in planning and decision making in rainfed agriculture.

At the first stop on our weed control field trip, Mr. Ben Ammar made valuable comments on equipment. Problems discussed were dosage variation caused by variation in ground speed, the importance of agitation for wettable powders and skips and overlapping which occur for lack of a marking system. The problem of controlling the path of the sprayer is solved on the demonstration farm at Fretissa by not seeding in the wheel track space. In this technical age, the mechanical problems are solvable. In the meantime, extra extension effort is needed to help growers with their application problems. For example, in Tunisia the greatest impediment to adoption of the new methods for grass weed control has been application errors. Dosage must be more accurately controlled than with 2,4-D and disastrous results have occured when mistakes were made. This has turned many communities against the new product which happened to be in the sprayer at the time.

Wheat varieties now in use show striking differences in resistance to weeds. Therefore, progress is possible in breeding for weed resistance if proper objectives are chosen for growth pattern and plant architecture. Rapid root growth and early development of a canopy which intercepts most of the light are important. The weed control advantage of a high canopy must be balanced off against the risk of lodging and the inevitable reduction of harvest index. In Tunisia, the wheat canopy suppresses broad-leaf weed development much more effectively than it suppresses grass weed development. This means that the growth pattern of the anticipated weed competition should be considered in developing varieties resistant to weeds.

Another promising approach is genetic resistance to certain important herbicides, especially those which control a broad spectrum of weeds. Some work of this type is underway. Screening for herbicide x genotype interaction of universally used herbicides may be a valuable part of breeding programs. In the meantime, each country has an obligation to check the safety of the herbicides they use, or wish to use, on the crop varieties being produced.

In summary: cultural practices other than herbicides constitute the basic method of weed control and many innovations and improvements are yet to be made. However, we have stressed herbicide use at this workshop because immediate, spectacular improvements in production are often possible and special effort is needed in order to bring this relatively new technology into full use.

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SUB-COMMITTEE REPORT: DURUM WHEAT IMPROVEMENT

A. Daaloul

I. Introduction: Importance of Durum Wheat

Durum wheat is a very important crop in the world with a total area of approximately 22.5 million hectares (1969-70 estimation) and a total production of 25,134,000 metric tons. This durum wheat is consumed in the form of pasta (28%), couscous (16%), bread and other uses (24%). The remaining 42% is the consumption of China and the U.S.S.R. for which no figures were found. The nutritional value of durums is much higher than that of bread wheats because of a better amino-acid balance and more vitamins. The consumption figures of this crop show an increasing demand for durum wheat; however, the stocks available have drastically decreased because of population growth. As a result, durum wheat prices increased from 75 to 300 dollars per ton. The major exporting countries of durums are Canada, the USA and Argentina. The major importing countries are the European countries (70%) where durums are mainly used for pasta; that is why most of the quality traits considered up to now are for pasta making.

In the Mediterranean, Near and Middle Eastern region durum wheat remains the major staple food crop. It occupies 11.5 million hectares (a little over half of the world area), with a production of 11,500,000 metric tons. This production is consumed mainly as bread (43%), couscous (25%), pastas (20%) and others (12%). It should be noted that pasta is not the predominant use of durums in this region as compared to the rest of the world. All the countries of this region are either importers or self-sufficient but none is an exporter.

II. Varietal Status and Distribution in the Region

From the questionnaire and from the different countries' reports we have all remarked that most of the varieties grown in this region are local varieties (Land or improved land varieties). These varieties are generally tall and weak strawed; they are also susceptible to many diseases, and consequently they are of low productivity. Their merits are the good adaptation, the drought tolerance and the good quality characteristics.

Improved varieties resulting from hybridization are also used in the region: INRAT 69, Badri (North Africa), Capeiti (Algeria and Cyprus). These varieties remain of low yield potential despite their good productivity. The recently developed high yielding varieties (Cocorit, Jori, Maghrebi, Amal, Gediz, Dicle, Anhinga, Creso, etc.) occupy very low areas compared to the first two groups. However we can be optimistic in view of the national reports which indicate that these lines are in recent cultivation and multiplication in many countries of the region.

III. Problems and Needs of the Durums in the Region

Besides the low productivity of durums due directly to low yielding ability of the varieties grown, many other problems reduce the production each year such as: (1) diseases, (2) weeds, (3) poor soil preparation, (4) low soil fertility and (5) fluctuating climatic conditions (rainfall). As a result most of the breeding programs of the region have the following objectives: (a) high yield and yield stability, (b) disease resistance and (c) quality.

(1) Yield and yield stability

The high yielding semi-dwarf germplasm must have an adequate pattern of development to be adapted to the countries of the region -- the spring durum varieties adapted to the region should be:

- either semi-winter with good cold tolerance
- or spring type but with late flowering and early ripening.

This objective is being met in many countries by a crossing strategy of the Mexican semi-dwarf germplasm with the locally adapted material. For example, Tunisia is crossing the Mexican, Italian and American germplasm into the D63.8-6A-3A and the D68.5 lines which are well adapted to Tunisian conditions.

Another way to achieve yield and yield stability is to get better lodging resistance. Most of the programs have reported the use of Norin 10 x Brevor source of dwarfism to obtain lodging resistance. As you all know, Norin 10 x Brevor is associated with some sterility problems. The CIMMYT report has promised among the new developments in CIMMYT programs to get the sterility genes out of the Norin 10 x Brevor source. The use of a different source of dwarfism was also mentioned, the short Capelli mutants.

However, in many countries where weeds are still a problem semi-dwarf germplasm lacks competitive ability with weeds; for this reason, some programs have suggested the use of germplasm with medium height but having a solid stem.

(2) Disease resistance

Diseases cause approximately 12% loss of durum wheat production in the region. These are rusts, Septoria, mildew, smuts, bunt and some foot rots. The picture may be complicated by other pests (insects, nematodes and viruses).

To overcome these problems most of the breeders of the region are taking advantage of the regional disease nurseries such as the RDISN, RTN, ISEPTON, rust nurseries, IDSN, etc. These nurseries give a wide range of information about the genetic resistance to these diseases. The use of lines from these nurseries allows the national programs to incorporate into their material a broad-based genetic resistance. From the discussions it was felt that the continuation of this type of exchange is of a tremendous importance to the region.

(3) Quality

Durum wheat quality concepts are not really well defined yet. From this conference it appeared that the only quality criteria used are the pasta-making ones. This is indeed of great importance to the exporters; however, the question was raised about quality criteria for the region where the main uses of durum are for bread, couscous and bulgur.

Anyhow, for pasta-making quality it was stressed by some speakers that the gluten strength is the first objective to be attained. From the Italian report it seems that measuring gluten strength will no longer be difficult because of the possibility of good correlations with the measuring of thiol groups in semolina.

(4) Physiology of yield

Looking optimistically to the future the conference looked into the problem of physiology of yield so the countries of the region could make new breakthroughs in terms of yields. Problems of nitrate reductase, protease activities, ideotypes, rapid emerging coleoptile, ATP levels, etc. were discussed.

IV. Conclusions

The durum wheat improvement sessions have stressed the following points:

1. There is still much to be done to combine all the desired characteristics.

2. Efforts should be intensified to find good durum cultivars, this can only be done by:

   (a) Use of great genetic diversity

   (b) Exchange of germplasm among countries and through international and regional agencies (CIMMYT, ALAD, ACSAD, FAO).

3. Decisions should be made in an integrated effort in the region about the quality concepts.

4. Consideration should be given to the entire package of cultural practices (soil, weeds, seeds) that should be used in association with the high yielding varieties to achieve high production.

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GENERAL CONCLUSIONS OF THE WORKSHOP

R.G. Anderson

Mr. Chairman, Mr. Chalbi, Honored Delegates, Lady Interpreters, Gentlemen.

The Workshop dealt with four general areas of significant importance in the agriculture of the Mediterranean Region.

(a) The production of durum wheat, its importance, problems associated with its production, its uses and the research approches required to support continued advance in its production.

(b) Seed production, the need, problems associated with seed production and the form in which it might be organized in the region.

(c) The problem of weeds, losses they cause, national weed control programs, methods of control and experimentation to improve these methods.

(d) The importance of crop rotations in the region with particular reference to the forage legume-cereal rotation.

Associated with the formal sessions, a series of well-organized field trips were arranged in such a way as to illustrate these four general areas as they apply to Tunisia which in turn represents a large part of the region. These visits to farm fields, experimental sites and a seed processing plant were very successful and were of great value to the various participants.

Those outsiders who have had the pleasure of association with the Tunisian program over the past several years could not but be impressed with the tremendous change that has occurred in Tunisian agriculture due to the efforts of its scientists, extension and government personnel. Some years ago the wheat areas were sown to tall varieties of lower yield potential, fertilizers were only marginally used, particularly nitrogen, and weed populations flourished. Although, as in all countries, Tunisia still has many problems to solve, the crop which the delegates were privileged to see is widely weed-free, well fertilized and promises a high yield if once more, general rains are forthcoming. A particular mention should be made of the "adjoints techniques" who

as extension personnel are not represented in a major way at the workshop. This group of young people have been instrumental in moving research from the research results into practice in the farm fields.

I should like to turn now to a consideration of some of the significant features of the areas discussed in this workshop.

Durum Wheat Improvement

As discussed, durum wheat is an important field crop occupying some 22 million hectares world wide with a production of 25-30 million tons. The Mediterranean area comprices somewhat more than half of the hectares sown and produces about 11.5 million tons. Much of the area is still sown to local varieties or selections made from local varieties but an increasing area is sown to improved and semi-dwarf varieties. Such varieties as INRAT 69, Bedri, Jori 69, Cocorit 71, Amel and Maghrebi are now grown on substantial areas within the region. The more traditional varieties are generally well-adapted with considerable drought resistance but are generally because of height, lack of response to fertility and widespread disease susceptibility, of low yield potential. The newer varieties have better disease resistance, lodging resistance, reasonable drought resistance and have the high yield potential which now equals that of the bread wheats.

There are several problems with varieties presently available to the farmers of the region. Some are general and other require specific breeding techniques.

In general, the present varieties are somewhat late in maturity. Resistance to stem rust, Septorici tritici and scab are still inadequate as a whole. Resistance to leaf rust is generally good as also to stripe rust although there is still room for improvement. Active breeding programs are going forward in several of the National Programs and at CIMMYT aimed at correcting these deficiencies and because of wide spread testing on a geographic basis, good resistance of the horizontal type is being bred into the varieties. The semi-dwarf genes of Norin 10, derived from the earlier produced bread wheat source, carried with them genes for floret sterility. This has not yet been solved satisfactorily so that each time crosses are made with these materials, a large proportion of the segregates have noticeably inferior spikelet and floret fertility. In the selection program, fertility has been selected leading to the development of such successful varieties as Jori 69, Cocorit 71 and more recently some of the Anhinga, Brant and Stork series of lines. However, these have rather polygesic fertility factors and again on crossing, the painful process of selection must be again pursued. CIMMYT is introducing genes for fertility from several sources with the view of correcting this deficiency.

Yield stability is a part of the strategy of breeding. The Workshop discussed the advisability of growing widely adapted vs. specifically adapted varieties. The fear was expressed that widely adapted varieties would lead to a monoculture of one or two varieties which would increase the danger to virulent races of one of the airborn pathogens. While this is true, it is equally true that farmers will tend to move towards that variety which gives greatest returns. Further, if a variety is selected for wide adaptability it is identified by its maintenance of high yield over wide geographic areas, in which, in any one year, it encounters a wide diversity of environmental conditions. This results in the selection of a successful variety with a high degree of buffering against both disease and environment so that at a single location within a single country, it will tend to be buffered against vagaries of weather and moisture conditions encountered from one year to the next. This is yield stability.

There are, as mentioned, a number of problems specific to the region in the agronomic sense. In such areas as the high plateaux of Turkey and Algeria there is a need for some winter tolerance. The delegates learned that winter durum germplasm and winter bread wheat germplasm was being introduced into the spring durum types to increase winterhardiness for these areas.

Another of the problems specific to the area is the need to have varieties for some of the areas bordering on deserts which have a long vegetative period and a short maturative period. This would protect the crop against frosts at heading time and provide a measure of escape from damage caused by the "sirocco" or "camesin" winds which occur during maturation. Selection is being made for such types to incorporate this characteristic in the durum germplasm.

It is suggested that varieties for the region should be of the one gene to two gene semi-dwarf type rather than the full three-gene-dwarf type in order to provide better weed competition since weeds are still a major problem of several areas. In the same line, it was suggested that breeding might be done for resistance to weeds, having a genotype which had prostrate leaves with fast growth in the early stages to smother the weeds. Although this might be done it is at best a poor substitute for better cultural practices or chemical control.

The delegates learned that basic research conducted indicates that the presence of high nitrate reductase in the roots during early growth and in the leaves and leaf sheathes of later growth are positively correlated with yield of the variety. In the first stage this enables the plant to rapidly absorb nitrogen and in the second to increase the speed of its translocation to the grain, thus, raising protein content. Level of protease activity is also directly related to protein level in the grain. Hence yellow berry is reduced.

In the area of quality, it was suggested that greater study should be made of the sulphydryl (S and SH) linkages in the proteins which are associated

with cooking quality. It was surprising to find that only 20 percent of the durum wheat of the region is used for pasta and the remainder is used for bread, couscous and bulgur. There seems to be little information that would indicate that what is desirable for quality of pasta is necessarily desirable for quality of bread or couscous. This warrants additional study.

As a general summary of the durum situation, yield potential is now equal to that of bread wheats. Disease resistance must still be reinforced for Septoria, scab and stem rust. Earliness, better fertility, and more closely adapted varieties are possible and are being developed. Durum wheats are important and will continue to play an important role in the agricultural economics of the region.

Seed Production

Seed production continues to be generally weak in most countries, although some are developing sound programs. This weakness delays the release of new varieties and often the life expectancy of the variety is cut in half by this lack of a seed production policy. A word of caution is required in the development of seed laws and regulations. Countries should avoid placing standards so high that the law inhibits spread of varieties. There must be flexibility left to accept somewhat lower standards in particular years because of particular problems associated with variety, environment under which it is grown and so forth, which would prevent the production of adequate seedstocks in that year. Thus, for example, one year might produce a higher level of loose smut in the fields of a susceptible widely grown variety. This could be accepted in field certification but steps could be taken to have it treated for this malady in the seed production process.

The suggestion was made that regional training of personnel would have real advantages since this would lead to greater uniformity of standards in the various countries. Such similarities would enhance the possibility of seed sales from country to country which in itself leads to greater intra-regional commerce. Whether training is indeed accomplished within the region or not, every attempt should be made to ensure as close similarity as standards as possible. There is no question, however, but what each country should build itself a seed production capability adequate to its seed needs. The size of installation should be governed by the expected demand taken over years. Provision should also be made to allow some increase of seed before actual release so that some seed is available at time of release. Should the variety not be released this would be sold as grain. Although this entails some loss of money, the potential loss from not having seed stocks of successful varieties available is infinitely greater.

Weed Control

Weeds are a major problem of the Mediterranean Region. Estimates by various speakers ranged from 4 percent to 50 percent for various

areas. This makes weed losses one of, if not the worst of, the yield detractors. In one paper the reduction in number of heads per measured area due to weeds was directly correlated to loss in yield. Thus any methods by which the weeds can be brought under control must be explored. Principal methods of control are broadly, agronomic practices, crop rotations and the use of chemical herbicides.

Speakers concluded that the real solution to weed control lay in improved agronomic practices, the substitution of clear fallow for weedy pasture fallow and so forth. One of the best methods where it can be employed is to delay seeding until after the first rains have germinated a crop of weeds which are destroyed in the pre-sowing cultivation. This allows the crop to come up and compete strongly with weed growth as the weeds are shaded and do not grow vigorously since they germinate after the crop has started. Various intertilled row crops can also reduce weed seed populations in the succeeding cereal crop. Other rotations are discussed in a later section. Chemical weed control may also be used in the cereal crop year. A whole host of new selective herbicides are available which control both broad-leaved and grassy weeds in cereal. One must exercise considerable caution in their use so as not to damage the commercial crop. Another problem is that their successful use at some times will depend on the prevailing weather conditions in the year of application. In other cases research must be conducted to determine whether there is a residual carryover of chemical which can destroy or damage the succeeding crop. In an interesting paper presented from Tunisia, weather conditions for 73 years were evaluated to establish the probabilities of rainfall in the pre-plant, vegetative growth and maturation periods. This model then sought to establish the probability that weather would act in a particular way. It is hoped that such a prediction would assist farmers and government planners in making a decision on whether or not to use herbicides or whether greater or lesser amounts of chemicals should be purchased for a country's use.

One of the points not stressed which would seem important is that weeds not only compete for sunlight, fertility and so forth but are competing for water supply from the soil which in this area where water supply is usually the chief limiting factor. Research must be continued on all methods of controlling weeds and once satisfactory methods of either chemical or tillage methods are worked out a great deal of extension education will be needed. It is generally agreed that the best place to conduct agronomic training courses is in the country where the extension work is to be put into operation. Training centers for training "trainers" are required in either international or regional centers where active research is being carried forward. These trainers would then establish training courses within country for the development of extension personnel. There is no other known way of providing training in the required numbers.

Crop Rotations

The medicago-cereal rotations developed in Australia and now being

adapted to Mediterranean agriculture were discussed in various aspects. In this region there are needs for Nitrogen fixation to reduce outflow of foreign exchange for very costly nitrogen fertilizers, weed control and an increase in forage production. If one were looking for a system which would provide the fulfillment of all three needs it would be difficult to find a system better fitted. The nitrogen is fixed by the medic legume for use by the following cereal crop, weeds are controlled by competition if proper management is practised and forage production is greatly increased over the weedy pasture normally practised. There are, however, a number of problems involved. The system must be adapted to local conditions of the social system. Rotational grazing is difficult as compared with Australia since no fencing is presently used. By and large those who own or farm the land do not control the sheep which are owned by nomadic peoples. Further, in many areas no drinking water is available for sheep. This means that forage must be cut for lay and trucked to sheep feeding sites. It also means a different type of management in the establishment year of the medic. Top cutting above the medic crop must be practiced to remove top growth of weeds coming through the medic to prevent seeding. This means providing rotory or other type mowers. Further the system calls for shallow tillage to keep the seed on the surface and prevent it from being buried deeply. This means such surface cultivators as sweep plows, rod weeders and so forth which will have to be purchased. Seed of Australian varieties which are being used for introduction of the system is expensive and although suitable varieties have been identified, they may not be the best adapted possible. Therefore, research on developing better ones for the area from native plant collections should be pursued. The current varieties are not sufficiently hardy for the higher altitude, colder sections of the region. There are, however, local biotypes that exist at these levels. These must be tested and increased. Seed production will have to be established to supply seed needs in the different countries. Research on identifying the best rhizobial cultures to fit the different varieties is necessary. Since the system depends on the degree of hardseededness or dormancy of seed which will allow for regeneration after the cereal crop, cultivars must be identified which have a high degree of dormancy. Considerable numbers of problems still exist and satisfactory methods must be developed to overcome these deficiencies. Most of the problems are questions of ways and means of establishing proper management practices. It seems evident that the system if properly applied can certainly add a great deal to the prosperity of the region as a whole.

Other types of rotations, as cereals with grain legumes such as horsebean, lentils and chickpeas can also be employed in a similar manner except that these will produce nitrogen and be a means to control weed populations but not produce forage. The effectiveness of these latter rotations was well demonstrated to the delegates on their visit to the farm of Mr. Ben Chiboub where weeds were of no moment in the cereal folds as they had been eliminated in the row-crop part of the rotation.

International Cooperation

The holding of this meeting which has brought together National scientists of many countries is one example of international cooperation. New information and ideas have been exchanged. New contacts have been made and old ones renewed. This is certain to open up greater and greater cooperation. In the field of germplasm the various international and regional agencies working with National Programs have as their entire mandate the assisting of National Programs to develop strong research and extension capabilities. Anything that any of them can do to provide germplasm, I am sure they will do within the limits of their capabilities. In return the National Programs should send in any materials which are promising, in order to provide an expansion of the germplasm available to the group and the world as a whole. The picture drawn by Dr. Borlaug of the frightening advance of food needs and the extremely critical current state of the art of food production leaves no room for complacency. All of us working jointly can provide a breathing space in which it may be possible to bring population pressures into some sort of equilibrium. Our greatest asset is international cooperation. Alone we are only partially effective. Together great things are being accomplished and greater things can be done.

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DURUM WHEAT IN CYPRUS

A. Hadjichristodoulou

The dry and hot climate of Cyprus, particularly at the period of grain development, favours the production of good quality durum wheat. Before the introduction of high yielding aestivum wheat varieties from CIMMYT, only durum wheat was grown in Cyprus.

In the 1930's, 50 durum and two aestivum varieties were grown in Cyprus (Anonymous, 1937). Kyperounda, Psathas and Tripolitico durum wheat were the main varieties occupying 80% of the total wheat area. At present 80,000 ha are sown with wheat, of which about 50% are sown with durum wheat. The average yield is about 1.5 ton/ha. Kyperounda occupies 60% of the durum wheat area, Psathas 10%, Tripolitico 10% and Capeiti 8 10%. The Italian variety Capeiti 8 yielded 13% more than Kyperounda and was released in 1972 (Hadjichristodoulou, 1973).

The local varieties are late, tall and susceptible to lodging and rust. Kyperounda and Psathas are grown mainly under rainfed conditions in areas of 200-400 mm annual rainfall. An area of about 10% of durum wheat is irrigated in winter or early spring by spate irrigation from small rivers.

Pure line selection exercised in Kyperounda populations showed that this variety is not genetically homogeneous for either agronomic or quality characters (Hadjichristodoulou and Della, 1975). Most of the off-types in the local varieties are durum wheat, but some aestivum wheat is also present. Purity of durum wheat is necessary when it is used for the extraction of semolina, but it is not so important when durum wheat is used for bread making.

The cultivation of durum wheat is completely mechanized. It is sown in December and harvested in June. Yields are reduced and grains shrink when drought or hot winds prevail during the period from flowering to dough stage.

Trials were conducted at 27 locations over a period of four years to compare yields of durum and aestivum wheat, and barley under rainfed conditions (Hadjichristodoulou, 1974). The mean yield of Kyperounda durum wheat was 1605 kg/ha, of Pitic 62 aestivum wheat 1820 kg/ha and of Athenais barley 3182 kg/ha. In spite of lower yields, durum wheat is more profitable than aestivum wheat because it commands the highest prices among winter grain cereals in both the local and world market. The profitability of durum

wheat will be comparable to that of barley, when new high yielding durum varieties are grown.

Vitreousness of grains of durum wheat in Cyprus varies with location but it is usually 95-99%. Protein content and volume weight of Kyperounda durum wheat was the highest among cereals, 13% and 78.1 kg/hl respectively (Hadjichristodoulou 1974). In one small area in the central plains of the island durum wheat of lower quality was produced (Vitreousness 5-50% and protein content 8%). It was found that this was not due to low N content in the soil but probably to other environmental factors (temperature).

Breeding

The breeding programme for durum wheat aims at introducing and testing new high yielding varieties and collecting and evaluating indigenous germ plasm. Locally adapted varieties are being crossed with introduced lines mainly for the improvement of yielding capacity under dryland conditions and under irrigation or high rainfall.

Capeiti 8 was tested for six years and was released in 1972. It is more drought resistant, earlier and produces larger grains than Kyperounda. Among the other varieties tested, Jori C69, Cocorit 71 and R.A.E. Tc^2 x S.T.W. 63/AA"S" were the best. In 1973/74 these varieties outyielded Kyperounda by 20 - 40% (Table 1); they are also earlier and produce larger grains.

Table 1. Grain yield in kg/ha of five durum and one aestivum wheat varieties.

Variety	Skylloura	Margo	Dromolaxia	Mean for 3 locations	Akhelia	Mean for 4 locations
1. Kyperounda	1591 c	1347 c	651 b	1196 c	955 b	1136
2. Capeiti	2013 bc	1369 c	932 ab	1438 b	1214 a	1382
3. Jori C69	2368 ab	1702 b	1162 a	1744 a	1029 ab	1565
4. Gr 145	1695 c	1362 c	829 ab	1295 bc	577 c	1116
5. Pitic 62 (aestivum)	2694 a	1991 a	858 ab	1848 a	814 b	1589
6. Psathas	1613 c	1450 c	1110 a	1391 bc	932 b	1276
Mean	1996	1537	924	1485	920	1344
Plot size (m^2)	44.8	44.8	44.8		12.8	

Among the indigenous lines Makrokoutsi, grown in small areas on the Troodos mountains, produced grains of very good quality, but it is very tall, about 150 cm. This line is being crossed with introduced lines to reduce height and increase yield potential.

Segregating populations of durum wheat were introduced from CIMMYT. Some lines selected from F_2 populations are very promising. They are very early, short and lodging resistant, tiller profusely and appear to have high yielding capacity. The best of these lines will be evaluated in replicated trials in the next season.

Genes for short stem in CIMMYT durum wheat originated from aestivum wheat. The wide use of CIMMYT varieties in crossbreeding programmes in the countries of Near East and North Africa may result in the development of durum varieties producing grains of lower quality than indigenous durum wheat. To avoid this, local varieties which are adapted to the dry and hot climate of the island are crossed with both CIMMYT varieties and the Italian mutant Gr A145.

Efficient and fast screening techniques for quality of durum wheat are not available. At present early generation screening is based on grain size, vitreousness and protein content. New techniques are needed to facilitate screening of durum wheat.

Forage legumes

Screening of many varieties of winter forage legumes showed that the most productive species in Cyprus is Lana woollypod vetch (*Vicia dasycarpa*) followed by common vetch and fodder peas (Table 2).

Table 2. Dry matter yield in kg/ha of winter forage legume species.

Species	1967/68 5 loc.	1968/69 6 loc.	1969/70 3 loc.	1970/71 3 loc.	1971/72 7 loc.	1972/73 1 loc.	1973/74 7 loc.	Weighted Mean 32 loc.
Lana woollypod vetch	1909	4884	3656	4869	2279	696	3004	3191
Local common vetch	2250	4026	2834	3885	1650	881	3041	2790
Local fodder peas	2146	3552	3937	3937	1547	814	2250	2596

Cutting stage: Lana beginning of flowering, common vetch and fodder peas beginning of pod formation.

The following legume species were tested in Cyprus under rainfed condition but gave lower yields than common vetch.

Trifolium subterraneum	(Subclover)
Trifolium repens	(White clover)
Trifolium hirtum	(Rose clover)
Trifolium cherleri	(Cupped clover)
Trifolium fragiferum	(Strawberry clover)
Medicago truncatula	(Barrel Medic)
Medicago littoralis	(Strand Medic)
Vicia Villossa	(Hairy vetch)
Vicia atropurpurea	(Purple vetch)
Vicia pannonica	(Hungarian vetch)
Lupinus angustifolius	(New Zealand Lupin)
Lupinus sp.	(Sand plaing Lupins)
Ornithopus compressus	(Yellow Serradella)

For the las five years variety trials were carried out to select high yielding varieties of the three best legumes, woollypod vetch, common vetch and fodder peas. Five new varieties of common vetch (M6900, Bi-45, No. 7392, Bi-64 and Bi-65) outyielded the local variety by 10-20%. However, the commercial varieties of woolly pod vetch and fodder peas gave the highest yields among all the varieties tested.

Cereal forage crops produced 5,535 kg/ha dry matter, more than twice the D.M. produced by vetches under rainfed conditions (Hadjichristodoulou, 1973). Protein yield of cereals was also slightly higher than that of legumes. Among the new barley varieties tested, 628 and 48 Alger yielded 20% more D.M. than the commercial variety Athenais.

Rotations

In the past the most widespread rotation practiced in durum wheat was cereal-fallow. With increasing mechanization of cereal produc-

tion and the use of fertilizers, the area under fallow is being restricted. Recently the policy has been for legume and cereal forage crops to replace fallow. However when rainfall conditions are favourable there is a tendency among the farmers to seed most of their land. Durum wheat very often follows wheat.

Experimental work that approaches completion shows that fallow could be replaced profitably by a leguminous or cereal forage crop.

Fertilization

A recent series of NP fertilization experiments carried out over the period 1968-1972 with Kyperounda durum wheat, Pitic 62 aestivum wheat and Athenais barley showed that, as expected, response to fertilization varies with rainfall. In years of high rainfall cereals respond to N but not to P, even though soil P is low. However, in years of low rainfall, particularly in the early part of the season, P fertilization increase yields. Significantly, while N fertilization may even reduce yields. The soils are well equipped with K (they contain more than 300 ppm exchangeable K) and cereals do not respond to K fertilization. Under average conditions the experiments have shown that for Kyperounda durum wheat 40 kg N and 60 kg P_2O_5/ha are required.

Weed control

The major weeds infesting cereals are broad-leaved weeds and wild oats. Broad-leaved weeds are easily controlled by postemergence applications of 2,4 - D and M.C.P.A. In trials carried out in 1969 preemergence applications of methozole and terbutryn controlled broad-leaved weeds. So far there has been no efficient chemical control of wild oats in commercial fields. Trials with preemergence applications of Avadex showed variable effectiveness. The new chemicals suffix (Bensoylprop ethyl) and Avenge (Difenzoquat or Difenzolium) were tested in 1973/74 and both gave good results for the control of wild oats in wheat fields. Avenge, the only chemical suitable for barley, also gave good results in barley fields. The experiments continue.

Seed Production

The production of certified seed of durum wheat in Cyprus has expanded considerably in the last few years. The Government has established a Seed Production Centre equipped with modern seed cleaning machinery.

The seed is provided by private growers but the fields are inspected and certified by specialist staff of the Department of Agriculture prior

to harvesting. At present certified seed represents one third of total annual requirements in durum wheat.

A premium price, higher than the normal price is paid to growers of certified seed. The sale price of the seed is usually about 20% higher than the purchase price in order to cover the costs of cleaning, processing, transport, etc. Cereal growers are increasingly more appreciative of the superiority of certified seed and do not object to its higher cost.

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PRESENT STATUS OF DURUM WHEAT IN THE ARAB REPUBLIC OF EGYPT

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Introduction

Wheat is one of the most important cereal crops in Egypt, and has been under cultivation since early times. The durum and pyramidale wheats, grown formerly, have now almost completely given way to bread wheat (T. aestivum) which was first introduced from India in the early twenties of the present century. This was due to low productivity of local durums and their susceptibility to lodging and rust diseases, along with their poor quality. All the cultivated area is under controlled irrigation since Egypt is practically considered as a rainless country.

Present Situation and Wheat Improvement

With an annual cultivated area estimated at about 550,000 ha, almost entirely of bread wheat, the average yield is about 3.5 tons/ha, and the country has to supplement its production (1.8 million tons) by importing about 3 million tons to supply the annual demand of local requirements. These imports are likely to rise with the rapidly growing population which deserves the effort of all the concerned to pay greater attention to increasing production to meet the continuous demand in the future.

Since it is not possible to increase area under wheat cultivation, the solution is to be sought in the increase of yield per unit of area. This can only be solved by a complex treatment of a series of factors of production, the most important of which are high-yielding varieties, larger application of mineral fertilizers and improvement of production technology. As the variety is the first production factor, representing the given capacity which is to be exploited, we have been faced with the problem of finding and developing wheat varieties capable of producing high yields and possessing good resistance to rust diseases, as the main challange we are facing in wheat production is the wheat rusts.

Research progress achieved great success in the last two decades

and the breeding work was expanded by introducing a greater diversity of varieties and accordingly a number of new improved varieties resulting from the extensive crossing program have been released periodically and have contributed towards increasing the national average yield which has almost doubled within this period as it rose from 1.8 tons in 1952 to 3.5 tons/ha in 1973.

Crop Rotation

Crop cultivation mostly follows a two or three-year rotation. In the first, a given crop is grown on the same plot every other year, while in the second case, after every two years.

According to the two-year rotation, winter crops (including clover, beans, wheat, barley and flax) take up 50% of the area. They are followed by summer crops, i.e. rice and maize. The other 50% of the area is either cultivated with clover (one cut) or left fallow until cultivated with cotton as a summer crop.

In the three-year rotation, the area is divided into three equal parts. The first is either sown with clover (one cut), or left fallow until cultivated with cotton. The second part is taken up by beans and/or clover. These crops are succeeded by maize and/or rice. The third part is sown with wheat, barley and flax, followed by maize and/or rice. Sorghum is usually replacing rice or maize in Middle Egypt.

Both systems of rotation are applied in Egypt; however, the latter, i.e. the three-year rotation is recommended and is mostly used as it was found to be more remunerative from increased production and soil fertility points of view.

Present Status of Durum Wheat

Durum is popularly known as "Dakar" and has been grown in Egypt for a long time. However until recently, the breeding programs were more active in bread wheat and very little work was being done on durums. The earlier work was concentrated on the selection from local material from which Dakar 49 and Dakar 52 were developed. In spite of their good adaptability they generally lack resistance to lodging and diseases besides being low in yield and of poor quality. Consequently, their cultivation has generally dwindled.

Recently, work on the improvement of durum wheat has been in progress since the 1960's through the continuous help and successful cooperation with CIMMYT, FAO, ALAD, Ford Foundation and other agencies. During this period, a number of screening nurseries, yield nurseries (regional and inter-

national) and segregating materials were supplied for testing under local conditions. A number of persons were trained, particularly for durum improvement, in International and Regional Training Centers at both CIMMYT in Mexico and in Italy.

Yield Tests

Since 1965/66, a number of durum varieties have been tested under Joint FAO/IAEA Uniform Durum Mutant Yield Trials and the International Durum Yield Nurseries (IDYN).

Based on the results of these trials, the outstanding varieties are: Cocorit 71, Jori C-69, Crane "S", Jo "S" x Cr "S", Anhinga "S", Brant "S". FB 55, GVZ 385, Jori "S", Ganso and 21563 - Jo 'S' were selected for further testing last season 1973/74 in macro-plot yield trials at 8 different locations. Also, the 5th IDYN was grown at two locations representing two different types of environment: Bahteem in the Delta and Shandaweel in Upper Egypt.

Summarizing the last season results, the following general conclusions could be drawn.

a — The yield results of the 5th IDYN consisting of 25 varieties are presented (Table 1). The eight top yielding varieties for individual locations are:

BAHTEEM			SHANDAWEEL			MEAN		
Rank	Varieties	Yield kg/ha	Rank	Varieties	Yield kg/ha	Rank	Varieties	Yield kg/ha
1	Chenab 70	6725	1	Brant"S"	5450	1	Chenab 70	5559
2	Cajeme 71	5633	2	Anhinga"S"	5167	2	Brant"S"	5267
3	Cocorit 71	5542	3	Garza	5042	3	Anhinga"S"	5188
4	Jori C-69	5392	4	Cocorit"S"	4717	4	Garza	5171
5	Garza	5300	5	Cajeme 71	4450	5	Cajeme 71	5042
6	Anhinga"S"	5208	6	Cocorit 71	4442	6	Cocorit 71	4992
7	Brant "S"	5083	7	Inrat 69	4400	7	Jori C-69	4805
8	Crane "S"	4858	8	Gab 125	4392	8	Cocorit "S"	4650
				Chenab 70	4392			

It may be noticed that the varieties Brant "S", Anhinga "S", Garza, Cocorit 71 and the bread wheats Chenab 70 and Cajeme 71 are among the highest yield group at both locations and the overall mean, while Jori C-69 held the fourth rank at Bahteem with ayield of 5392 kg/ha.

b — Results of the macro-plot yield trials consisting of 12 varieties (11 durums plus the check bread wheat Chenab 70) are presented (Table 2) for only 6 locations as the yield of the two others conducted at Bahteem and Shandaweel were damaged by birds. The experimental field design was a four-fold replicated randomized block. The experimental plot size was 10.5m^2 (3.0 x 3.5m).

The analysis of variance indicated highly significant differences in yield at various locations. According to the overall means of the different regions, the average yield of the five top yielding varieties in kg/ha could be summarized in a descending order as follows:

DELTA (3 expts)

Rank	Varieties	Yield kg/ha
1	Chenab 70	5048
2	Cocorit 71	4876
3	Brant "S"	4727
4	Jo "S"xCr"S"	4707
5	Ganso	4678

MIDDLE EGYPT (2 expts)

Rank	Varieties	Yield kg/ha
1	Ganso	6700
2	Gvz 385	6618
3	Cocorit 71	6552
4	Brant "S"	6294
5	Crane "S"	6287

UPPER EGYPT (1 expt)

Rank	Varieties	Yield kg/ha
1	Anhinga "S"	4126
2	Ganso	4029
3	Cocorit 71	4002
4	Crane "S"	3998
5	Gvz 385	3917

OVERALL MEAN (6 expts)

Rank	Varieties	Yield kg/ha
1	Cocorit 71	5289
2	Ganso	5244
3	Gvz 385	5165
4	Brant "S"	5084
5	Jo"S"xCr"S"	5066

The results have clearly shown that Cocorit 71, Ganso, Gvz 385, Brant "S" and Jo"S" x Cr "S" occupied the five top positions with their average overall mean yields of 5289, 5244, 5165, 5084 and 5066 kg/ha, respectively. The average yield of Chenab 70 was 4989 kg/ha. In Middle and Upper Egypt, nearly all the tested durum varieties gave better yields as compared with the bread wheat Chenab 70.

Considering individual locations, it may be noted that grain yield at Gemmeiza (in the Delta), Sids and Mallawi (in Middle Egypt) were better for

all varieties as compared to the grain yield at other locations. The location mean yield for all varieties at the three stations are 6740, 6132 and 6177 kg/ha, respectively (Table 2).

Grain Quality Tests

The tested samples were analyzed for test weight, crude protein, carotenoids, wet and dry gluten, milling yield, water absorption and fermentation test. Results are shown in Table 3.

For the pasta industry it is preferred that durum flour should possess higher figures of the first seven tests, and a lower figure of the last test, i.e. the fermentation test.

As shown from the results in Table 3, the different tested varieties can be grouped as follows:

1st group (excellent quality),	included Jori C-69, Gvz 385, Jo"S" x Cr"S", Brant "S", and Ganso
2nd group (medium quality),	included Chenab 70, FB 55, $(By_E^2$-Tc) $(Tac_E$-$Tc^2)$ $(By_E$-$Tc^2)$ and $(By_E^2$-Tc) $(Tac_E$-$Tc^2)$ x AL"S"
3rd group (low quality),	included the rest, i.e. Crane "S", Anhinga "S", and Cocorit 71.

It is interesting to note that the excellent quality group of varieties had also shown higher yields.

Industrial Use of Durum Wheat and Future Outlook

As regards the pasta industry in A.R.E., macaroni is made from imported vulgare flour. To overcome the inferior quality of such flour from the standpoint of pasta industry, some of the factories apply the sous-vide (under vacuum) method in order that the produced macaroni would be of better cooking quality.

Importing semolina or durum flour will be costly for the pasta industry as the price of such a product is almost 150% of that of the bread wheat flour.

Growing durum wheat and consequently milling it locally to obtain the required amount of semolina for the pasta industry may be the solution

for that problem. Milling durum wheat gives the following extraction yields:

60%	Coarse and fine semolina
24%	Dunst or flour
16%	Bran
100%	

With this extraction yield, and according to the annual consumption of 80,000-90,000 tons of pasta, a total of about 50,000 ha of durum wheats has to be grown annually to meet the local flour requirements for the macaroni industry. This can save the country $10.5 million annually.

The result of making available coarse and fine semolina for the pasta industry instead of the currently used imported bread wheat flour will undoubtedly improve the quality of the produced pasta from the standpoints of the industry itself and the cooking quality. Moreover, the flour which will be obtained besides the semolina can be mixed with the bread wheat flour used for European and local bread to improve their quality due to the higher enzymatic activity of durum flour.

Furthermore, the higher price of durum wheat as compared with that of bread wheat can be made use of in the future for exporting the excess durum wheat at a premium to give the chance for importing more bread wheat.

Discussion

Why do you not test local durums in Egypt?

Local durum varieties (formerly grown in Egypt) were extensively studied in the past and were included in International and Regional Durum Yield Trials as local checks. But, in spite of their good adaptability, they were very susceptible to diseases (Bunt, loose smut and stripe and stem rusts) besides their low productivity as compared with bread wheats and the new imported durum varieties. Their quality test (for macaroni industry) was also very poor. For all these reasons, their cultivation has dwindled and has almost completely given way to bread wheat. However, they are included in our crossing blocks and are used in breeding programs.

What techniques do you use for mutations and what mutants have you obtained?

Actually and up to the moment, we do not have any mutation program, and the mutants which were tested under our local conditions in the 1960's were through the joint FAO/IAEA Uniform Durum Yield Trials. Some of these mutants such as GaB 125, Capeiti and FB 55 were comparatively good as far as yield is concerned.

TABLE 1. RESULTS OF THE 5th INTERNATIONAL DURUM YIELD NURSERY (IDYN) CONDUCTED AT BAHTEEM & SHANDAWEEL (EGYPT), 1973/74.

YIELD kg/ha.

Var No.	Varieties	Origin	Bahteem		Shandawell		Mean	
			Rank	Yield	Rank	Yield	Rank	Yield
25	Chenab 70 (local check)		1	6725	8	4392	1	5559
21	Brant"s"	Mexico	7	5083	1	5450	2	5267
20	Anhinga"s"	"	6	5208	2	5167	3	5188
22	Garza	"	5	5300	3	5042	4	5171
19	Cajeme 71(bread)	"	2	5633	5	4450	5	5042
18	Cocorit 71	"	3	5542	6	4442	6	4992
17	Jori C-69	"	4	5392	12	4217	7	4805
13	Cocorit"s"	"	10	4583	4	4717	8	4650
15	Capeiti	Italy	9	4708	10	4300	9	4504
23	Crane"s"	Mexico	8	4858	24	3567	10	4213
24	Gs"s" D27/666	"	13	4258	14	4092	11	4175
6	Rolette	U.S.A.	11	4358	17	3942	12	4150
8	D 6647	"	12	4283	17	3942	13	4113
16	INRAT 69	Tunisia	16	3758	7	4400	14	4079
10	GAB 125	Italy	17	3750	8	4392	15	4071
12	Gerardo 575	"	14	4250	19	3858	16	405[illegible]
9	D 6654	U.S.A.	15	4233	23	3750	17	3992
2	Hercules	Canada	19	3575	13	4167	[illegible]	3871
3	Allfen	Chile	22	3433	11	4225	19	3829
4	Quilafen	Chile	21	3525	15	4083	20	3804
5	Leeds	U.S.A.	20	3533	19	3858	21	3696
14	Tehuacan 60	Mexico	23	3292	16	3992	22	3642
7	Wells	U.S.A.	18	3708	25	3467	23	3588
11	Gerardo 574	Italy	24	3108	22	3825	24	3467
1	Parana 66/270	Argentina	25	2500	21	3850	25	3175
	Location mean			4344		4223		4284
	CV %			17.0		13.0		
	L.S.D. 5%			1210		970		

TABLE 2. RESULTS OF THE DURUM MARCO-PLOT YIELD TRIALS, 1973/74.

YIELD kg/ha (6 locations).

Var. N°	Varieties	Origin	Delta				Middle Egypt			Upper	Overall Mean	
			Nobr.	Sakha	Gem	Mean	Sids	Mall	Mean	Matn.	Rank	kg/
1	Coocrit 71	Mexico	2833	3981	7814	4876	6888	6218	6553	4002	1	528
2	Jori C-69	"	2452	3594	5714	3920	5238	5375	5307	3762	12	435
3	Jo"s" x Cr"s"	"	2690	4320	7112	4707	6498	6020	6259	3755	5	506
4	Crane"s"	"	2214	3806	6864	4295	6429	6144	6287	3998	7	490
5	Anhinga"s"	"	2298	3399	5924	3874	5850	6262	6056	4126	10	464
6	Brant"s"	"	2524	4832	6824	4727	6277	6370	6294	3736	4	508
7	FB 55	Italy	2000	4104	6281	4128	5802	5612	5707	3638	11	457
8	GVZ 385	"	2786	4421	6633	4613	6883	6352	6618	3917	3	516
9	$(BY_E^2-TC)(TAC_E-TC^2)(BY_E-TC^2)$	Mexico	2286	3964	6476	4242	5981	5748	5865	3607	9	467
10	Ganso	"	2381	4510	7143	4678	6620	6780	6700	4029	2	524
11	$(BY_E^2-TC)(TaC_E-TC^2)$ x AL"s"	"	1738	3964	6819	4174	6150	6407	6279	3810	8	48[illegible]
12	Chenab 70	Pakist	3524	4338	7283	5048	5024	6833	5929	2931	6	495
	Location Mean		2477	4103	6740	4440	6132	6177	6154	3776		49[illegible]
	CV %		21.1	13.5	8.2		8.4	7.2		5.4		
	L.S.D. 5 %		752	800	800		733	638		371		
	1 %		1009	1066	1066		990	866		524		

Table 3. GRAIN QUALITY TESTS (mean of 8 locations).

Var No.	Varieties	Test wt. kg/hl	Moisture %	Crude Protein %	Flour Extract %	Carotenoïds	Ferment Test min.	Wet Gluten %	Dry Gluten %	Water Absorption %
1	Cocorit 71	79.5	11.2	10.75	62.3	1.653	36.9	21.08	8.61	147.33
2	Jori"C - 69	81.4	10.9	11.68	60.1	1.935	27.1	22.04	9.02	143.33
3	Jo"s" x Cr"s"	79.3	10.6	11.26	61.0	2.265	33.3	21.28	9.09	131.86
4	Crane"s"	80.7	10.9	11.23	57.4	1.632	26.8	19.97	7.47	139.52
5	Anhinga"s"	81.6	11.2	11.72	59.9	1.541	32.4	20.31	7.94	156.55
6	Brant"s"	79.2	11.2	11.87	60.4	1.634	25.9	22.62	8.59	154.59
7	FB 55	81.8	10.8	10.79	60.8	1.898	38.3	22.79	9.31	154.53
8	GVZ 385	78.5	11.0	11.11	62.3	2.807	29.8	20.58	8.19	157.09
9	(BY_E^2-TC) $(BY_E-TC)^2$	81.4	11.0	11.58	56.0	2.291	28.1	18.05	7.05	155.75
10	Ganso	81.0	11.0	11.36	58.5	2.572	37.4	20.89	8.18	158.74
11	(BY_E^2-TC)xAL "s"	80.9	10.8	11.92	59.3	2.043	29.4	17.72	7.02	152.37
12	Chenab 70	81.1	11.3	10.52	66.2	2.330	48.3	23.94	9.18	162.47

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THE SEED INDUSTRY IN EGYPT

A. Y. El Gamal

1. In 1958, the general policy for agricultural development established by the Government included a comprehensive plan for producing sufficient seed quantities on high yielding varieties of the main field crops to replace the old low yielding ones.

The steps followed in carrying out this national vigorous program of seed production were based on a highly advanced technical system.

Plant breeders of the research institutes supervise the production of basic seed (Elite, breeder and foundation seeds) in the Agricultural Experiment Stations. Production of certified seeds is carried out by the Seed Department (Ministry of Agriculture) through contracts with seed growers.

The objective of this policy is to provide a continuous supply of suitable varieties to renew cotton seed annually, and once every two or three years for the other major field crop seeds (wheat, rice, onion, corn and legumes).

a) Field crop seed represents 90% of total area and is the responsibility of the seed Department.

b) Horticultural seed represents 10% of the total area and is the responsibility of the Horticulture Research Institute and the Egyptian Agricultura Organization.

2. The Government provides seed industry with:

a) All its requirements of the highly trained technical staff, laboratories and storage.

b) Sufficient funds to pay the adequate premium to encourage seed growers to deliver seed with high purity and good quality. At the same time, the Government provides sufficient subsidies to reduce the sale price to the level the farmers can afford. In addition, farm-

ers can buy the seeds on credit through their co-operatives.

The whole work of the seed industry is carried out by the Ministry of Agriculture with the exception of a very small portion of horticulture seed trade which is carried out by the private sector.

3. The early steps in seed production which involve the development of new and more advance varieties are undertaken by plant breeders of the research institutes.

The above work is being conducted in the Agricultural Experiment Stations located all over the country where facilities are provided. In developing these new varieties, important objectives are considered such as: Increasing yield, breeding for disease and insect resistance, early maturity and improving crop quality. Evaluation of the agro-economic values of new varieties is practiced in comparison with checks for several years and locations. Following evaluation, larger areas are planted by the growers with the assistance of the extension service personnel and varieties with the best performance are widely increased.

4. Steps for seed increase of the new varieties are conducted as follows:

a) Research Institutes take care of basic seed increase areas in the Ministry of Agriculture Experiment Stations and farms.

b) Seed Department is responsible for seed propagation through contracts in the fields of selected seed growers and cooperatives.

5. One major objective in seed propagation is to cover the area devoted to each crop within a given time programme.

6. As Egypt produces a large portion of the world production of long staple cotton (the major crop of Egypt), for the maintenance of its varietal purity, the following well planned system has been put fully in practice since 1958:

a) Varietal zoning and allocation of one type only to each district.

b) The systematic destruction in the field of plants

which are not true to type. This is done through the rouging process which is carried out yearly since 1954 under the supervision of the seed Department. Rouging is practiced to get rid of all the off-type plants, especially Hindi and Hybrid Hindi. Yearly, this process covers all the acreages under contract for each variety from which seed will be allocated for sowing in the next year.

c) The exclusive use of a ginning factory for each variety. Maintaining the varietal purity of cotton seed depends largely on the supervision and precautions taken during the ginning process. The system of prohibiting more than one variety to be ginned in one gin has been applied since 1959. Also, seed cotton (under contract) has the priority in the ginning process which has to be completed before December 31st of every year to get full use of the best selected quality seed and to provide seed quantities required for sowing early. The efficiency of this system in avoiding seed mixing is quite clear.

7. As for the other cereal crops, we also pay much attention to producing good quality seed with high physical purity. Annually, seed saved for sowing of the two main cereal crops (45.000 tons of wheat, and 36.000 tons of rice) have to pass through an accurate cleaning process before utilization. This process is carried out in large centralized cleaning stations located all over the country which eliminate weed seeds and all inerts. To prevent seed mixing each cleaning station is devoted to only one variety. Farmers are only charged with one forth of seed cleaning costs and the government subsidizes the 3/4. Cleaning costs (as these stations are state property) are determined on the mere actual costs, with no profit at all. In addition, the seeds must initially meet the legal established standards of certification which involve varietal purity, germination, physical purity, and freedom from diseases and insects in order to be accepted and utilized.

8. Legislation and adequate regulations organize all the steps and procedures of seed industry in A.R.E. as follows:

a) Registration and testing of a new variety.

b) Seed production (varietal purity control and field inspection).

c) Processing (concerning ginning in case of cotton and cleaning in case of other field crops);

d) Laboratory testing (concerning purity, cleanliness, germination, and seed born diseases).

e) Certification.

f) Marketing (distribution, handling, importing, exporting and seed trade).

All the above mentioned steps are organized by laws - some of which concern the seeds of other crops. The laws include all the above mentioned stages through which the seed pass. The certification regulations, methods and standards are based on international schemes (ISTA)1/.

g) Effective plant quarantine measures are strictly implemented to avoid the dissemination of harmful seed-born disease and pests and to stimulate international seed movement and exchange.

9. There is a well planned system for certified seed distribution under the supervision of the Seed Department as follows:

a) The large quantities of seeds produced annually of each crop and each variety are classified by various standards (according to purity and strain records). The better the seed grower, the higher the seed quality rating he receives.

b) The rest of the acreages are provided with the second quality standards of certified seed.

c) Each variety is distributed where it performs best. This varietal zoning is very important in increasing yield and achieves the maintenance of varietal purity.

d) When releasing a new improved variety a seed extension campaign takes place in the locations chosen for promotion of this variety. The variety shows better performance than the old ones and the reaction is prompt.

e) To encourage seed utilization, the distribution plan includes these facilities:

1/ International Seed Testing Association

- Through the government subsidy, sale prices are very appropriate.
- Possibility of purchasing these seeds on credits.
- Availability of seed delivery to the cooperative store nearest to the farm.

As a result of all these facilities for seed distribution, farmers prefer to utilize the seed produced under the improved seed scheme rather than saving seed from their crop.

Seed prices are fixed annually by the government according to a planned policy aiming to encourage all farmers to use such seeds. This implements the seed program which is designed to cover total acreage by certified seed annually, or once every two to three years.

10. Finally, one can see that during the last twenty years the seed industry in Egypt has accomplished much progress and almost approached the same level as that of the most advanced countries in modern agriculture. However, we are looking forward to more progress in this important field. Raising the varietal purity of our major crops to its maximum levels is one of our main objectives in this respect. This can be attained by accelerating seed multiplication rates. One way of implementing this, is to promote the utilization of planters. These planters will reduce seeding rates by not less than one half, and subsequently basic seed acreages will be doubled. This doubling will shorten the number of years required for seed circulation and renewal from the time it is released from the breeder till it reaches the hands of all farmers in the country. Undoubtedly, beside saving the costs of production, this will contribute much to raising the yield and quality of all field crops.

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DURUM WHEAT PRODUCTION AND RESEARCH IN ETHIOPIA

G. Gebeyehou

General Consideration

Wheat Triticum spp. is one of the major cereals grown in Ethiopia. It is an annual grain crop indigenous to Ethiopia. It is a staple food crop but is less important than "Tef" or barley. The demand for wheat as a staple food grain is increasing, especially in the urban population. The utilization of either durum or breadwheat in the near future will be high even in rural societies. The total production of wheat in 1971 was estimated as 839,500 metric tons and in 1974 production has been estimated as 927,042 metric tons with average yields of 0.74 ton/ha and 0.80 ton/ha respectively. Total cultivated wheat area rose from 1,091,600 hectares (1971) to 1,158,802 hectares (1974). Total durum wheat area was estimated as 90% and the rest (10%) was under breadwheat production. Total durum wheat production increased from 657,708 metric tons (1971) to 834,338 metric tons in 1974.

The durum wheats grown in Ethiopia are a mixture of tetraploids suitable for unleavened bread (5%), "Ingera"(60%) and pasta products (35%). A large variety of species and types occur in the countryside. The species of durum wheats grown are mentioned below:

1. Triticum durum - This is mainly grown at the high altitudes, up to a maximum of 2800 m, but also throughout the main wheat growing areas between 1750 m and 2800 m. Different ecotypes predominate at different levels.

2. Triticum dicoccum - This is mainly grown in the warmer, drier parts of the wheat growing areas.

3. Triticum turgidum, T. polonicum and T. dicocoides are also grown in small quantities.

Limiting Factors

Climate

Durum wheat area in the highlands is restricted to between 6° and 15° North and 37° and 42° East from 1500 to 2800 m altitude and grown under

rainfed conditions. In most durum wheat growing areas low rainfall is unlikely to be a limiting factor, notably at above 1700 m. At higher altitudes it is principally affected through the indirect effects of greater diseases incidence, lodging in heavy rain, and the difficulty of weeding and cultivating in wet conditions. The total annual rainfall ranges between 400-1000 mm with an average of 750 mm. Most of the rainfall occurs between June and September and the peak fall comes in July and August.

Durum wheat is not found at the highest cultivated levels above 2800 m, where sharp night frost are frequent. In the main durum wheat growing regions, however, critically low temperatures are seldom encountered.

The absolute maximum and minimum temperatures range from 25° C to 30° C and 3° to 8° C respectively. Temperature does not directly limit the growing of durum wheat except above 2800 m. The main secondary effects of temperature are in the variation of maturation period that results. The dessicating winds in October and November cause premature drying of ears in some areas.

Durum wheat is generally sown from July to August, progressing to mid-September in some areas, and harvested from late December to February.

Soil

The topography is a mountainous mass. Soil erosion is a typical problem in the highlands with a loss of about 40-60% of soil annually. This is attributed to the heavy rainfall in July and August.

The soils are variable. They are mostly red ferrisol on the slopes and deeper, black, brown clays in the valley. These soils easily crack on drying. During the rainy season, they quickly become waterlogged, which makes the use of machinery difficult except the use of bullock power. This delays the sowing time and as the result, a tremendous reduction in yield.

Diseases

Durum wheat in Ethiopia suffers from several important fungus diseases, notably the three rusts; leaf blotch and glume blotch also cause considerable damage. Bunt, or stinking smut, causes considerable damage above 2400 m altitude. Several of these diseases are associated with or worsened by particular climatic conditions as outlined below:

1. Stem rust is the most important of the durum wheat rusts. It causes such losses that the resulting crop is not worth harvesting. Damage is generally more severe below 2300 m but some stem rust is also found at

higher altitudes.

2. Leaf rust is more important of the two severe rusts diseases of durum wheat below 2400 m.

3. Stripe rust is also important of the three rust diseases of durum wheat at altitude above 2100 m. The factor responsible for severe incidence of this disease at higher altitudes would thus seem to be low temperature rather than the higher rainfall normally associated with higher altitudes.

4. Glume blotch and leaf blotch are diseases with varying severity. Leaf blotch is more severe, at times almost defoliating the plant. Climatic conditions, the clay type soil, and waterlogging as well as low light intensity during the months of July and August favor the epidemics of leaf blotch which decreases yields as much as 90% in susceptible genotypes. Glume blotch is relatively unimportant.

5. Other fungal diseases: Bunt, loose smut, Root rot, Fusarium, Mildew, Alternaria, and Helminthosporium are likely less important.

Breeding Research

Over 400 genotypes of durum wheat were grown. About three-fourths was homozygous material including a wide range of genetic material. The durum wheat program actively collaborates with the CIMMYT and FAO/ALAD programs.

Varietal Evaluation in National Trials

In 1974/75, two yield trials were conducted at seven national locations. There were 25 genotypes involved. Of the durum wheats tested for the second year, Cocorit "S" (D-27617-9M-5Y-5M), Ld357E-Tc^2/AA "S" D-27534-3M-2Y-3M-0Y, Cisne "S" (D-27617-9M-5Y-5M) and INRAT 69 were most promising compared with the local check (Ashanan) with average yields of 3866, 3508, 3485, 3026, and 2588 kg/ha respectively. INRAT 69 is in small scale multiplication and will be tested on a wider scale. Genotypes of Mexican origin have excellent yield potential, but, unfortunately, many lack adequate disease resistance and have a long reproductive cycle which reduces drought tolerance/resistance compared with the local types. They are useful mostly as parents in the crossing program to improve the local genotypes.

The plant pathology section is adding strong support to the durum wheat improvement work. Durum wheat breeding was started in the 1973/74 season and the durum program is now being rapidly expanded. Most breeding

work is conducted at Holetta and Debre Zeit research stations. Last season (1974/75) over 300 crosses were made.

The crop season in Ethiopia usually has a dry period in the latter part, genotypes with a long vegetative, short reproductive cycle or ones with long duration and high drought tolerance and dessication tolerance can be expected to perfrom well.

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DURUM WHEAT IN JORDAN

J. Ghosheh

Introduction

Jordan is an Agricultural Country where agriculture is considered the main source of national economy. Furthermore, about 30% of the national income is based on agriculture.

Geographically, Jordan lies between latitude 29:33N and longitude 35:39E. The weather in general is mild, cold during the winter season in which rain falls for about four months (November to early April), while the summer season is hot and dry and lasts about 8 months. Climatogially, Jordan could be divided into four regions as follows:

Region	Rainfall mm.	Winter temp. C. average	Summer temp. C. average
1 - Western Coastal Plains	400-600	5	34
2 - The high land region	400-700	2	30
3 - The Jordan Valley	50-350	8-10	40
4 - The eastern desert region	0-100	2-5	39

Jordan has an area of 96,000Km^2 and only about 10,000 Km^2 is cultivable land. Moreover, most of the cultivated land (93%) is farmed under rainfed conditions.

Wheat has always been the most important crop in Jordan in terms of both acreage and total gross value and this is due to its adaptation to dry farming. Wheat will continue to be the most important crop in terms of both area and domestic needs.

Jordan's average wheat yield of approximately 700 kg/ha is among the lowest in the world. Scarce and erratic rainfall is considered to be

the principal limiting factor. Furthermore, traditional methods of farming also contribute to the low yield.

Area Production and Average Yield

Wheat is the main cereal crop in Jordan and occupies one third of the total cultivated land. Wheat is grown in areas receiving an average rainfall which ranges between 200 and 500mm. In addition, there are some areas sown to wheat under irrigation in the Jordan Valley but on a small scale, about 2 - 5% of the total area. Durum wheat is the dominant wheat grown in Jordan (95%). The bread wheat is located mainly in the Jordan Valley.

The area which is sown to wheat varies from year to year (table 1) depending on the amount of rain during November and December. Production of wheat fluctuates considerably depending on the amount of rain (whole season) and the distribution of rainfall. The average area planted to wheat during the period 1967 - 1973 was about 200,000 ha and the average production was about 140,000 metric tons for the same period. On the other hand, the total consumption is estimated at 300,000 metric tons, where annual wheat consumption per capita is estimated at 140 Kgs. and is mainly used for bread.

Table 1. Area, production and average wheat yield for the period 1967/74

Year	Area/ha	Production Tons	Av. kg/ha.
1967	225.980	196.100	9867
1968	218.430	095.100	0435
1969	188.960	216.184	1144
1970	222.840	054.100	0240
1971	239.304	162.755	0700
1972	223.670	211.400	0945
1973	244.180	050.400	0444
1974	210.000	180.000	0857

All wheat grown in Jordan is the spring type, and normally is sown during November and December;however, in some cases wheat could be

planted in January. June is considered the harvesting month and most of the wheat is harvested during this month, depending on the availability of combines and laborers.

Durum Diseases

Most of our wheat is grown under rainfed condition. Because of this situation diseases are not a serious problem in Jordan. In general, black stem rust is noticed in some years coupled with late rainfall in late April and early May. The bunt disease Tilletia foetida still causes some losses to wheat growers in Jordan, but on a very small scale. Most of the farmers now are treating their wheat seeds with fungicides to protect their fields from this disease.

Durum Wheat Varieties

Horani Nawawi and Fa 8 are the main durum wheat varieties grown in Jordan and occupy about 80% of the total area. Both Horani Nawawi and Fa 8 were introduced from the neighbouring countries. Some farmers still use some local varieties but this is on a small scale about 15% of the total area.

Deir Alla 2, a new line selected from the cross 1110/T x Horani 21, is now under seed multiplication. About 40 wheat demonstrations in farmer's fields were planted with this variety this year, 1975.

Breeding Work

The main objective of the breeding program is to develop new wheat varieties taking into consideration the following characters:

1 - High yielding capacity.

2 - Early maturing varieties.

3 - Drought resistant.

4 - Medium Tall.

5 - Resistant to disease, mainly stem and leaf rust.

The varietal improvement program involves a large number of experimental trials all over Jordan. The research work includes varietal trials, crossing, selection, disease nurseries, cultural practices and fertilizer trials.

Quantity of Certified Seeds Produced and Distributed

A seed production and distribution program has been under way for the last few years, but on a small scale. Seed multiplication is carried out on government stations to produce registered seeds which are given to the agricultural cooperative societies and some progressive farmers for production of seeds. About 1000 tons of certified seed is produced and distributed to farmers every year. However, according to the recommendations of the wheat committee (1) the Ministry of Agriculture is going to produce about 500 tons of registered seed which will be given to agricultural cooperative societies in order to produce enough certified seed for 1/4 of the total wheat area.

Weeds and Weed Control

Weeds are considered the second problem facing wheat growers in Jordan where moisture is the major limiting factor in dryland area. Therefore, the elimination of these competitors will certainly increase yields and production.

A few weed control trials were carried out on wheat in the government stations in the dryland regions and under irrigated conditions. Furthermore, many weed control demonstrations were carried out in farmers' fields and all showed that wheat yields were increased. Also, observation trials indicated that weeds had lowered wheat yield 10 to 20% or more, depending upon weed populations in the field.

Studies have shown that the major weeds observed in the wheat fields are the following:

Scientific name	Common name
1 - Brassica kaber	Mustard
2 - Sinapis arvensis	Wild Mustard
3 - Girsium syriacum	Syrian Thistle
4 - Malva spp	Cheese Weed
5 - Avena sterilis	Wild Oats
6 - Centauria spp.	Star Thistle
7 - Lactuca seriola	Prickly Lettuce
8 - Ammi majus	Bishop's Weed

Tillage Operations

Wheat is grown in three different regions: (1) irrigated, (2) dry farming cropped every year with a two or three year rotation, 300 - 400 mm of rain and (3) dry farming with one fallow year, 250 - 300 mm of rain.

(1) Developing of wheat production in Jordan, working paper, March, 1974.

Normally, in the first and second regions two tillage operations are practiced for seed bed preparation. With summer fallow more operations are performed. These are mainly during the summer to get rid of weeds and cracks in the soil surface in order to keep moisture in the soil to be used the next year. Types of equipment used are disc, chisel, sweep plow, spike tooth or disc harrow, and rod weeder.

Herbicides Uses

Herbicides have been used in Jordan for the last few years, but on a small scale not exceeding 5 - 8% of the total wheat area, while about 20 - 25% is hand weeded.

Mainly 2-4-D compounds are the most common herbicides used in controlling weeds in wheat fields. Some studies showed that some other compounds could be used such as bromoxynil, MCPA, and dicamba.

Research and Extension Activities

Most of the work carried out is devoted to applied research and extension. Several trials on tillage practices and weed control were carried out in the government stations and in the farmer's fields this year. Strengthening of facilities, funds and staff members are needed.

The Ministry of Agriculture is participating in the weed control program but on a limited scale, mainly as extension work on field demonstrations; furthermore, in some cases field weed control equipment is offered free to wheat growers to be used in their fields.

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DURUM WHEAT IMPROVEMENT IN MOROCCO

M. Bouchoutrouch

and

M. Tourkmani

The agricultural orientation of the Moroccan Government gives priority to the development of cereal production in order to insure wheat self-sufficiency of our country. Indeed, cereals absorb 1/3 of the family food expenses while sugar and fats together absorb only 1/5 of it (1). After barley, durum wheat is the most cultivated crop in Morocco. It occupies an annual average acreage of 1,5 million Ha. which is three times larger than the acreage sown to bread wheat.

For the last six years, the average national production was 1,5 million metric tons within a range of 2,1 million tons in 1968 to 1,2 million tons in 1969. These important variations are mainly due to the irregular climatic conditions.

Our needs in durum wheat continue to increase in proportion to the population increase.

The average national yield is still low, about one metric ton per hectare, mainly due to the irregularity of the rainfall and to the use of unsuitable agricultural practices. On the other hand, if technical practices are improved by better soil preparation, good fertilization and good weed control, and if the rainfall is adequate and well distributed the local varieties lodge.

It is thus obvious that the efforts made for the improvement of the plants must be oriented towards creation of new varieties resistant to lodging in the event that nitrogen is applied.

The Agronomic Research Department has established the durum breeding program with the objective of creating varieties having good response to high rates of nitrogen, and resistant to rusts, Septoria, powdery

(1) Inaugural address given by the Minister of Agriculture and Agrarian Reform on the occasion of the Seminar devoted to Cereal Production.

mildew and Hessian fly. The new types must also have abundant tillering and highly fertile spikes.

This program has provided interesting results and a variety (number 52/71) is undergoing seed increase. This variety named "Hadj Mouline" is very productive, dwarf, highly fertile, tolerant to leaf rust and stem rust but is susceptible to Septoria. Though the fertility of the spike is high, kernel size is small.

The next step in our breeding program is the improvement of the seed size and the incorporation of genes confering resistance to Septoria.

The cooperation of CIMMYT and the Moroccan Agronomic Research Department concerning durum wheat resulted in the release of Cocorit which is resistant to lodging, tolerant to rusts, but susceptible to Septoria. However, this variety has the advantage of having large kernel size.

During this season (1974-75) the varieties "Hadj Mouline" and "Cocorit" are being seed increased in G3 in the experimental stations of the Agronomic Research Department on respective acreages of 170 and 17 hectares. Next year (1975-76) their seeds will be distributed to the seed multipliers in order to produce the first generation of certified seed. During the 1977-78 season, the distribution of the second generation of certified seed will permit the cultivation of durum for consumption on about 80,000 to 100,000 ha.

We are convinced and confident that durum wheat has an important future in Morocco. The first step has been taken and this is the beginning of a new period for the cereal production of our country.

Original: French

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WHEAT IMPROVEMENT IN THE PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Saeed A. S. Ba-Angoo

Wheat cultivation in PDRY is restricted to certain areas due to climatic conditions. The area under cultivation is estimated at 10,000 hectares. Primarily aestivums are grown. Durums have restricted distribution and are grown as mixtures with aestivums. Local cultivars are highly susceptible to lodging and rust attack. The government introduced two semi-dwarf varieties from India namely, Kalyansona and Sonalika in 1973. These are much superior to the local ones. They give an average of 2.85 tons/ha compared to 1.5 tons/ha given by the local ones, and in addition they show conspicuous superiority over locals in lodging resistance, grain size, colour and hardness. During 1974-75 about 1800 hectares have been covered with these varieties and 3500 hectares will be covered in 1975-76. By the end of the current Five Year Plan (1978-1979), 10,000 hectares have to be covered; this makes a total of approximately 80 percent of the total proposed area under wheat. Special seed production and processing units are intended to be established.

Aphids, termites and a curculionid species are the major pests attacking the local as well as the introduced varieties. Stripe rust, leaf rust, and stem rust are usually the main diseases of the local varieties. The introduced ones remain free so far. Cyperus rotundus and Brassica spp. are the major weeds encountered in wheat fields.

INTRODUCTION

The Peoples Democratic Republic of Yemen is located in the South-Western part of the Arabian Peninsula between 12°N and 19°N latitude. It occupies an area of about 290,000 km^2 of which about 0.3 percent is under cultivation. Population according to 1973 census is estimated at 1.6 million with an annual growth rate of 2.7 percent; 80 percent of the population is engaged in agriculture.

In the second development plan for the period 1974-75 to 1978-79, priority has been given to agriculture. The plan envisages 54 percent increase

in over all agricultural production, and 47.5 percent in cereal production.

Wheat cultivation and use

Wheat cultivation is restricted to certain parts of the country due to climatic factors. Soils usually range from sandy to silty clay to loams in these areas and mean minimum temperature in December and January is around 10°C, while the maximum reaches 29°C. Wheat is usually planted in October and November and harvested in February and March. All wheat is grown under ground water irrigation and the usual number of irrigations ranges from 6 to 8.

Area under cultivation is estimated at 10,000 hectares and the domestic production is insufficient to meet the country's requirements; accordingly, large quantities are imported annually. Aestivum is the predominant species. Durum is grown in small areas mixed with bread wheat. All wheat is consumed either as home made bread or as bakery products.

Wheat improvement

Several local varieties are grown (Halba, Maisani, Baftim, etc., etc.) which differ in maturity ranges and the average yield is around 1.5 tons/ha. All the local varieties suffer from severe lodging, rust incidence and aphid infestations.

Experiments on introduction of semi-dwarf types were conducted in 1971-72 with the materials received from the Regional Cereal Improvement Project. The results indicated the possibility of useful introduction of some of these types in the country. In 1973, 13 tons of seeds of two semi-dwarf types, Kalyansona and Sonalika, were imported from India, and were grown in the same year for large scale testing as well as for further seed multiplication. Data on performance of these varieties is given below:

Performance of Kalyansona and Sonalika Wheat varieties in PDRY in 1973-1974

Region	Variety	Total area sown in hectares	Total yield in tons	Average yield per ha in tons	No. of samples taken	Calculating yield tons/ha based on samples (10m x 10m)
Wadi Hadramout (5th Gov.)	Kalyansona	50.2	123.9	2.47	6	3.95
Nissab	Sonalika	12.4	50.3	4.05	5	6.55
Modia	Kalyansona	4.0	15.6	3.96	4	5.52
Overall average		-	-	2.85	-	5.05

Noteworthy points regarding the performance of these varieties are: first, the crop was grown under a wide variety of soils and climatic conditions and an overall yield of 2.85 tons/ha was realized compared to the 1.5 tons/ha usually obtained with local varieties Data from samples indicated these varieties have substantially high potentialities.

Second, these varieties showed conspicuous superiority over locals in lodging resistance, grain size, colour and hardness. During 1974-75 cultivation of these varieties has been extended to over 1800 hectares.

Further experiments on the effect of seed rate, irrigation regimes, and other cultural practices on yield are in progress.

Preliminary experiments to test 93 durum species have also been inititated.

Pests, diseases and weeds

In this country, the incidence of all the three rusts, stripe rust, stem rust and leaf rust, have been noticed. The extent of damage depends on climatic conditions, which vary from one season to another. All local varieties were found to be susceptible to these diseases while Kalyansona and Sonalika remained free so far. No other disease has been reported on these varieties.

Aphids, together with termites and other corulinonid species, are the major pests encountered. Among these, aphids are the most serious. The extent of damage caused by aphids depends on the prevailing temperatures during wheat growing season. Higher temperatures lead to early and heavy infestation. In 1974-75 this pest was found to attack local as well as introduced varieties and was successfully controlled by using Dimethoate (Roger 40) insecticide. Termites and the curculionid species are controlled by Dieldrin 50 being put with irrigation water.

Cyperus rotundus L. and other Graminae and Brassicae species are the major weeds encountered in the area.

Seed Production

The government attaches high priority to production of seeds of the introduced varieties. In 1973-74, about 190 tons of seeds of these varieties were produced. During the current year, seeds are being multiplied on 180 ha to cover about 3500 hectares in 1975-76. By the end of the country five-year plan (1978-79) it is anticipated that there will be 10,000 hectares under these varieties which amounts to approximately 80 percent of the total projected area under wheat. Special seed production and seed processing units are intended to be established.

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WHEAT PRODUCTION IN THE KINGDOM OF SAUDI ARABIA

Anonymous

Durum Wheats are of major importance in Saudi Arabia. Accurate figures are not available but estimates made by experienced workers indicate that at least 50% of the total wheat area is planted to Durum varieties. This means that approximately 30,000 hectares out of a total wheat cultivation area of 60,000 hectares is durum wheat. The yield of durum is often slightly less than for bread wheats which means that somewhat less than half the total wheat produced is durum. Estimates are that approximately 40,000 tons of durum are produced compared to 50,000 tons of bread wheat.

The total requirement of durum wheat is really unknown but is normally limited to the annual production. That is, very little durum wheat is imported so the amount consumed is equal to that produced. How much would be consumed with unlimited supplies is not known.

It is felt that the future requirement of durum may decrease but this depends upon a number of factors. At present the main use of durum wheat is in traditional cooking. A number of dishes using cracked durum wheat as a base are widely used, especially by rural people. This use of durum is decreasing because this type of cooking is becoming less popular. However, if wheat mills and factories for producing macroni, noodles and other pastes were built in Saudi Arabia the demand for locally produced durum wheat would probably increase.

As with all wheat in the Kingdom, about 80% of the average total production is under controlled irrigation. The only extensive rainfed wheat production is in the west and south west parts of the Kingdom in the mountains of Asir and Hejaz. In the major wheat growing region of Central Saudi Arabia wheat is grown with semi-modern practices. Tractors are used for plowing and seed bed preparation and combines or other threshers are used to thress the grain. Planting is still usually performed by hand broadcasting but is often covered with tractor drawn implements. Harvest of wheat is largely by traditional hand cutting and threshing is usually by machines. In the outlying and more remote areas of the Kingdom, particularly the mountainous regions where rainfed farming is practiced, the wheat is almost exclusively produced by traditional methods.

Research trials have indicated that the most suitable planting date is from November 15 to December 15. Planting earlier than this results in

slightly less yield and also requires one or two more irrigations. Plantings made on November 1 often result in plants being too large during the cold season and poor tillering results. Planting too late also results in poor tillering and often hot weather comes before the plant is fully developed and maturity is speeded up without proper head and kernel development.

Harvest by hand often starts in the last part of April and lasts for approximately one month. Harvest by machine must be delayed to at least May 1 because the grain must be fully, ripe. Machine harvest presents some problems because nearly all the wheat is ready to harvest at the same time and if harvest is delayed very long after maturing the grains will shatter if wind or rain occurs. This is a more serious problem with new varieties such as Super X and Jori than the local varieties.

At present no wide-spread distribution of improved Durum varieties has occured. Jori and Cocoritt 71 are both included in the seed multiplication program being implemented in the Kingdom. About 16 tons of basic seed of Jori will be produced from 40 donums of land this harvest season. This seed will be distributed to a limited number of farmers next season and further increased as certified seed for distribution the following year. Breeders seed of both Jori and Cocoritt 71, about 100 kg each, will be maintained by the Ministry of Agriculture and Water at the Dirab Research Station.

Jori was chosen for release first over Cocoritt 71 because of its excellent seed quality and near identical appearance of the plant and grain to the local durum wheat. A number of local durums are grown but their pedigree is not known. The most common variety is known as Lokaimy. Other varieties identified with different names may actually be identical. At the same time the variety known by the name Lokaimy may actually be a different variety in different locations.

Most of the local durums as well as local bread wheats are highly susceptible to most common wheat diseases. The more severe outbreaks of wheat disease occur in the rainfed region in west and southwest Saudi Arabia. Here some crop loss or yield reduction occurs nearly every year due to stem rust and also to smut. Fortunately, in the major wheat growing region of Central Saudi Arabia the disease problem is less severe and losses are very infrequent although some rust is observed quite often in the late part of the season.

Weed control in wheat is still in the research phase with very few if any farmers practicing weed control other than limited removal of weeds by hand. Losses by weeds are generally not serious although some loss occurs every year. The more serious weed infestations occur when wheat is grown after wheat in two successive years. The most serious weed species are Lolium temulentum and Malva parviflora. Research trials using the chemicals Banvel-K and Dicuron are showing good promise in controlling these weeds

but actual recommendations to farmers are not being made as yet.

The usual practice in wheat production is to till the soil 1 or 2 times before planting, plant in dry soil and irrigate for germination. This usually allows the wheat to emerge and get a head start on weeds. If the stand of wheat is good and growing conditions are good, the weeds are eliminated by competition. There is usually no tillage operations during the growing season except for hand weeding around the edges of fields and along irrigation canals.

As far as crop rotations are concerned the usual practice is for wheat to follow 1 or 2 seasons of fallow or wheat following crops such as vegetables or watermellons. There are some possibilities of double cropping with sorghum and summer vegetables but this is not widely practiced.

The possibilities of rotation with annual legumes has not been examined in depth but the chance of success in a purely irrigated type of farming is less than with the rainfed agriculture in North Africa.

The following summary from the 1973-74 Annual Report gives further information on wheat and barley plant improvement and cultural practices.

KINGDOM OF SAUDI ARABIA
MINISTRY OF AGRICULTURE AND WATER
RESEARCH AND DEVELOPMENT DEPARTMENT
PLANT PRODUCTION DIVISION

WHEAT AND BARLEY, VARIETIES EVALUATION, DEVELOPING AND AGRONOMIC TRIALS

SUMMARY

This report, on wheat and barley trials in 1973/1974 in Saudi Arabia, is in two parts. Part I deals with "EVALUATION AND DEVELOPING OF VARIETIES/LINES". Part II includes "AGRONOMIC TRIALS".

Part I. Evaluation and Developing of Varieties/Lines

Objective

The main objective of this work is to discover varieties that perform better than those now considered the best in Saudi Arabia namely Super X (bread wheat) and Lokaimy (durum wheat).

A. Varieties Evaluation

1. Fifth Regional Wheat Varieties/Lines Yield Trial (5^{th}RWYT)

This trial included 24 foreign varieties/lines and the local variety Hinta Medaini. All varieties out yielded Hinta Medaini in irrigated land at Dirab. The variety Super X was not included in this trial. Top yielders were: Azz, Barouk, Mexipak 65, 36896-Cj 54^2 x Yt54A(H), and Dakar 49 x Ciano 'S'-Pj 62.

2. Yield Trial with 25 Bread Wheat Varieties/Lines

The variety Super X (6.38 ton/ha) ranked 10 but not statistically lower in grain yield as compared with the 9 top entries. The variety Hinta Medaini (4.45 ton/ha) was the lowest yielder. The top yielders were: Pi 62 x Y 54-

Gb55, Mida-N(ThK117A x 8156^2), Tanori 71, Line 1571/4762, 12300 x LR64A -8156/Nor 67 = Jupateco 73, Pfn'S' x Ofn'S' - 4160 x Yt54E

3. Yield Trials with Few Promising Bread Wheat Varieties

These trials included varieties Super X and Hinta Medaini. They were at three locations namely, ElKharj, Uneizah and Eltaif.

Variety Super X was either the best or one of the best varieties with no statistically significant or even practically appreciable difference in favour of the top variety.

4. Yield Trials with 15 Durum Wheat Varieties/Lines

This trial included 14 foreign varieties/lines and the local variety Lokaimy. Twelve entries outyielded Lokaimy (4.18 ton/ha). Only two entries with average grain yields 5.41 and 5.18 ton/ha were significantly larger than the average grain yield of the variety Lokaimy, Flamingo (D27582 - 8M - 12Y - 5M-0Y) and Gaviota (D31725-3M-13Y-0M).

5. Yield Trials with Few Promising Durum Wheat Varieties

These trials included the local variety Lokaimy and were performed at ElKharj, Uneizah and Eltaif.

The local variety Lokaimy was at the top of the list at Uneizah without being significantly different from the rest of the varieties. It was however, the lowest yielder at ElKharj and Eltaif with differences being highly significant or significant in favour of other varieties.

B. Varieties Development

1. Third Preliminary Observation Nursery

In this nursery 68, 49 and 52 entires of bread wheat, durum and barley respectively, were studied in irrigated land at Dirab and 32 bread wheat entries were observed under rainfed conditions at Souda in Aseer.

2. Fields for Developing Wheat Varieties/Lines

a) Selection of Disease Resistant Lines Under Natural Conditions

Sixty one entries were studied at Abha and Eltaif.

b) Purifiaction of Some Local Strains

Twenty five local strains were grown at Dirab and offtypes were

removed from each strain.

c) Hybridization

Five crosses with the local bread wheat variety Hinta Medaini are under study and likewise four crosses with the local durum variety Lokaimy.

d) Seed Multiplication of Sompe Promising Varieties

Eight varieties (bread and durum) were multiplied to increase their seed for further testing.

Part II. Agronomic Trials

Objective

A. Fertilizer Rates

Trials were carried out with various rates of nitrogen at Dirab, Uneizah and ElKharj using the bread wheat variety Super X and the durum variety Cocorit 71. Levels of (N) ranged from 0.0 to 180.0 Kg N/ha. Phosphate was kept at 75 Kg P_2O_5/ha except in the control treatment where no fertilizer was applied.

Results showed that 120 Kg N/ha split into two equal doses (at sowing and one month later) proved best in presence of 75 Kg P_2O_5/ha in one dose at sowing. This treatment was recommended by the Ministry of Agriculture and Water for the wheat variety Super X and still is in order.

B. Sowing Dates

Trials at Dirab, Uneizah and Eltaif with varieties Super X and Cocorit 71 in five sowing dates from Nov. 1 to Dec. 30 showed that for variety Super X optimum sowing dates were from Nov 1 to Dec. 15 at Dirab, from Nov. 15 to Dec. 15 at Uneizah and during December at Eltaif. For variety Cocorit 71 optimum sowing at Dirab was from Nov. 15 to Dec. 30, but at Uneizah no conclusion was reached.

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DURUM WHEAT IN SYRIA

A. K. Kauweider

M. Al - Hamawi

Cultivated wheat area in Syria is about 1.3 - 1.5 million hectares, less than 170,000 hectares under irrigation and the rest under rainfed. Production of this area fluctuates from year to year, depending on the quantity, time and period of the rainfall in the cultivated season. The production in a year of average rainfall is about 1.5 million tons, this quantity drops down to 600,000 tons in the worst year of rainfall and it increases to two million tons in a good rainfall year.

Syria is the origin of the wild and cultivated tetraploid species of wheat (T. dicoccoides, T. durum). However, only durum varieties were used for centuries under traditional methods of agriculture. We started cultivating bread wheat varieties when we introduced Florence Aurore in 1932 from Tunisia. This variety covered about 15% of the total area cultivated with wheat at the time the Mexican high yielding varieties were introduced in 1970.

Now, after introducing Mexican soft bread wheat, durum wheat remains dominant in the rainfed area with an average rainfall of 400mm and less. About 1,063,000 hectares were cultivated with durum wheat last year,1974,which produced 1.00-1.15 million tons. Fifty tons of Jori 69C were imported in 1972 for cultivation in the irrigated and high rainfall areas, in order to avoid increase of Mexican soft varieties at the expense of the local durum varieties in these areas.

Need and use of durum wheat:

Bread is the main use of durum wheat in our country. One hundred % of the bread on farms is made from durum wheat. Local bread is made from mixed flour, 25 to 40% durum and 75 to 60% bread wheat. In addition, durum is used as food by making grit (bourghol) which equals rice in cooking. The semolina flour is also used for pastes and macaroni. Total durum need, including seed used for cultivation, is about 700,000 - 800,000 tons. This quantity increases according to our yearly population of 3.3%.

Cultural practices:

Durum wheat is profitably grown in all cultivated lands in the country which are under irrigation or receive over 300 mm of rainfall. The area cultivated with durum wheat varies with the rainfall at the beginning of the season.

Date of planting extends from the midole of October to the end of December; however, on irrigated land planting date may extend to the end of January or the beginning of February. Traditionally, about 95% of the durum wheat was cultivated under rainfed conditions and 5% under irrigation. After introducing the high yielding variety Jori 69 C, the irrigated area increased.

In rainfed areas wheat cultivation is mechanized in most regions; however on small holdings, seed is broadcast and the crop is harvested by hand. In irrigated areas, tillage, the first fertilizer application, seed drilling, and furrowing and ditching for irrigation are mechanized. The second fertilizer application and the herbicide treatment are made by laborers. Recently, aircraft have been used for applying fertilizer and herbicide on government farms. Most farmers harvest their crop by combine but in good harvest years owners of combines prefer harvesting crops in the rainfed area because of the difficulty they find in the irrigated area due to canals and ridges. Therefore, in good years farmers who rent combines often harvest by hand before their yield shatters on the ground. A second reason is that they can use the straw for feeding their livestock.

Environmental conditions:

Obviously yield of durum wheat depends on environmental conditions. We get maximum harvest with the following conditions:

1. High rainfall before planting, not less than 40 mm.

2. Date of planting from the 15th of November to the 15th of December.

3. Average rainfall with good distribution during the season.

4. Nice cold winter, and cool spring weather.

Any disturbance of these conditions results in a sharp decrease in yield. For example, late planting in January with hot weather at ripening time causes shrivelled grain and loss in yield and price. The same thing happens if rain stops at the end of April with hot wind. Late varieties are more affected by these environmental conditions than early varieties.

Our durum varieties are adapted to cold winter temperatures (not less than -5°C to -7°C) which occur in December, January and February for a short time. Severe cold occurs every several years which stops growth of wheat plants and burns new tillering and leaves; however, the plants survive and developed new tillers and leaves. Severe damage occurs only when this cold stays for a long period at the heading stage.

Rainfall:

The rainy season corresponds with the growing season of wheat, it starts at the beginning of October and stops at the beginning of May. The last rains often occur with hail which breaks ears and shatters grain. High early rainfall damages the cotton crop badly, but it is good for wheat growers because it lets weed seeds germinate before preparing the lands for wheat and all germinated weeds are killed when the land is ploughed.

Amount of rainfall differs from place to place and ranges from 150mm to 1000mm. In durum wheat areas, the range is from 250 to 400mm of rainfall.

The normal monthly rainfall curve has a peak at January or February and 50% of the rain falls from tillering to the shooting stage, 25% from planting to the tillering stage, 20% from shooting to dough ripening, and the remaining 5% before planting.

Varieties:

Local durum wheat varieties were cultivated centuries ago in this country for their drought resistance. Their names are Hourani, Hamari, Bayadi and Shihani.

Hourani is the first in yield, quantity and cultivated area. Hamari equals Hourani in everything and we rank these two varities in the same grade, only the growing area is less than that of Hourani. Bayadi is known only in a small area near Damascus. Shihani is similar to Bayadi and grown in Hasaka province.

All these varieties are tall and lodge in irrigated and high rainfall areas, but under the average rainfall these varieties give the highest yield.

The Senator Cappelli variety was introduced in 1932 from Italy for irrigated and high rainfall areas. When we introduced the Meixcan soft varieties in 1970 for the same purpose, this variety was occupying the total areas of wheat under irrigation and high rainfall. From 1971, durum wheat in these

areas started to decrease rapidly because of the Mexican high yielding varieties. In order to avoid this decrease of thebest exporting durum variety in the country, 50 tons of Jori 69 C were introduced for its characteristic of dwarfness, high yield and good grain. The farmers like this variety because its grain is similar in shape to that of our varieties (Hourani and Hamari); however, its baking quality is less.

Disease:

Growing durum wheat under the environmental conditions of dry farming (400-250mm rainfall) gives active protection to our susceptible varieties against any leaf disease development. Because of this viewpoint, farmers do not pay any attention to disease problems. Nevertheless, disease causes serious damage to the crop when favourable conditions occur, such as high rainfall in spring or in irrigated areas with high humidity.

Bunt (*Tilletia Spp.*). Is the most widespread disease in our durum wheat varieties. Prior to the general use of seed treatments Bunt caused large reductions in the yield. It reached 15% in the infected areas and the grain quality was lowered.

Stem Rust (*Puccinia graminis tritici*). Is a problem in most seasons and causes great damage to our susceptible varieties and yield of grain is reduced.

Leaf Rust (*Puccinia tritici*) and Stripe Rust (*Puccinia glumarum*). Are less important and they cause less damage, specially Stripe Rust.

Loose Smut (*Ustilago tritici*). We do not know this disease on durum wheat but it is a problem on vulgare wheat, specially the Florence Aurore variety.

Other diseases are not important in our country.

Research:

Wheat research objectives are the following:

1. Introducing and developing high yielding and drought resistance varieties.

2. Improving the local varieties by selecting and crossing them with high yielding varieties to introduce higher potential yield as well as good varietal characteristics.

3. Improving cultural practices as:

Mechanization, tillage practices, fertilizers, weed control, and improving the current cropping pattern through rotations.

Rainfall amount and distribution plays the most important role in wheat production in Syria. We know that the high yielding varieties give good response with suitable fertilizer and irrigation or rainfall. On the other hand, the production of the high yielding varieties decreases as number of irrigations or the amount of rainfall decreases.

High productivity was the first objective in our breeding program in the irrigated and high rainfall areas (500mm and above). By the end of the first five year plan in 1965 the varieties Pitic 62, Lerma Rojo 64 A, Mexipak 65 and Syrimex showed considerable superiority. It was suggested these varieties be introduced in large plantings in these areas.

During the second five year plan effort was concentrated on durum varieties for dry cultivation together with the continuation of breeding operations for the irrigated and high rainfall areas.

Four Mexican varieties were approved by the second five year plan and by the end of 1970, 5000 tons of Pitic 62, Mexipak 65 and Lerma Rojo 64 were imported while Syrimex was increased locally. In low rainfall areas (less than 400mm) the Italian durum variety GAB 125 was approved for extension purposes. Under irrigation or high rainfall (above 400mm) the Italian variety Giorgio 331, and Jori 69 C were approved.

During the third five year plan, it was decided to grow good durum varieties for macaroni processing beside the soft Mexican ones in order to avoid increase of the latter at the expense of the former, specially Senator Cappelli. Fifty tons of Jori 69 C were imported in 1972 while Giorgio 331 was increased from the breeder stock. The program for wheat improvement in dry areas continues, including durum quality evaluation in order to determine which varieties are best.

Work on cultural practices, such as mechanization, tillage and fertilization is carried out at our Substation at Ezraa. The results of this research will be applied on farms in the country.

Wheat seed production program

Wheat seed production in Syria started from 1960. The project progressed in 5 stages concluding with production of 15,000 tons of improved seed. This seed equals 1/10 of the total seed used for all areas under cultivation and is to be distributed to the farmers. Each farmer cultivates 1/10 of his land from this seed to produce his own commercial seed which he should plant the following year on 9/10 of his land and the remaining 1/10 with new improved seed, and so on.

The first and second stages are carried out by the Cereal subsection of the Directorate of Agricultural Research, and the remaining three stages of multiplication are carried out by the Directorate of Agricultural Affairs. The first two stages are conducted on the research stations and the remainder on Government farms.

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WHEAT PRODUCTION IN THE YEMEN ARAB REPUBLIC

A. A. Shihab

The total wheat area in 1974 was 65,000 hectares, and the total production was 78,000 metric tons.

The present requirement for food is 150,000 metric tons, future requirement is expected to increase up to 200,000 tons.

Nearly 5% of the total wheat area is under irrigated conditions, the rest is rainfed, cultural practices are still traditional.

Seeding season in Sana'a Governorate is in February and March, with harvesting starting in May. In other areas (Taiz - Ibb - Sa'ada) seeding is in November and December, with harvesting starting in February.

The five months of winter are moderate. In 1974, annual rainfall was 236.5 mm in Sana'a, and 1500.1 mm in Ibb. Monthly rainfall in February and March was 14.3 and 49.24 mm respectively in Sana'a. In Ibb, 50.7 mm for October, with no rainfall in November and December.

Local wheat variety testing experiments were conducted on irrigated and rainfed terraced lands. Yield performance and order of major diseases are shown in the following table quoted from Technical Report No. 2 (1972) prepared by Mr. M. Rizania, harvest of 1971:

Name of Variety	Grain Yield T/ha		Leaf Rust 1/	Stem Rust 1/	1000 Grain Wt.	Plant Height cm	Days to Maturity
	Irrigated	Rainfed					
Russi Zagir (local)	3.1	1.45	60%S	20%S	35	87	114
Russi Kabir (local)	2.82	-	10%S	70%S	30	80	117
Baouni (local)	1.82	-	96%S	5%MR	34	83	107
Arabi (local)	3.2	-	R	R	-	89	130
Masseri (local)	1.7	-	S	S	-	92	134
Wissmy (local)	-	1.54	-	-	-	-	122
Canadian (local)	-	1.55	-	-	-	-	121
Y.C.A. 2/	-	1.84	-	-	-	-	129

1/ S-Susceptible; R-Resistant; MR-Moderate Resistant

2/ Y.C.A.-Yemen Collection A, a selection from the local (Canadian) grow during previous years.

Rezania also reported superiority of the local varieties over the new improved varieties under rainfed conditions and the least response to manuring.

The following table gives data from experiments on promising improved varieties, harvest of 1971:

Name of Variety	Grain Yield T/ha		Leaf Rust	Stem Rust	Days to maturity	Average Plant Height
	Irrigated	Rainfed				
PA/70	6.3	-	Very resistant		146	127
Chenab	5.2	1.23	5%MR	R	144	98
Safid Lerma	5.4	0.45	R	R	142	111
Mexipak 69	5.1	1.49	-	-	149	103

Local wheat varieties are mainly used as bread without any need to be blended with white imported flour. Quality analysis of some local and imported varieties made by the German Farm (Sana'a) is shown in the following table:

Variety Name	Damp. Glutein Contents	Swelling No.	Structure
Baouni (local	16.6	6/5	Very short
Alas (local)	14.2	1/0	Short
Samra (local)	17.2	1/0	Short
Tobari 66	42.2	17/3	Some short
Lerma Rojo	41.4	2	Some short
Penjamo	40.8	1/1	Short
Chenab 70	31.4	2/0	Some short

Wheat improvement activity has been limited because there have been no Yemeni or foreign wheat breeders, plant pathologists or cereal tech-

nologists. There has been no research on weed control, or rotation systems. The crops grown in rotation with wheat are mainly alfalfa and food legumes.

In regard to insect problems, there has been heavy damage due to aphids in the present crop year (1974-75).

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SPECIAL SESSION ON REGIONAL NURSERIES, APRIL 30, 1975

Chairman: R. G. Anderson

Major Points Discussed

Dr. Anderson outlined the basic CIMMYT nursery details and objectives. He spoke of the type of nurseries which are being despatched from CIMMYT to the Region. These are as follows:

Bread Wheat

1. Crossing Block
2. F2 (irrigated)
3. F2 (Dryland)
4. F2 Spring x Winter Wheat
5. International Breadwheat Screening Nursery
6. Elite Selection Yield Trial
7. International Spring Wheat Yield Nursery
8. International Septoria Observation Nursery
9. Multiline

Durum

1. Crossing Block
2. F2
3. International Durum Screening Nursery
4. Elite Durum Yield Trial
5. International Durum Yield Nursery

Triticale

1. Crossing Block
2. F2 (Irrigated)
3. F2 (Dryland)
4. F2 Spring x Winter Wheat
5. International Triticale Yield Nursery
6. International Triticale Screening Nursery
7. Triticale Disease Resistant Nursery
8. Forage Lines.

Barley

1. Crossing Block
2. F2
3. International Barley Observation Nursery
4. International Barley Yield Nursery

Anderson

He said that CIMMYT in principle does not release any varieties. It is up to the national programs to select material from the CIMMYT nurseries which they consider best suited for their country. The International Screening Nurseries contain a wide array of germplasm in F4 to F6 generations which the national programs may wish to observe very closely and pick up the best material to be included in their own national yield trials.

Borlaug

Any of the national programs are encouraged to send their advance lines for inclusion in the International Nurseries composed by CIMMYT, for wide testing throughout the world. However, the sender should accept that any of the cooperating programs would be free to use that material in their programs with appropriate acknowledgement to the program from whence the material originated.

Saari

Outlined the purpose and objectives of the regional nurseries prepared and distributed jointly by ALAD/CIMMYT/FAO.

The nurseries are:

1. RDISN - Regional Disease and Insect Screening Nursery
   Lines which are entered into the first year of national trials.

2. PON - Preliminary Observation Nursery
   Second year of yield trials with acceptable level of disease resistance. All PON entries go on into RDISN the second year.

3. RWYT - Regional Wheat Yield Trial
   Entries that do well in PON, yield well in national trials and have acceptable disease resistance levels. RWYT entries will then be included in RDISN.

4. RfWYT - Rainfed Wheat Yield Trial
   Needs new promising lines rather than old established varieties.

5. RfBYT - Rainfed Barley Yield Trial
The same as for Wheat. There will be a barley section in RDISN and PON.

6. RTN - Regional Trap Nursery
Two sections, A and B. A will be commercial varieties to check on virulence changes in commercial acreage. B will include single gene lines to determine effective genes for each area.

Srivastava

Made comments regarding the operation and reporting on the data from some of the nurseries. In order to further improve the entries in the Regional Nurseries it is imperative that the cooperating programs should send the necessary data back as soon as possible so that this information is utilized while selecting the new entries for the next year's nurseries. Maybe the cooperators need not send the detailed information on Crossing Block and PON. If they simply tick-mark the lines which they find superior in the Crossing Block and PON, without any yield data or agronomic characteristics such as plant height, grain color, etc. The information on superior lines from each location will give a good idea regarding the adaptability of these lines to various locations. The other characteristics such as disease resistance, plant height, days to heading, maturity etc., will be gathered by the regional staff and circulated back to the cooperating stations in time to be used in their national programs.

From the 1975-76 season, only the new genotypes with special characteristics found suitable for use in the crossing program will be sent to the national program to supplement their own crossing block. It was indicated, therefore, that the national programs should select and keep their own seed from the current crossing block since this will not be sent next season.

Hafiz

Reviewed the development of the Regional Nurseries over the past few years and emphasized the need to further accelerate the durum program in the Region.

Bozzini

Suggested that the new durum lines developed in Europe should be screened in the Region.

Kayyal

Gave a brief description of the purpose and objectives of ACSAD nurseries in the Region. He indicated that ACSAD was sending nurseries to 12 Arab countries.

Klatt

Outlined the work being done on winter wheat in Turkey and the purpose and objectives of the International Winter Wheat Screening Nursery prepared jointly by the Rockefeller Foundation, CIMMYT Turkey program and the Oregon State University. He said that a number of promising lines from IWWSN are coming out which can be utilized by the national programs. The IWWPN, organized by Nebraska State University is in its 8th year and is grown in 70 locations in various parts of the world. Dr. Klatt offered to send Segregating Populations from spring x winter wheat or spring x winter x winter wheat crosses to any of the programs on request.

Borlaug

Suggested that a flow chart be made of the type of material that is being sent by different agencies and organizations to the national programs and also the purpose of each material and the quantity of seeds sent should be indicated along with the season and time of the material being sent, and address of the national coordinators, to better coordinate the genotypes being sent to the national programs.

Anderson

Asked the national program leaders to indicate to the different agencies if they did not wish to obtain any of the nurseries. Since putting up the nurseries and the despatch requires much resources, every effort should be made by the international agencies and national program leaders to ensure that only the material that is asked for, is sent.

Duweiri

Wherever possible, the protein level of the material be indicated.

McCuistion

The regional nurseries are serving a very useful purpose. Would it be possible to have the field note books printed in light green or light blue paper rather than yellow?

Anderson

In certain situations in some countries Triticales are performing well. The triticales have done well at higher elevations in Kenya, Ethiopia and India. In the state of Punjab in India, some triticale lines gave 29% higher yield than Kalyansona in the experimental plants of Punjab Agricultural University, Ludhiana. The triticales are resistant to bunt, immune to loose

smut and in general possess better rust resistance as compared to wheat. They are tolerant of low pH and aluminium toxicity. Lack of tillering is one of the main drawbacks although now better tillering lines are available from the crosses between spring into winter triticales.

Talaat

All the programs in the Region should follow the same abbreviations for varieties as printed by ALAD/CIMMYT/Turkey Rockefeller Program.

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SPECIAL SESSION ON THE KENYA NURSERIES, MAY 2, 1975

Chairman: R. G. Anderson

The main points discussed were:

In general the value and the purpose of the Regional Summer Nurseries for the wheat and barley program in Kenya were outlined. For the past two years this facility was made available to the national programs in the Region to advance their material by one generation during off-season in the nursery at Njoro, and also to screen their lines against rust, particularly stem rust, which is fairly severe at that station. In the past, the facilities were kindly provided by the Government of Kenya at the Plant Breeding Station at Njoro in Kenya but since the amount of material being sent is increasing, and in order to further expand this facility there is a possibility that CIMMYT may post one staff member at that station specifically for this purpose. It was decided that the different national programs should send their material, which they wish to be grown at Njoro, to Dr. J.P. Srivastava, so as to reach Beirut by June 5 at the latest. Dr. G. Kingma from CIMMYT, Mexico, will collect all of this material from Beirut and plant it in Kenya by mid-June.

The following points were discussed and agreed:

1. The national programs will send their material in two categories and these categories should be clearly labelled:

   a. seed that is required to be harvested and returned to the sender.

   b. seed where only information regarding disease resistance is required.

2. The seed must reach Beirut by June 5. All seed arriving at that time will be carried to Kenya on 7th June along with the field books which will be prepared in Beirut. It will be difficult to include any material for planting in Kenya which arrives after that time.

3. Information on the disease reaction of this material will be returned to the national programs in October and seed will be sent by the end of October or early November.

4. The representatives of Algeria and Tunisia suggested that a special arrangement should be made to bring the seed from these two countries to Beirut. Possibly one person from Tunis and/or Algeria should carry the seed to Beirut to save time, or someone from Beirut should go to these countries to pick up the seed.

5. Representatives from the following countries gave tentative numbers of genotypes which they wished to be grown at summer nursery in Kenya during the 1975 season.

	(return seed + information)	(return information only)
Algeria	a. -	b. 200-300
Cyprus	a. 100	b. 50
Egypt	a. 300 - 200*	b. 50
Jordan	a. -	b. 100
Lebanon	a. 200	b. 1,000
Morocco	a. 30	b. -
Syria	a. -	b. 20
ACSAD, Syria	a. 1,000	b. -
Tunis	a. 450	b. -
Turkey	a. 300	b. 100
Yemen (North)	a. 2	b. -

* Special material from Dr. A. Kamel for disease observation.

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CLOSING ADDRESS
(In summary form)

E. Chelbi

It is a pleasure and an honor for me to preside at the closing of this Third Regional Wheat Workshop which is directly related to the serious shortage of world food supply. This encourages us to double our efforts to create policies which will increase our production of food items. At this conference there are many well qualified technicians, world authorities on wheat and world leaders such as Dr. Norman Borlaug and Dr. Abdel Hafiz.

The summary by Dr. Anderson illustrates the high technical standards of this conferences. A strong scientific base provides the information needed for programs which range from fundamental research to adaptation to conditions in remote localities as well as for the chain of activity from production to consumption and the government policies which control it.

Our progress should not be measured by the increase of present activities but by the realization of objectives. This means overcoming the factors which have limited production and will require changing some systems and some points of view. We have considerable potential in most of the countries represented here. Unfortunately some of this potential is not very well exploited in spite of progress which has been made up to this point. New effort should be made in order to realize this potential as soon as possible.

The action is not limited to the laboratory and extension of information to the field. Problems of economics or motivation often interfere with adoption of improved practices; therefore, means of encouraging these practices must be developed. This can be accomplished in a number of ways. Take weed control for an example, the government may take over this operation, provide subsidies and credit, manipulate costs and prices, control or reorganize the management of farms etc. All this must be done in a way that is economically sound and is adapted to the local conditions. This problem of creating change must be studied and policies developed. It is a fundamental part of the cereal production program and every policy of the program must be in harmony.

The cereal sector is, of course, subject to perturbations throughout the world. We have seen the prices go up and the prices come down, but they have not come down to the level of the sixties or the beginning of the seventies. It is not necessary to wait until the price becomes steady. It is necessary to satisfy, at all costs, the cereal needs of each country. This requires more than isolated national efforts. To be economically sound, the policies of each country must be compatible with prices on the world market.

Your conference has approached these problems in a rational way. The exchange of information helps and reinforces the actions within each country. I take this opportunity to thank all the technicians on whom, most of all, research and development within their countries depends. I also thank all of the cooperating organizations who are helping us in Tunisia in this regard. I hope that the cooperation generated in this conference will be of benefit to everyone and will continue.

Original: French

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APPRECIATION

G. Anderson

On behalf of the group I would like to extend our thanks

1) To the Government of Tunisia and the Organizing Committee of this Workshop, particularly the work of the Chairman Mr. Piero Bronzi, for the hospitality, warmth of reception and many kindnesses shown to the participants of this Third Regional Wheat Workshop. I am sure that the delegates will return to their specific countries with widened horizons and an appreciation of the value of new and old contacts and exchange of information made at this Workshop.

2) Special thanks are extended to His Excellency Mr. Belkoja, Minister of Agriculture, for taking time from his busy schedule to open this Workshop. Also the Minister and Government of Tunisia for the reception to be tendered this evening to the delegates. Also to Mr. Chalbi, Chef de Cabinet of the Minister, for his closing remarks.

3) Special thanks are extended to Mr. and Mrs. W. LeMelle, North Africa Representative of the Ford Foundation who so graciously hosted the Monday evening reception at their home.

4) Our thanks are extended to Mr. Boulaaba, Chief of the Office of Cereals for a most enjoyable luncheon served at Beja on Wednesday afternoon.

5) We are grateful to the two farmers Mr. Ben Amar and Mr. Ben Chiboub for their kind reception of our group and their full explanation of the activities on their respective farms and to the CCSPS for their hospitality and explanation of the seed processing operation.

6) We extend our appreciation to the various sponsors of the visits of delegates to this Workshop without whose support the holding of this meeting would not have been possible.

7) To the young lady interpreters we owe a special debt of gratitude for their unfailing dedication to a most difficult task. Work well done.

8) To the other behind the scenes people including the secretaries who have worked so hard to make papers available to the delegates, to arrange hotel and travel accommodations and the many other tasks, we extend our sincere appreciation.

9) Wives resident in Tunis are to be congratulated on their organizing tourist functions for the benefit of the wives of visiting delegates.

10) Finally, at the risk of our self-congratulation, I would like to say how much I personally enjoyed the lively discussion and the outstanding presentation of the delegates. To the chairmen and rapporteurs a word of appreciation for an excellent performance. In my opinion the productivity of this meeting will be hard to emulate in the future.

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